Uniting the Mind and Body in Psychological Measurement: The Influence of Mind-Body Connections on Indicators of Emotional Functioning

Kristen Van Bael

Thesis submitted for the fulfillment of the requirements for the degree of Doctor of Philosophy

Victoria University, Australia

Institute for Health and Sport

August, 2024

Abstract

Atypical interoceptive and emotional processing increasingly characterise various pathophysiologies and psychopathologies, indicating their growing importance in clinical and research settings. These functions inform case conceptualisation, treatment, and the development of embodied understandings of mechanisms underlying such pathologies. Assessing the mind-body connection requires information on three salient constituents: subjective interoception, alexithymia, and mind-body beliefs. Each represents a transdiagnostic risk factor and determinant of health-promoting behaviours. However, current assessment tools lack a unified approach to these factors within existing self-reports and conceptualisations. This thesis bridges the gap between mind and body in psychological measurement, involving construct and measurement validation with four aims: (1) elucidate the salient psychological constituents of the mind-body connection; (2) clarify the association between specific aspects of self-reported interoception and alexithymia; (3) develop and validate a new self-report questionnaire to measure the hypothesised psychological constituents of the mind-body connection; and (4) examine how mind-body connection constituents influence typical experiences of positive and negative emotions. To address these aims, the research comprises three interrelated studies.

Paper 1 addresses the first two aims through a systematic review and meta-analysis of the association between specific aspects of self-reported interoception and alexithymia at global and facet levels. Synthesising findings from numerous studies, this paper quantifies this proposed relationship and highlights the intricate interplay between emotional, cognitive, and physiological processes. It demonstrates that interoceptive deficits are critical in difficulty identifying and describing feelings in alexithymia, warranting their assessment in clinical settings. The findings affirm the importance of concurrently capturing subjective interoception and alexithymia in self-report measures as salient psychological constituents of

the mind-body connection.

Paper 2 addresses the first and third aims, detailing the development and preliminary psychometric evaluation of the Body-Mind Connection Questionnaire (BMCQ), developed to operationalise the notion that the mind-body connection involves three salient components: (a) Interoceptive Attention, (b) Sensation-Emotion Articulation, and (c) Body-Mind Values. The study outlines the item generation process and exploratory factor analyses, which established a 3-factor model. Reliability and validity analyses demonstrate the BMCQ's robust psychometric properties, including internal consistency and construct validity.

Paper 3 addresses the third and fourth aims, validating the BMCQ through confirmatory factor analysis and identifying distinct latent mind-body connection profiles. These profiles are explored in relation to typical emotional experiences, including emotional reactivity and regulation. The findings confirm that the BMCQ reliably captures the three components identified in Paper 2. The study also delineates profiles characterised by varying levels of mind-body connection and integration, offering insights into the practical implications of mind-body connection in daily life and clinical practice.

The thesis concludes by clarifying the conceptualisation and measurement of subjective interoception, leading to proposals for a psychometrically robust construct validity framework to promote greater construct-measurement congruence, enhance the reliability and validity of assessments, and enable more clinically meaningful interpretations. The BMCQ emerges as a valid, reliable tool for assessing mind-body integration, facilitating a more unified approach than previously available. The thesis concludes with recommendations for individualising treatment based on mind-body connection profiles, promoting adaptive interoceptive and emotional functioning in dynamic environments.

Student Declaration

"I, Kristen Van Bael, declare that the PhD thesis entitled **Uniting the Mind and Body in Psychological Measurement: The Influence of Mind-Body Connections on Indicators of Emotional Functioning** is no more than 80,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work."

"I have conducted my research in alignment with the Australian Code for the Responsible Conduct of Research and Victoria University's Higher Degree by Research Policy and Procedures."

Signature: Kristen Van Bael [redacted] Date: 09/08/2024

Ethics Declaration

"All research procedures reported in the thesis were approved by the Victoria University Human Research Ethics Committee: HRE21-001."

Signature: Kristen Van Bael [redacted] Date: 09/08/2024

Acknowledgements

I would like to express my deepest gratitude to those who have supported me throughout my PhD journey.

First and foremost, I am profoundly grateful to my supervisors, Prof. Michelle Ball, Dr. Jessica Scarfo, and Dr. Emra Suleyman. They have instrumentally and emotionally supported and accommodated me, which allowed me to complete this thesis. Michelle, your immense experience and unwavering support has been instrumental in building my confidence and helping me to grow as a person and professional. Your sense of humour and your deep appreciation for language have made our interactions both enriching and immensely enjoyable. Thank you for guiding me with utmost respect and encouragement. Jessica, your incredible expertise and support in helping me harness my own skills has been invaluable and simply cannot go unacknowledged. From my Honours year to now, working closely with you has been an absolute pleasure, and I am so excited for you as you embark on the journey of motherhood. I wish you all the best for a safe delivery. Emra, your trust in allowing me to delve into the complex field of interoception has been a pivotal factor in my academic and personal growth. Your guidance has opened many doors and led me to explore beautiful and intriguing avenues (and down several rabbit holes) in my research.

I am also deeply appreciative of Dr. Andrew Court and Jenny Cations from the Royal Children's Hospital. Although our collaboration was separate from this thesis, working with such passionate professionals was a transformative experience, providing me with critical insights into the real-world implications of the processes I studied. Your work has allowed me to see how these concepts translate into practical, impactful outcomes. Additionally, working within the Campus Mental Health Strategy Team at Murdoch Children's Research Institute and with people with lived experience profoundly shifted my perspectives, enabling me to better understand the impact of severe somatic symptoms on quality of life. This significantly enriched the depth and relevance of my research.

I extend my heartfelt thanks to my fellow PhD candidates, Natasha Grimble and Jessica Katherveloo. Your support and collaboration have been crucial in navigating the inherent challenges of this journey. Your companionship and insights have been a constant source of light-heartedness and motivation, and I hope that my presence and contributions have provided you with commensurate support and encouragement throughout your own PhD experiences. I also wish to thank and acknowledge Sera Osmani, who has been a veritable pillar of support for me since our Undergraduate days together.

I am immensely grateful for the support of my dear friends Jessie, Natasha, and Ellyce. Without you, languishing in bed for four or so years like Colin from *The Secret Garden* would have been a very real possibility for me.

Finally, I wish to thank my family for their genuine interest in what I’ve been doing and for their ongoing support. This is especially extended to my mother Anna, my father Peter, and my Dedo Chris. The sacrifices that each of you have made for me cannot go unmentioned and your support has been the bedrock of my academic journey. My dear Mama, your unwavering encouragement and your patience as I talked endlessly about my research have been an immense source of comfort and strength. Dad, your belief and pride in my abilities and your readiness to listen and offer advice, even when I doubted myself, has been invaluable. Dedo, your constant encouragement and support has provided me with the motivation to maintain an intense focus necessary for seeing this through. Each of you has played such a crucial role in helping me stay grounded, and I am deeply grateful for everything you have provided me. I am beyond blessed to call you family.

Thank you all for being an integral part of this journey.

Details of Included Papers: Thesis with Publication

VICTORIA UNIVERSITY

DETAILS OF INCLUDED PAPERS: THESIS WITH PUBLICATION

Please list details of each scholarly publication and/or manuscript included in the thesis submission. Copies of published scholarly publications and/or manuscripts submitted and/or final draft manuscripts should also be included in the thesis submission.

This table must be incorporated in the thesis before the Table of Contents.

Chapter No.	Publication Title	Publication Status • Published • Accepted for publication • In revised and resubmit stage • Under review • Manuscript ready for submission	Publication Details • Citation, if published • Title, Journal, Date of acceptance letter and Corresponding editor's email address • Title, Journal, Date of submission
4	A systematic review and meta-analysis of the relationship between subjective interoception and alexithymia: Implications for construct definitions and measurement	Revised and resubmitted. Under review.	Van Bael, K., Scarfo, J., Suleyman, E., Grimble, N., Katherveloo, J., & Ball, M. A systematic review and meta-analysis of the relationship between subjective interoception and alexithymia: Implications for construct definitions and measurement. PLOS ONE. Applied:
5	Assessment of the mind-body connection: preliminary psychometric evidence for a new self-report questionnaire	Published	Van Bael, K., Ball, M., Scarfo, J., & Suleyman, E. (2023). Assessment of the mind-body connection: preliminary psychometric evidence for a new self-report questionnaire. BMC Psychology, 11 (1), 309. https://doi.org/10.1186/s40359-023-01302-3
6	Elucidating the role of mind-body connection profiles in emotion reactivity and regulation amongst typically developed adults	Under review	Van Bael, K., Ball, M., Scarfo, J., & Suleyman, E., & Ball, M. Elucidating the role of mind-body connection profiles in emotion reactivity and regulation amongst typically developed adults, BMC Psychology. Applied: 26/07/2024

Declaration by [candidate name]: Kristen Van Bael

Signature: Kristen Van Bael — Digitally signed by Kristen Van Bael Date: 2024.08.01 11:13:09 +10'00'

Date: 01/08/2024

Declaration of Co-Authorship

VICTORIA UNIVERSITY

THE NEW WAY TO DO UNI

OFFICE FOR RESEARCH TRAINING, QUALITY AND INTEGRITY

DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

1. PUBLICATION DETAILS (to be completed by the candidate)

Title of Paper/Journal/Book: A systematic review and meta-analysis of the relationship between subjective interoception and alexithymia: Implications for construct definitions and measurement

Surname: Van Bael

First name: Kristen

Institute: Institute for Health and Sport

Candidate's Contribution (%): 90

Status:

Accepted and in press: ☐ Date:

Published: ☐ Date:

2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

[redacted] 02/08/2024

Signature **Date**

3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;
2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

PO Box 14428, Melbourne,
Vic 8001, Australia
+61 3 9919 6100

VICTORIA UNIVERSITY

THE NEW WAY TO DO UNI

3. There are no other authors of the publication according to these criteria;

4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and

5. The original data will be held for at least five years from the date indicated below and is stored at the following **location(s)**:

Secondary data extracted from included articles for narrative review and meta-analysis are provided in the manuscript.

Name(s) of Co-Author(s)	Contribution (%)	Nature of Contribution	Signature	Date
Dr. Jessica Scarfo	2.5	Conceptualisation, Supervision, Writing - Review & Editing	[redacted]	31/7/24
Dr. Emra Suleyman	2.5	Conceptualisation, Supervision, Writing - Review & Editing		31/7/24
Natasha Grimble	1.25	Investigation, Data Curation		1/8/24
Jessica Katherveloo	1.25	Investigation, Data Curation		02/08/24
Michelle Ball	2.5	Conceptualisation, Supervision, Writing - Review & Editing		1/08/24

Updated: September 2019

PO Box 14428, Melbourne,
Vic 8001, Australia
+61 3 9919 6100

VICTORIA UNIVERSITY

THE NEW WAY TO DO UNI

OFFICE FOR RESEARCH TRAINING, QUALITY AND INTEGRITY

DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

1. PUBLICATION DETAILS (to be completed by the candidate)

Title of Paper/Journal/Book: Assessment of the mind-body connection: preliminary psychometric evidence for a new self-report questionnaire

Surname: Van Bael First name: Kristen

Institute: Institute for Health and Sport Candidate's Contribution (%): 85

Status:

Accepted and in press: ☐ Date:

Published: ☑ Date: 06/10/2023

2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

[redacted] 01/08/2024

Signature **Date**

3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;
2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

x

VICTORIA UNIVERSITY

THE NEW WAY TO DO UNI

3. There are no other authors of the publication according to these criteria;

4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and

5. The original data will be held for at least five years from the date indicated below and is stored at the following **location**(s):

Presently, the original data are stored on on Kristen Van Bael's personal device that requires biometric authentication to ensure confidentiality and security. An application to the Victoria University R:Drive has been submitted. Upon access to the R:Drive folder, all data files will be uploaded and stored for a 7 year period after completion of the thesis (i.e., until 2031).

Name(s) of Co-Author(s)	Contribution (%)	Nature of Contribution	Signature	Date
Prof. Michelle Ball	5	Conceptualisation, Methodology, Interpretation, Supervision, Writing - Review &	[redacted]	1/8/24
Dr. Jessica Scarfo	5	Conceptualisation, Methodology, Supervision,Interpretation,	[redacted]	1/7/24
Dr. Emra Suleyman	5	Conceptualisation, Methodology, Supervision, Interpretation, Writing - Review	[redacted]	31/7/24

Updated: September 2019

PO Box 14428, Melbourne,
Vic 8001, Australia
+61 3 9919 6100

Victoria University ABN 83776954731
CRICOS Provider No. 00124K (Melbourne),
02475D (Sydney), RTO 3113

VICTORIA UNIVERSITY

THE NEW WAY TO DO UNI

OFFICE FOR RESEARCH TRAINING, QUALITY AND INTEGRITY

DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

1. PUBLICATION DETAILS (to be completed by the candidate)

Title of Paper/Journal/Book: Elucidating the role of mind-body connection profiles in emotional reactivity and regulation amongst typically developed adults

Surname: Van Bael First name: Kristen

Institute: Institute for Health and Sport Candidate's Contribution (%): 85

Status:

Accepted and in press: ☐ Date:

Published: ☐ Date:

2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

[redacted]	01/08/2024
Signature	**Date**

3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;

2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

3. There are no other authors of the publication according to these criteria;

4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and

5. The original data will be held for at least five years from the date indicated below and is stored at the following **location(s)**:

Presently, the original data are stored on on Kristen Van Bael's personal device that requires biometric authentication to ensure confidentiality and security. An application to the Victoria University R:Drive has been submitted. Upon access to the R:Drive folder, all data files will be uploaded and stored for a 7 year period after completion of the thesis (i.e., until 2031).

Name(s) of Co-Author(s)	Contribution (%)	Nature of Contribution	Signature	Date
Prof. Michelle Ball	5	Conceptualisation, Methodology, Interpretation, Supervision, Writing - Review &	[redacted]	1/8/24
Dr. Jessica Scarfo	5	Conceptualisation, Methodology, Interpretation, Supervision, Writing - Review &	[redacted]	31/7/24
Dr. Emra Suleyman	5	Conceptualisation, Methodology, Interpretation, Supervision, Writing - Review &	[redacted]	31/7/24

Updated: September 2019

PO Box 14428, Melbourne,
Vic 8001, Australia
+61 3 9919 6100

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ACC	Anterior cingulate cortex
AIC	Anterior insula cortex
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
ANS	Autonomic nervous system
ASD	Autism spectrum disorder
BAQ	Body Awareness Questionnaire
BMCQ	Body-Mind Connection Questionnaire
BMI	Body mass index
BPQ	Body Perception Questionnaire
BPQ-BA	Body Perception Questionnaire - Body Awareness Scale
BPQ-R	Body Perception Questionnaire - Autonomic Reactivity Scale
CFA	Confirmatory factor analysis
CNS	Central nervous system
DDF	Difficulty describing feelings
DIF	Difficulty identifying feelings
dlPFC	Dorsolateral prefrontal cortex
DV	Dependent variable
EDI-IAw	Eating Disorder Inventory - Interoceptive Awareness scale
EFA	Exploratory factor analysis
EMA	Ecological momentary assessment
EOT	Externally oriented thinking
HPA axis	Hypothalamic-pituitary-adrenal axis
HSPS	Highly Sensitive Person Scale
IAcc	Interoceptive accuracy
IAS	Interoceptive Accuracy Scale
IATS	Interoceptive Attention Scale
IAw	Interoceptive awareness
ICQ	Interoceptive Confusion Questionnaire
IRT	Item response theory
IS	Interoceptive sensibility
ISQ	Interoception Sensory Questionnaire
ITPE	Interoceptive trait prediction error
IV	Independent variable
KMO	Kaiser-Meyer Olin measure of sampling adequacy
LPA	Latent profile analysis
MAIA	Multidimensional Assessment of Interoceptive Awareness
MAIA-AR	Attention Regulation subscale of the MAIA
MAIA-BL	Body Listening subscale of the MAIA
MAIA-EA	Emotional Awareness subscale of the MAIA

MAIA-ND	Not-Distracting subscale of the MAIA
MAIA-NW	Not-Worrying subscale of the MAIA
MAIA-SR	Self-Regulation subscale of the MAIA
MANCOVA	Multivariate analysis of covariance
MCAR	Missing completely at random
MEQ	Multidimensional Emotion Questionnaire
MVA	Missing value analysis
NA	Nucleus accumbens
NTS	Nucleus of the solitary tract
OFC	Orbitofrontal cortex
OGRS	Omnibus groups regions of significance
PAF	Principal axis factoring
PAG	Periaqueductal grey
PANAS	Positive and Negative Affect Schedule
PAQ	Perth Alexithymia Questionnaire
PCA	Principal component analysis
PERS	Perth Emotion Reactivity Scale
PFC	Prefrontal cortex
PN	Parabrachial nucleus
PNS	Peripheral nervous system
SAQ	Self-Awareness Questionnaire
SMC	Squared multiple correlation
SNS	Sympathetic nervous system
SPS	Sensory processing sensitivity
SSAS	Somatosensory amplification scale
TAS-20	Toronto Alexithymia Scale, 20-item version
TCE	Theory of constructed emotion
VAS	Visual analogue scale
VIF	Variance inflation factor
vmPFC	Ventromedial prefrontal cortex

Chapter 1. Contextualising the Thesis

Cognitive science has predominantly focused on mental processes as detached from the physical body, relegating the body to a secondary role (Wilson, 2002). Indeed, a commonly held belief of the mind and the body is that they exist as distinct and separable entities (Demertzi et al., 2009; Forstmann & Burgmer, 2015, 2017). While some may experience their mind as qualitatively different to their body, this is not biologically plausible. Major advancements in neuroscience indicate that cognition is embodied (Friston, 2010), wherein continual interactions between the environment and the individual's body and brain influence thoughts and feelings to engender situationally appropriate behaviour (Barrett & Finlay, 2018). From this perspective, the mind is not confined to the brain, and cognition is not solely comprised of abstract computations; rather, the mind emerges from sensorimotor systems, with the body playing an integral, centralised role in thoughts, feelings, and behaviours (Wilson, 2002). Recognition that the body and mind operate as a connected and integrated force has immense implications for physical and psychological health (Farb et al., 2015; Forstmann et al., 2012).

Recent developments have highlighted the significance of the body in cognitive activity and subsequent behaviours. This shift has led to the emergence of the concept of 'embodied cognition', which posits that cognitive processes are closely intertwined with bodily experiences and actions (Niedenthal et al., 2005). Embodiment theory emphasises the interconnectedness of the mind and body in shaping behaviour and experiences, embraces the notion that thought is inherently linked to behaviour, and emphasises the importance of adapting cognitive processes to suit the demands of the current context (Wilson, 2002). This perspective challenges dualistic views that separate mental processes from bodily experiences, highlighting the inexorable connection between cognition and action (Niedenthal et al., 2005).

Growing evidence for the role of psychological processes in the onset, progression, and recovery from illness is fostering increased acceptance of integrative mind-body perspectives in both clinical practice and research (e.g., Brower, 2006; Taylor et al., 2010). The 'mind-body connection' is a term that has come to represent the link between thoughts, feelings, behaviours, and physical and mental health. This term is increasingly employed in healthcare settings to provide patients with a framework for understanding how the link between the body and the mind can contribute to various conditions and illnesses, such as depression and anxiety (Lemon & Wagner, 2013), medically unexplained symptoms (Payne & Brooks, 2018; Spurrier et al., 2023), somatic symptom disorder (Kurlansik & Maffei, 2016; Tuttle et al., 2024), and functional neurological disorder (Jablonski & Lange, 2022; Saxena et al., 2020). The term itself is useful, as it readily provides a foundation for accessibly conveying complex information regarding brain-body communications when smooth versus when disrupted.

Whilst the defining characteristics of the mind-body connection provide some indication of implicated factors and functions, the term is diffuse and currently lacks clarity. Elucidating the salient psychological constituents of the mind-body connection could therefore facilitate the employment of holistic treatments targeted at cultivating healthy mind-body connections, thus engendering adaptive functioning in challenging, dynamic environments. Doing so is crucial, considering the importance of the mind-body connection amongst persons with lived experience of mental health conditions (Jenkinson et al., 2024). Operationalising such constructs may further enable researchers and clinicians alike to efficiently measure, target, and monitor subjective mind-body perceptions contributing to maladaptive functioning.

Evidence suggests a fundamental component characterising the mind-body connection is interoception—the processes by which the nervous system anticipates, senses, interprets, integrates, and regulates signals originating from the body across unconscious and conscious levels (Khalsa et al., 2018; Quigley et al., 2021). Atypical interoceptive processing has increasingly been characterised as an explanatory mechanism for various conditions and diseases (Bonaz et al., 2021; Brewer et al., 2021; Khalsa et al., 2018), thus presenting a promising avenue for developing targeted interventions aimed at improving patient wellbeing. Interoception is typically conceptualised as a multidimensional construct, consisting of objective and subjective aspects accessible to consciousness (e.g., Garfinkel et al., 2015; Khalsa et al., 2018; Murphy et al., 2020), although there is no consensus regarding the specific interoceptive dimensions. Consequently, a profound lack of convergence between interoceptive construct definitions and operationalisation permeates interoceptive research (Desmedt et al., 2023). Despite the prominence of objective tests of interoception (e.g., heartbeat counting and tracking tasks) in research (Khalsa et al., 2018), these assessments often require sophisticated techniques and specialist administration. Conversely, interoceptive self-report scales are an economical and practical method for assessing subjective interoception, providing critical insights into how individuals perceive and interpret their bodily sensations, which can be crucial for understanding various health conditions and informing treatments aimed at holistically enhancing adaptive physical and emotional functioning.

Emotions further represent an essential mind-body connection component. Although various perspectives exist, it is generally accepted that they constitute psychological states which include subjective experience, cognitions, expressive movements and behaviours, and physiological changes (Damasio & Carvalho, 2013; Gross & Feldman Barrett, 2011; LeDoux & Hofmann, 2018). Emotional dysfunction is a common feature of various psychiatric conditions, including anxiety and related disorders (Paulus & Yu, 2012), mood disorders (Elliott et al., 2011; Vanderlind et al., 2020), feeding and eating disorders (Kittel et al., 2015;

Svaldi et al., 2012), and neurodevelopmental disorders (Nuske et al., 2013). In considering how emotions may arise, a longstanding tradition proposes that they are generated through the interpretation of physiological changes in context (Critchley & Garfinkel, 2017; James, 1884; Lindquist, 2013; Schachter & Singer, 1962), therefore inexorably linking interoception to such experiences. Despite this connection, these components are disparately captured in interoceptive self-report scales that are regarded as proxy measures of the mind-body connection in research.

Alexithymia is a multifaceted trait that arguably exemplifies a mind-body disconnection, which is characterised by difficulties in identifying and describing emotions, and a tendency towards externally oriented thinking (Luminet et al., 2021; Taylor et al., 1991). Traditionally, it has been viewed as the culmination of cognitive and emotional deficits, leading to poorer physical and psychosocial functioning, and treatment outcomes. However, when the facets of alexithymia are inverted, they reflect emotional expertise, including the ability to identify and describe feelings and internally oriented thinking, which support robust mental representations of emotions (Hoemann et al., 2021). However, recent theories propose that alexithymia stems from interoceptive deficits, challenging the traditional view of it as merely a cognitive and emotional deficit. It is hypothesised that alexithymia reflects a fundamental impairment in interoceptive ability, leading to confusion and poor differentiation between bodily and emotional states (e.g., Brewer et al., 2016; Shah, Catmur, et al., 2016). Empirical evidence suggests that alexithymia may not occur without atypical interoception, which consequently diminishes the recognition, representation, articulation, and experience of emotions. Accordingly, enhancing certain interoceptive abilities through targeted interventions could reduce alexithymia and improve patient outcomes. Despite these prospects and growing interest in this area, no existing scale comprehensively measures both interoception and all facets of alexithymia.

Moreover, explicit beliefs about the mind-body connection, including whether they are seen as integrated or separate, have scarcely been explored in interoception and emotional research. These beliefs are important, as they influence the prioritisation of health and wellbeing. Research indicates that adults often intuitively endorse dualistic beliefs, viewing the mind and body as distinct entities (Demertzi et al., 2009; Forstmann & Burgmer, 2015). This dualism can lead to neglecting the body (Forstmann et al., 2012), and is associated with reduced engagement in health-promoting behaviours. In contrast, believing in the connection between bodily conditions and mental wellbeing is linked to prioritising health-centric values (Burgmer & Forstmann, 2018; Forstmann et al., 2012). Overall, mind-body beliefs may significantly shape how individuals perceive, promote, and address their health and wellbeing. Although there is limited evidence linking these beliefs to interoception and alexithymia, measuring them could provide deeper insight into and context for adaptive and maladaptive interoceptive and emotional beliefs.

In Chapter 2, an expanded review of the literature is presented, which contextualises hypothesised components of the mind-body connection: interoception, identification and articulation of emotions (derived from alexithymia facets), and mind-body beliefs. Concepts that are reviewed and analysed in Paper 1, Paper 2, and Paper 3 are expounded on in greater detail, including interrelations between alexithymia, emotional reactivity, and emotion regulation and their respective associations with interoception. The potential psychological components that may underlie the mind-body connection construct are also delineated and preliminarily proposed. This chapter concludes by identifying gaps in the literature, whereby the majority of interoceptive self-report scales do not holistically capture emotional proficiencies nor explicit mind-body connection beliefs and values. Given that embodied perspectives on health and wellbeing are increasingly being embraced in clinical and research settings, this presents a clear need to develop a self-report questionnaire which captures such psychological constituents.

Following this expanded literature review, the general methodology adopted in this thesis is overviewed in Chapter 3, which outlines the evolution of the systematic review and meta-analysis delineated in Paper 1, comprehensively expands on scale development phases undertaken to develop a new self-report questionnaire of the mind-body connection, discusses the statistical analyses employed in Paper 2 and Paper 3, and summarises how statistical assumptions were assessed for each analysis.

Chapter 4 presents Paper 1, a systematic review and meta-analysis of the association between interoceptive self-report scales and alexithymia at global and facet levels involving difficulty identifying feelings, difficulty describing feelings, and externally oriented thinking (Taylor et al., 1991). This study extends upon the meta-analyses conducted by Trevisan et al. (2019), which identified that high alexithymia was associated with poor subjective interoceptive accuracy (i.e., inaccurate detection of interoceptive signals) and maladaptive interoceptive attention (i.e., hypervigilance toward interoceptive signals), whereas low alexithymia was associated with greater awareness of interoceptive sensations and of the connection between sensations and emotions—aspects proposed to underly adaptive interoceptive attention (Mehling, 2016; Trevisan et al., 2021). Conducting this study was imperative, due to the extensive range of interoceptive self-report scales not considered in the previous analysis. Additionally, the profound lack of convergence between constructs and measurements in interoceptive research has consequently obscured the reliability, validity, and generalisability of clinically meaningful findings (Desmedt, Heeren, et al., 2022; Desmedt et al., 2023; Trevisan et al., 2021). In doing so, the paper addresses two gaps in the literature: it provides further clarity regarding which aspects of subjective interoception reinforce or reduce alexithymia at the global and facet level and elucidates the key differences between interoceptive self-report scales based on their association with alexithymia. Collectively, these findings underscore the relevance of interoceptive traits in alexithymia, indicating a need for these components to be concurrently measured and considered in research and psychological interventions for conditions that may benefit from enhancing adaptive interoceptive and concomitant emotional processing.

Following Paper 1, Paper 2, provided in Chapter 5, addresses a gap in existing measurements of the mind-body connection through the development and preliminary evaluation of a self-report scale that was developed to capture three salient constituents hypothesised to underlie the mind-body connection: interoceptive attention, sensation-emotion articulation, and body-mind values. In accordance with pre-existing literature and the findings of Paper 1, evidence indicates that these constructs are related and may collectively impact upon indicators of wellbeing (Brewer et al., 2021). This study is therefore an important step toward operationalising the mind-body connection, providing an efficient, holistic questionnaire that improves upon existing interoceptive self-report scales disparately capturing these constructs through their unification.

Paper 3 presented in Chapter 6, validates the mind-body connection self-report questionnaire that was developed and preliminarily investigated in Paper 2, thus providing additional support for this as a psychometrically sound and efficient measure for use in mind-body research and practice. Moreover, this paper examines how particular mind-body connection scale responses impact upon typical reactivity for positive and negative emotions and ease of regulation in everyday life. This is an important undertaking, as positive and negative emotional experiences can differentially affect the body and the mind—both momentarily and longitudinally (Schenk et al., 2018; Willroth et al., 2020)—therein highlighting the importance of interoception and emotion for promoting adaptive functioning in dynamic environments. This paper addresses several gaps in the literature. First, research examining the association between self-reported interoception and measures of emotional reactivity is scarce. Where conducted, correlational or regression-based analysis have typically been employed to examine their association (Edwards & Lowe, 2021; Vig et al., 2022). Whilst illuminative, these techniques do not consider within-sample heterogeneity that can differentially affect the outcomes of interest. Secondly, one study has employed cluster analysis to explore how response subtypes affect emotional reactivity, wherein clusters consisted of self-reported interoceptive aspects only (Yun-Hsin et al., 2023). As alexithymia is known to influence emotional reactivity (e.g., Panayiotou et al., 2018; Panayiotou et al., 2021) and relates to adaptive and maladaptive interoceptive aspects of subjective accuracy and attention (Brewer et al., 2016; Trevisan et al., 2019; Trevisan et al., 2021), its omission within clusters is problematic. To address these gaps, this study utilised latent profile analysis to identify more holistic mind-body connection profiles that include interoceptive propensities, emotional capacities, and mind-body connection values together. This provides a more nuanced account for individual differences in mind-body connection tendencies and conceptualisations and how particular profiles influence the frequency, intensity, persistence, and ease of regulating positive and negative emotions in everyday life.

The final chapter presents a summary of main research findings of the papers presented within this thesis, describing the key psychological constituents of the mind-body connection, overviews the association between aspects of self-reported interoception and alexithymia, the development and validation of the self-report questionnaire assessing the mind-body connection, and the influence of mind-body connection profiles on emotional reactivity and ease of regulation. Implications and recommendations are provided to improve how self-reported interoception and, more broadly, the mind-body connection is conceptualised and measured in research. Doing so is argued to promote the cultivation of healthy, adaptive cognitions and values to support effective functioning supporting wellbeing.

Chapter 2. Expanded Introduction

2.1.1. Homeostasis and Allostasis

Our most fundamental task as humans is to survive. Together, the biological processes of homeostasis and allostasis provide the foundation for survival and wellbeing by ensuring that organisms can maintain internal stability, adapt to changing conditions, and effectively respond to stressors and challenges in their ever-changing environments. By balancing stability with flexibility, these physiological processes support optimal functioning and resilience in the face of diverse threats and demands.

Homeostasis is a dynamic and ongoing process by which a multitude of integrated bodily mechanisms work in concert to maintain physiological parameters (e.g., temperature, nutrient levels, pH) within a narrow range, conducive to optimal functioning and survival (Carvalho & Damasio, 2021; Craig, 2003a, 2003b; Petzschner et al., 2021). This concept was first alluded to by Bernard (1865/1957) in the context of the 'milieu intérieur', noting the necessity for living systems to maintain various internal variables within narrow ranges. Cannon (1939) extended on this notion and introduced the term 'homeostasis', emphasising the body's ability to maintain internal stability despite external fluctuations. Characterising homeostasis as a condition that is relatively constant, Cannon proposed that organisms actively regulate physiological mechanisms to ensure a dynamic equilibrium, or 'steady state', conducive to health and survival. In mammals, these mechanisms include autonomic, neuroendocrine, and behavioural mechanisms (Craig, 2003a).

In the 1940s, homeostatic regulation began to be conceptualised as involving feedback mechanisms (Cooper, 2008; Goldstein, 2019). Negative feedback was the first contributory process explaining how homeostasis operates (Woods & Ramsay, 2014). This entails a reactive strategy in response to external perturbation, whereby deviation from the optimal set-point of a regulated variable is detected, leading to corrective responses aimed at returning the variable to its original state (Petzschner et al., 2021). For instance, in the regulation of body temperature, if body temperature rises above the set-point, negative feedback mechanisms, such as sweating and vasodilation, are activated to bring temperature back into the normal range. Conversely, if temperature drops below the set-point, shivering and vasoconstriction occur, facilitating raising the temperature to a desirable level (Kurz, 2008).

Preserving homeostasis and survival necessitates adaptivity. To be adaptive, organisms must interpret information gathered from their sensors about past and present environmental conditions and then modify their actions accordingly (Petzschner et al., 2021). These actions will influence the environment, thus shaping future sensory inputs. Therefore, adaptive behaviour creates a feedback loop involving the environment, sensors, and effectors. Whilst homeostatic accounts of physiological regulation entail adaptive aspects, these are limited and can be disadvantageous when faced with an ever-changing environment (Petzschner et al., 2021).

Allostasis is an alternative model of physiological regulation, involving the dynamic adjustment of homeostatic setpoints through physiological, neural, or behavioural change in response to constantly changing internal and external environments (Karatsoreos & McEwen, 2011; McEwen, 1998; Schulkin & Sterling, 2019; Sterling, 2012; Sterling & Eyer, 1988). The dynamic regulation of various bodily systems, including the autonomic nervous system (ANS), endocrine system, and immune system, ensures that internal conditions remain within an optimal range suited to environmental fluctuations (Sterling & Eyer, 1988). This emphasis on flexibility stands in contrast to homeostasis, which aims to maintain physiological parameters within a set range.

Allostasis has been associated with prospective control, as pre-emptive actions occur prior to anticipated homeostatic perturbation, thereby preventing future dyshomeostasis (Petzschner et al., 2021). Sterling and Eyer (1988) contended that regulatory processes which predict and prevent errors, rather than correct them, are more efficient for effective functioning and survival. In this view, survival necessitates the continual intake of metabolic and other biological resources, which are required to plan and enact behaviours, to acquire resources and to protect against threats (Barrett, 2017b).

In terms of how allostasis is implemented, Sterling (2012) proposed that the brain integrates prior knowledge with incoming sensory data that together facilitate predictions regarding what resources are required, based on current environmental conditions. The brain subsequently directs effectors to optimise resource distribution. In doing so, the brain encodes, consolidates, and updates prior knowledge based on such experiences in the service of optimising future resource predictions. An accumulating body of research (see Kleckner et al., 2017, for discussion) indicates that visceromotor regions are primarily implicated in the implementation of allostasis, which include the amygdala, ventral striatum, insula, orbitofrontal cortex (OFC), anterior cingulate cortex (ACC), and medial prefrontal cortex (mPFC). In conjunction, primary mediators include hormones of the hypothalamic-pituitary-adrenal (HPA) axis (e.g., cortisol, epinephrine), catecholamines, and cytokines (McEwen, 2005).

Whilst prototypical allostasis is conceptualised as the achievement of optimal and efficient operation of key bodily systems with minimal expenditure (Barrett, 2017b), allostatic systems can cause dysfunction and impact upon wellbeing when they are over- or underactive (McEwen, 2005). The allostatic model has been drawn upon to explain how exposure to stressors cumulatively contributes to chronic dysregulation of the internal milieu. McEwen and Stellar (1993) introduced the concept of allostatic load to reflect the 'wear and tear' of the body, involving the cost of chronic exposure to elevated or fluctuating immune, neuroendocrine, metabolic, and cardiovascular responses resulting from exposure to repeated challenges that are experienced as stressful (McEwen, 1998, 2005; Peters et al., 2017). Allostatic load may accumulate following four physiological responses: (1) *frequent stress*—the magnitude and frequency of responsivity when repeated over the lifespan; (2) *failed shut-down*—chronic physiological activity and failure to terminate adaptive autonomic and neuroendocrine responses; (3) *inadequate response*—failure to adequately respond to challenge; and (4) *failure to habituate* to repetition of the same stressor, leading to persistent elevation of mediators such as cortisol (McEwen, 1998; McEwen & Gianaros, 2010). As such, if an individual's supportive life systems are constantly fluctuating and maladaptively operating at metabolically costly levels, this would arguably hinder regaining physiological integrity.

Homeostasis and allostasis are clearly fundamental physiological processes that are vital for maintaining physiological integrity, stability, adapting to changes, and promoting survival and wellbeing. Over time, each has increasingly been linked to ongoing conscious experiences of the physiological condition of the body—interoception (Craig, 2002; Damasio & Carvalho, 2013; Kleckner et al., 2017; Petzschner et al., 2021).

2.1.2. Interoception

Interoception refers to the collective processes by which the nervous system anticipates, senses, interprets, integrates, and regulates signals originating from the body across unconscious and conscious levels (Khalsa et al., 2018; Quigley et al., 2021). Although terms such as ‘senses’ and 'integrates' imply unidirectional communication from organs to the brain, communications between the brain and the body are often bidirectional—further inclusive of communications from the brain to other organs and, subsequently, modulation of internal body signals sent back to the brain (Chen et al., 2021). Optimum sensing, interpretation, integration, and regulation of internal body signals—irrespective of occurring at unconscious or conscious levels—are pivotal for many vital physiological functions, including sleeping, breathing, drinking, thermoregulation, and eating, in conjunction with psychological phenomena encompassing a spectrum from diverse emotions and feelings to motivational drives and adaptive behaviours (Chen et al., 2021; Critchley & Garfinkel, 2017; Khalsa et al., 2018). Such understandings, however, have emerged in the context of contemporary neuroscience.

Interoception is a relatively recent concept—first alluded to by Sherrington (1906), who referred to the internal surface of the body as interoceptive, in contrast to exteroceptive, defined as constituting the external surface in direct contact with physical environment. Interest in interoception has fluctuated over time, with various terms proposed to encompass the processing of internal bodily states, including coenesthesia and somesthesia (Ceunen et al., 2016). In the 1980s, biological psychiatry was proliferated by observations of interoceptive dysfunction in panic disorder, although this trend declined following clarification that aetiological mechanisms extended beyond one molecular receptor target (Khalsa et al., 2018). Recently, investigations concerning interoception have surged, due, in part, to findings highlighting its crucial role in homeostatic and allostatic processes (Barrett & Simmons, 2015; Craig, 2002; Shaffer et al., 2022). Interoception is thus conceptualised as representing an essential factor contributing to momentary and long-term physical and psychological wellbeing.

Initially, interoceptive processing was proposed to involve processing of visceral signals that were then associated with the intestine (Sherrington, 1906). Understandings of the viscera expanded to subsequently include cardiovascular, respiratory, gastrointestinal, and genitourinary systems (Desmedt et al., 2023). Traditional views on interoception held that perceptions related to visceral and vasomotor functions, as well as sensations of hunger and thirst, were comparatively less defined and discernible when contrasted with sensations typically attributed to the somatosensory system, such as pain, itch, and temperature (Herbert & Pollatos, 2012). In line with such views, visceral signals project from the brainstem to the thalamus and then to the insula (Craig, 2014). Conversely, primary and secondary somatosensory cortices are putatively responsible for processing somatic sensations. These anatomical distinctions account for differences in subjective experiences between visceral and somatosensory sensations, with the former being more diffuse and the latter more localised (Craig, 2002; Desmedt et al., 2023; Herbert & Pollatos, 2012). Thus, pain and temperature processing, considered somatic signals, were localised to somatosensory cortices and were not encompassed within the definition of interoception.

In contrast to earlier perspectives, Craig's (2002) seminal research indicated that primates possess a distinct cortical representation of homeostatic afferent activity, encompassing all facets of the physiological status across bodily tissues. His findings suggested that all bodily sensations are encoded within a novel, phylogenetic system, derived from the afferent component of the evolutionarily ancient hierarchical homeostatic limb responsible for maintaining bodily integrity. As such, this system evolved from older neural pathways that originally served basic homeostatic functions, including thermoregulation, fluid balance, and energy levels, now integrating various bodily sensations contributing to our overall sense of internal bodily states.

This expanded conceptualisation of interoception departed from its original narrow definition limited to visceral sensations, instead encompassing the perception of the body's physiological state within the context of ongoing activities, closely intertwined with motivated behaviours aimed at homeostatic regulation (Craig, 2003a, 2009b, 2014). Interoceptive sensations thus include hunger, thirst, fatigue, temperature, respiration (e.g., dyspnea), distension, pain, itch, and affective touch (Craig, 2002; Craig, 2003a; Khalsa et al., 2018). A specific set of neural components is responsible for mapping the vast range of physiological reconfigurations that continuously occur in the body, which encompasses a varied array of structures, including nerves and ganglia within the peripheral nervous system (PNS), as well as pathways and nuclei distributed throughout all levels of the CNS (Carvalho & Damasio, 2021; Chen et al., 2021).

2.1.3. Physiological Pathways of Interoception.

The lamina I spinothalamocortical pathway is a major interoceptive pathway—responsible for transmitting interoceptive sensations from the body to specific regions in the brain implicated in processing these internal bodily signals. The pathway bypasses traditional nociceptive and visceroceptive pathways, providing direct afferent inputs regarding the physiological condition of the entire human body (Ceunen et al., 2016; Craig, 2002). Although the pathway is known for transmitting information to the brain regarding temperature and pain, neuroanatomical evidence indicates that its components are responsible for the relay of all homeostatic information (Craig, 2002; Craig, 2003b). Thinly myelinated Aδ and unmyelinated C small diameter primary afferents within the PNS innervate all bodily tissues and contain specialised receptors that conduct interoceptive information (i.e., mechanical, thermal, chemical, hormonal, and metabolic status of the skin, joints, teeth, muscles, viscera). Interoceptive information is then transmitted from the periphery to the lamina I layer of the dorsal horn in the spinal cord. Signals subsequently project to autonomic cell columns forming a loop for somato-autonomic reflexes. These also project to pre-autonomic sites in the brainstem, including the nucleus of the solitary tract (NTS), parabrachial nucleus (PN), and periaqueductal grey (PAG), which integrate homeostatic afferent activity; subsequently, integrated information is projected to the hypothalamus. Such regions form homeostatic motor control hubs, which engender goal-directed, autonomic, neuroendocrine, and behavioural activities (Craig, 2002; Craig, 2003b; Desmedt et al., 2023).

Although this pathway is specifically dedicated to transmitting interoceptive information, it converges within the diencephalon with afferent information carried via cranial nerves, including the vagus nerve (Critchley, 2005). All integrated interoceptive information is transmitted through posterior, basal, and medial thalamic nuclei to the dorsal section of the posterior insula, which facilitates primary sensory processing of interoceptive sensations (Ceunen et al., 2016; Craig, 2002; Craig, 2003b). This characterises a homeostatic pathway, as its components enable the CNS to process the physiological status of all bodily tissues and react to maintain integrity of the interior milieu. In conjunction with the lamina I spinothalamocortical pathway, interoceptive processing occurs through various routes (Critchley & Harrison, 2013), such as the cranial homeostatic pathway and ventricular, blood-brain, and microglial humoral pathways, whereby each reaches the CNS through circulation of substances (see Ceunen et al., 2016, for review). In line with such elucidations, the capacity to act upon deviation from a homeostatic setpoint or predicted deficit inherently involves interoception.

Through their synthesis of neurobiological findings, Carvalho and Damasio (2021) proposed that conscious bodily feelings—driven by homeostatic regulation—are dependent upon a distinct nervous system they termed the interoceptive nervous system (INS). The INS constitutes a collection of previously identified pathways (e.g., lamina I, vagal), nuclei and cortical regions which continuously sense chemical and anatomical changes in the body of an organism (Damasio & Carvalho, 2013). Relative to exteroceptive, cognitive, and motor pathways, the atypicality of INS features—including the thinly myelinated Aδ and C fibres of the lamina I and vagal pathways, localised gaps in the blood-brain barrier, varying modes of transmission mediated by specific neurotransmitters (e.g., dopamine, noradrenaline), and variable timescale with which changes are detected—instils further confidence in the view that interoception is structurally and functionally distinct from exteroception. It warrants mentioning such perspectives align with Craig's (2002) physiological definition, which has been critiqued as restricted to homeostatic pathway processing. For alternative perspectives, readers are directed to Desmedt et al. (2023), who advocate for a phenomenon-based definition of interoception.

2.1.4. Key Neural Regions of Interoception

Neuroanatomical research has substantiated the existence of an interoceptive network (Berntson & Khalsa, 2021; Craig, 2009a, 2014; Critchley & Harrison, 2013; Critchley et al., 2004; Khalsa et al., 2009; Kleckner et al., 2017), comprising primary and secondary somatosensory cortices, the insula cortex, ACC and prefrontal cortices (i.e., ventromedial prefrontal cortex [vmPFC], dorsolateral prefrontal cortex [dlPFC]). Moreover, that these regions implicated in interoception greatly overlap and interact with those involved in bodily regulation by way of homeostasis and allostasis (Carvalho & Damasio, 2021; Kleckner et al., 2017; Petzschner et al., 2021). A whole-brain network engages limbic and paralimbic areas of the brain (e.g., cingulate cortex, insula), nuclei located in the amygdala, ventral striatum, NA, PAG, NTS, Broca's area, dlPFC, and vmPFC (Barrett & Simmons, 2015). These cortical and subcortical structures are implicated in essential processes, such as monitoring internal emotional and visceroceptive states (Critchley et al., 2004) and engendering conscious notions of the core self (Araujo et al., 2015). Indeed, some are argued to form neural correlates of consciousness (Craig, 2009b).

The insula is consistently highlighted as crucial for interoception (Chen et al., 2021; Craig, 2002; Craig, 2009a, 2009b, 2014; Seth & Friston, 2016; Seth et al., 2012). This cortical structure is located within the lateral sulci of the brain and typically subdivided according to its gyri (Uddin et al., 2017). With respect to interoceptive processing, Craig (2002; Craig, 2008, 2009a, 2009b, 2014) proposed a posterior-to-mid-to-anterior progression hypothesis following the hierarchical organisation of the insula, which theorises that the integration of salient information progresses from the posterior to the anterior insula cortex (AIC) through the mid-insula. Each division is proposed to generate distinct interoceptive and higher-order representations. Inputs via spinothalamocortical and non-homeostatic pathways are speculated to generate an initial primary interoceptive representation of the entire human body in the dorsal posterior insula, termed the primary interoceptive cortex (Barrett & Simmons, 2015), providing the foundation for the construction of feelings. This progresses to the mid insula which integrates feedback from visual, auditory, and vestibular systems. The mid-insula further communicates with the amygdala regarding the significance of stimuli and emotional memories, as well as with the hypothalamus concerning the current state of the ANS and ongoing metabolic processes. This region interacts with and integrates information from putatively higher-order brain regions (i.e., temporal pole, NA, OFC), providing hedonic and incentive signals for the determination of salience. As such, the mid insula subsumes essential interoceptive components and is considered the central hub for integrated re-representation, feature extraction, and cross-modal integration (Ceunen et al., 2016). Upon re-representation and re-integration in the right AIC, interoception becomes truly conscious, given the concurrent integration of motivational, social, and cognitive conditions through interactions with the ACC, vmPFC, and dlPFC (Craig, 2009a, 2009b). Re-representation in the right AIC thus translates physiological changes into subjective perceptions of sensations, indicating its vital role in bridging objective physiological changes with subjective experiences (Craig, 2002; Craig, 2008, 2009a, 2009b, 2014). As such, interoception crucially involves multiple brain structures working in concert, forming a neural network for perceiving bodily states and providing a basis for understanding one's wellbeing.

The ACC also warrants consideration in the context of interoception. This structure is implicated in supporting various functions, including attentional allocation and orientation, cognitive control, motivation, and decision-making (Bush et al., 2000; Critchley, 2005;

Devinsky et al., 1995; Quadt et al., 2018), and forms part of the salience network alongside the AIC, facilitating detection of important environmental stimuli (Menon & Uddin, 2010). Whilst the AIC is pivotal for conscious interoception, the ACC is proposed to have a visceromotor function (Khalsa et al., 2009), thereby driving the transduction and regulation of unconscious physiological responses, and further, integrating interoceptive signals with cognitive and emotional processes to guide appropriate behavioural responses. Such notions are supported by neuroanatomical evidence demonstrating that the structures are functionally connected (Kleckner et al., 2017) A lesion study conducted by Khalsa and colleagues (2009) demonstrated that afferent processing of sensations from both the surface and within the body crucially involves the AIC and the ACC. Although physically separated, each of these structures contain von Economo neurons, which putatively facilitate rapid interconnections between them (Craig, 2009b) and the relaying of signals to other regions (Menon & Uddin, 2010). Together, such regions facilitate the generation of subjective feelings and active engagement with internal and external environments, engendering adaptive, contextually appropriate responses (Critchley et al., 2004; Medford & Critchley, 2010).

2.1.5. Predictive Accounts of Interoception

Afferent signals can be noisy and ambiguous, thus complicating the precision with which the state of the body can be interoceptively identified (Petzschner et al., 2021). Rather than conceptualising the brain as passively processing sensory input, computational and predictive accounts of interoception propose the brain is an active inference generator that employs a ‘Bayesian filter’ for incoming sensory inputs in order to overcome afferent noise (Barrett & Simmons, 2015; Seth, 2013; Seth & Friston, 2016; Seth et al., 2012).

In predictive interoceptive processing, the brain estimates the posterior probabilities of different internal states based on sensory evidence and prior beliefs (Petzschner et al., 2021). By combining sensory inputs with internal predictions, the brain computes the likelihood of different bodily states and updates its internal models accordingly (Barrett & Simmons, 2015). The brain constructs an internal model of its body in the world, involving beliefs or expectations about bodily states which are represented as probability distributions of both external and internal milieus (Barrett, 2017b; Seth, 2013). This Bayesian framework enables the brain to infer the most likely internal state given the available sensory information, facilitating efficient decision-making and adaptive responses to fluctuating conditions (Petzschner et al., 2021). When there is a discrepancy between actual (bottom-up) and expected (top-down) signals, these are termed interoceptive prediction errors (Seth et al., 2012). Interoceptive prediction errors are conveyed through ascending signals targeting ventromedial areas, while descending signals from these areas carry predictions about the causes of interoceptive signals (Barrett & Simmons, 2015; Seth & Friston, 2016). Prediction error minimisation can occur through several methods: propagation of the error along cortical connections to update the prediction, through physical movement to generate predicted sensations, and alteration of how the brain attends to incoming sensory input (Barrett & Simmons, 2015).

Within the Embodied Predictive Interoceptive Coding model proposed by Barrett and Simmons (2015), brain regions including the cingulate cortex, posterior vmPFC, posterior OFC, and ventral AIC—known as agranular visceromotor cortices—assess the body's autonomic, metabolic, and immunological resources and predict its needs, thereby enacting allostasis. These regions send predictions to other brain areas (e.g., hypothalamus, brainstem) to maintain internal balance. Simultaneously, they send predictions to the mid and posterior insula (i.e., the interoceptive sensory cortex). Feedback from this sensory cortex adjusts the predictions, but under normal circumstances, agranular regions are resistant to this feedback, leading to stable interoceptive predictions despite body changes. In terms of brain architecture and connectivity, the granular cortex, located in the mid and posterior insula, amplifies and distributes sensory inputs throughout the column.

In conditions characterised by the experience of somatic symptoms, this feedback loop may become disrupted, leading to increased prediction errors that may manifest as 'noisy' interoceptive inputs in the brain (Barrett et al., 2016; Henningsen et al., 2018; Van den Bergh et al., 2017). Smith et al. (2021) demonstrated that individuals diagnosed with psychiatric conditions, including depression, anxiety, and substance use disorders, tend to exhibit attenuated sensitivity toward cardiac sensations across various contexts, particularly during states of homeostatic perturbation. This suggests that such disorders might manifest as a result of a 'locked in' brain that is insensitive to environmental changes and consequently unable to minimise prediction errors arising from bottom-up signals nor incorporate such factors into their generative internal model (Barrett et al., 2016). Consequently, dysfunctional interoceptive processing can greatly inhibit adaptivity and wellbeing.

2.1.6. Taxonomies of Interoception

Interoception is now regarded as a multidimensional process, whereby the functions of sensing, interpreting, and integrating information about the state of the body involve distinct, albeit reciprocal, elements (Desmedt et al., 2023; Khalsa et al., 2018). Although interoception primarily occurs unconsciously, elements accessible to consciousness are measurable. Despite relative consensus on such notions, interoceptive terminology and dimensional conceptualisation is heterogenous in the field (Desmedt et al., 2023), considering the numerous taxonomies proposed. Table 2.1 at the end of this section provides an overview of existing and emerging taxonomies.

2.2.4.1. Garfinkel et al. (2015). To encourage greater consistency in construct definitions and operationalisation of interoceptive abilities, Garfinkel and colleagues (2015) proposed a three-dimensional model which differentiates interoception according to measurement methodology, consisting of accuracy, sensibility, and awareness. In accordance with their model, *interoceptive accuracy* (IAcc) refers to objective accuracy in detecting internal signals and is assessed through behavioural paradigms gauging performance, including silent counting of perceived heartbeats within specific timeframes (Schandry, 1981) or by judging whether an external stimulus (e.g., tone) is presented in synchrony with one's heart beating (Whitehead et al., 1977). *Interoceptive sensibility* (IS) involves the self-perceived dispositional tendency to focus on and detect internal signals, which is assessed by self-report measures, such as Porges' (1993) Body Perception Questionnaire (BPQ), although many interoceptive self-report scales exist and are employed for operationalisation of IS in mind-body research (Desmedt, Heeren, et al., 2022; Desmedt et al., 2023). The IS dimension has been conceptualised as an expression of a high-level model or overarching belief for how one generates top-down predictions about internal bodily sensations (Critchley & Garfinkel, 2017). In other words, factors modulating how the causes of the physiological condition of the body are inferred. *Interoceptive awareness* (IAw) entails metacognitive awareness of accurate detection of internal bodily sensations, where measurement involves the degree to which objective performance corresponds with subjective confidence in performance (i.e., with the area under the receiver operator characteristic curve). Previous evidence indicates that employment of these measures provides dissociable, distinct dimensions of interoception (Forkmann et al., 2016; Garfinkel et al., 2015; Murphy et al., 2020).

Garfinkel's model has facilitated recent examinations of 'interoceptive trait prediction error' (ITPE), representing discrepancies between bottom-up and top-down interoceptive signalling (Garfinkel et al., 2016). Operationalisation of actual versus presumed interoceptive acuity involves combining performance on IAcc tasks gauging accuracy in cardiac perception and IS appraisals based on BPQ responses which indicate propensities for over- or underestimating interoceptive abilities. This aspect has emerged as a clinically relevant feature in Tourette's syndrome (Rae et al., 2019), Autism Spectrum Disorder (ASD; Garfinkel et al., 2016; Quadt et al., 2021), fibromyalgia, myalgic encephalomyelitis/chronic fatigue syndrome (Sharp et al., 2021), and functional neurological symptoms (Koreki et al., 2020; Sojka et al., 2020). Presently, employment of ITPE is a relatively emerging method (Murphy et al., 2019). If this trend continues, this prompts consideration of whether the BPQ best encapsulates a high-level model influencing top-down interoceptive predictions.

2.2.4.2. Khalsa et al. (2018). Whilst Garfinkel's model provided much utility and a common language for describing interoceptive domains, the three dimensions could be considered too broad and at the same time, perhaps too parsimonious. A panel of experts convened in 2016 to formulate an alternative taxonomy of conscious interoceptive dimensions consisting of seven distinct facets (Khalsa et al., 2018). This taxonomy extends on Garfinkel et al.'s (2015) prior conceptualisation and delineates additional facets of interoception, accompanied by suggested methods for assessment of each facet. *Interoceptive attention* refers to the observation of internal bodily sensations and capacities for directing attentional resources toward them. This can be captured in either a bottom-up, stimulus driven manner (i.e., involuntarily triggered) or purposefully directed in a top-down, goal-directed manner and can be measured using behavioural paradigms in respiratory, cardiac, and gastrointestinal systems or via self-reports distinguishing between adaptive and maladaptive attention styles. *Interoceptive detection* entails the ability to detect and report the presence or absence of an interoceptive stimulus, assessed using objective behavioural paradigms. *Interoceptive magnitude* is the intensity that an individual perceives an internal bodily sensation, reflecting the amount of signal that an individual processes; it is a continuous variable that can be gauged through subjective reports using rating scales (e.g., visual analogue scales [VAS], numerical ratings), which can be estimated through combining prior expectations and current sensory input. *Interoceptive discrimination* refers to the capacity to both localise a sensation within a specific interoceptive system, channel, or part of the body, and differentiate it from exteroceptive sensations. Examples include the capacity to differentiate a sense of fullness after eating from a cough and distinguishing various sensations originating from the same internal bodily source. *Interoceptive accuracy* involves the ability to precisely and correctly monitor changes in internal body state, which has been the most commonly studied feature of interoception. This is analogous to IAcc proposed by Garfinkel et al. (2015), in that it similarly pertains to the ability to precisely and correctly monitor changes in the internal bodily state. This can be measured using behavioural tests in various systems (e.g., cardiac). *Interoceptive insight* is a metacognitive detailing of the correspondence between subjective experience and behaviour, with measurement entailing that previously described for IAw (Garfinkel et al., 2015). Khalsa and colleagues also proposed an *interoceptive sensibility*/IS domain, which similarly regards the trait-based tendency to focus on interoceptive stimuli, requiring an evaluation of propensities across broad timespans. This can involve reflection on autobiographical experiences by responding to questions, such as, *'To what extent do you believe you focus on and detect internal bodily sensations?*' (Garfinkel et al., 2015) or assessment via self-reports capturing regulatory and non-judgmental aspects of interoception, such as the Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2018; Mehling et al., 2012). Lastly, *interoceptive self-report scales*, entailing the capacity to reflect on autobiographical experiences of interoceptive states, make judgments about their outcomes, and express them through verbal or motor responses, is typically assessed experimentally using various instruments or scales. This aspect is proposed to be highly complex and nuanced, which remain somewhat elusive and requires deeper investigation.

2.2.4.3. Murphy et al. (2019). Due to their observations noting the equivocal association between IAw and ITPE outcomes developed by Garfinkel et al. (2015; 2016), Murphy and colleagues (2019) proposed a theoretical model that distinguishes how individuals differ in terms of interoceptive abilities. They argued for a 2×2 factorial model, whereby Factor 1 differentiates whether interoceptive accuracy or attention is the target of measurement and Factor 2 distinguishes whether objective performance on behavioural paradigms probing interoceptive detection or self-report scales are employed. Regarding Factor 1, accuracy pertains to the degree to which interoceptive perception is a precise representation of the true state of the body, whereas attention refers to the degree to which interoceptive signals are the object of attention. Conversely, Factor 2 differentiates assessment types, according to objective versus self-report measures. Accordingly, this model produces four facets: (1) *objective interoceptive accuracy*— objective measurement of the accuracy of interoceptive detection, indexed by performance on objective interoceptive measures (e.g., heartbeat tracking or detection procedures); (2) *self-reported interoceptive accuracy beliefs*—beliefs regarding the accuracy of interoceptive perceptions, including confidence ratings (e.g. ratings on a VAS from 'full perception/complete confidence' to 'total guess/no awareness') or scores on self-report scales, such as the Interoceptive Confusion Questionnaire (ICQ; Brewer et al., 2016) or Interoceptive Accuracy Scale (IAS; Murphy et al., 2020); (3) *objective interoceptive attention*—objective measurement of the degree to which interoceptive signals are the object of attention, assessed through experience sampling methods; and (4) *self-reported interoceptive attention beliefs*— beliefs regarding the degree to which interoceptive signals are the object of attention, for example scores from the BPQ. Across six studies, Murphy and colleagues (2020) determined that there is a distinction between individual differences in perceived interoceptive attention and accuracy across objective and subjective domains, thus demonstrating validity for the 2×2 factorial model—findings that have since been corroborated across the domains (Gabriele et al., 2022; Tünte et al., 2024)

2.2.4.4. Suksasilp and Garfinkel (2022). In acknowledging expanded definitions of interoception emphasising the sense, interpretation, and integration of internal bodily signals across both unconscious and conscious levels, Suksasilp and Garfinkel (2022) explicated a framework incorporating the processing of interoception across neural, behavioural, self-report, attentional, and higher order measures. Their approach to interoception extends on earlier multidimensional frameworks (Garfinkel et al., 2015; Khalsa et al., 2018) to integrate and differentiate dimensions based on the level of processing at preconscious and conscious, higher-order interpretational levels. *Neural representation* denotes CNS activity associated with interoceptive processing, including the coupling of central activity with afferent physiological signals, which can be gauged through neuroimaging and neurophysiological measures (e.g., electroencephalography). *Strength of afferent signals* involves the strength and nature of peripheral signals that communicate interoceptive states to the CNS, indirectly assessed by externally measuring physiological variables that activate sensory transducers at specific visceral organs. *Preconscious impact of afferent signals* involves the effect of fluctuations in afferent signals on their central neural representation and processing of external stimuli, which is particularly assessable through the cardiovascular system. Procedures investigating the impact of this system involve timing brief stimulus presentations to coincide with bursts of baroreceptor activity (during systole) or during the intervals between heartbeats (at late diastole), when baroreceptors and this cardiac channel are inactive. Other methods include experimentally manipulating organ physiology to measure associated changes in stimulus processing. *Interoceptive accuracy* represents correct and precise monitoring (i.e., the correspondence between) objectively measured physiological events and individuals' reported experience of those events, ascertained through behavioural tests. *Self-report and interoceptive beliefs* comprises measures of beliefs, available to and beyond conscious access, regarding interoceptive sensations and experiences. This dimension includes self-report measures, such as questionnaires including the IAS, Body Awareness Questionnaire (BAQ; Shields et al., 1989), and MAIA, confidence ratings on behavioural task performance, and task-based measures of implicit prior beliefs assumed to influence interoceptive perceptions. I*nteroceptive insight* is the metacognitive evaluation of experience and performance (e.g., the correspondence between accuracy during an interoceptive task, and self-reported perceived accuracy or confidence during the task). *Interoceptive attention* pertains to observing internal bodily sensations, and includes purposefully attending to interoceptive sensations when instructed, along with the habitual tendency to attend to interoceptive sensations, relative to exteroceptive sensations, which can be assessed using self-reports such as the BPQ, experience sampling methods, and brain-based measures. Lastly, *attribution of interoceptive sensations* involves the interpretation of interoceptive sensations and their causes, such as illness or threat, assessable through self-reports such as the Body Sensations Interpretations Questionnaire (Clark et al., 1997) or following experimental inducement to manipulate threat context.

2.2.4.5. Desmedt et al. (2023). Where Suksasilp and Garfinkel (2022) distinguish between bodily axes and differentiate dimensions according to the level of processing, Desmedt and colleagues (2023) offer a complementary framework that includes and differentiates dimensions based on their level of specificity. The framework proposes four broad categories comprised of specific, homogenous subfactors, measurable using self-report scales or objective behavioural paradigms. *Interoceptive attention* pertains to any attentional process related to internal signals, which includes interoceptive attention bias, attention regulation, and distracting subfactors. *Interoceptive sensing* encompasses the sense of internal bodily signals by the nervous system across conscious and nonconscious levels, involving interoceptive detection, magnitude, and localisation subfactors. *Interoceptive interpretations* refers to any interpretation, belief, attitude, and categorisation of internal signals, including interoceptive trusting, worrying, emotional awareness, and somatosensory amplification subfactors. *Interoceptive memory* entails any memory process related to internal signals, involving subfactors such as symptom reporting bias and internal pain memory subfactors. Although some constructs are more dysfunctional than others (e.g., somatosensory amplification cf. interoceptive body listening), Desmedt et al. (2023) contend that the constructs are dimensional as they contain functional, subclinical, and clinical indicators, and that relationships can exist between and within factors and subfactors.

Table 2.1

Domains, Definitions, Recommended Assessment Modes, and Assessment Examples Across Interoceptive Taxonomies.

Taxonomy	Domain	Definition	Recommended Assessment Modes	Assessment Examples
Garfinkel et al. (2015)	Interoceptive Accuracy	Objective accuracy in detecting internal bodily sensations	Objective tests of interoceptive accuracy	Behavioural performance accuracy during heartbeat detection/mental tracking tasks
	Interoceptive Sensibility	Self-perceived dispositional tendency to be internally self-focused and interoceptively cognisant	Subjective self-report measures probing perceived aptitude	Questionnaires, such as the BPQ or global self-report measures, such as average confidence
	Interoceptive Awareness	Metacognitive awareness of interoceptive accuracy	Relationship between objective performance (interoceptive accuracy) and awareness of performance	Area under ROC curves mapping confidence onto accuracy
Khalsa et al. (2018)	Interoceptive Attention	Observing internal body sensations	Behavioural paradigms in respiratory, cardiac, and gastrointestinal systems or self-reports distinguishing between adaptive and maladaptive attention styles.	Behavioural attention during tasks manipulating focus on specific systems; self-reports such as the MAIA
	Interoceptive Detection	Presence or absence of conscious report	Objective behavioural paradigms in respiratory, cardiac, and gastrointestinal systems	Heartbeat detection tasks
	Interoceptive Magnitude	Perceived intensity	Subjective reports	Rating scales, for example VAS and numerical rating scales
	Interoceptive Discrimination	Localise sensation to a specific channel or organ system and differentiate it from other sensations	Subjective reports	Differentiation of proximal vs. distal oesophageal sensation and subsequent gastric deposition following swallowing of food

	Interoceptive Accuracy (Sensitivity)	Correct and precise monitoring	Behavioural tests in various systems	Heartbeat tracking or detection procedures, intraclass correlations between bladder volumes and urinary urge
	Interoceptive Insight	Metacognitive evaluation of experience/ performance (e.g., confidence–accuracy correspondence)	Relationship between objective performance (interoceptive accuracy) and awareness of performance	Area under ROC curves mapping confidence onto accuracy
	Interoceptive Sensibility	Self-perceived tendency to focus on interoceptive stimuli (trait measure)	Questions probing autobiographical experiences or assessment via self-reports capturing regulatory and non-judgmental aspects of interoception	Questions such as, 'To what extent do you believe you focus on and detect internal bodily sensations?'; MAIA
	Interoceptive Self-Report Scales	Psychometric assessment via questionnaire (state/trait measure)	Experimentally using instruments or scales	BAQ, BPQ, MAIA, VSI
Murphy et al. (2019)	Objective Interoceptive Accuracy	Objective measurement of the accuracy of interoceptive detection	Performance on objective interoceptive measures	Heartbeat tracking or detection procedures
	Subjective Interoceptive Accuracy	Beliefs regarding the accuracy of interoceptive percepts	Confidence ratings or scores on self-report scales	Ratings on a VAS from 'full perception/complete confidence' to 'total guess/no awareness'; ICQ or IAS
	Objective Interoceptive Attention	Objective measurement of the degree to which interoceptive signals are the object of attention	Experience sampling methods	Real-time recording of quality of attention to interoceptive signals
	Subjective Interoceptive Attention	Beliefs regarding the degree to which interoceptive signals are the object of attention	Scores on self-report scales	BPQ
Suksasilp & Garfinkel (2022)	Neural Representation	CNS activity associated with interoceptive processing, including the coupling of central activity with afferent physiological signals	Neuroimaging and neurophysiological measures	fMRI, EGG
	Strength of Afferent Signals	The strength and nature of signals originating from the periphery that communicate interoceptive states to the CNS	Externally measuring physiological variables that activate sensory transducers at specific visceral organs	Systolic and diastolic blood pressure

	Preconscious Impact of Afferent Signals	The effect of fluctuations in afferent signals on their central neural representation and the processing of external stimuli.	Partially assessable via the cardiac system	Timing brief stimulus presentations to coincide with bursts of baroreceptor activity
	Interoceptive Accuracy	Correct and precise monitoring, i.e., the correspondence between objectively measured physiological events and individuals' reported experience of those events, ascertained through behavioural tests.	Behavioural tests	Heartbeat tracking or detection procedures, water loading procedure, judgement of resistive loads compared to free breathing
	Self-Report and Interoceptive Beliefs	Measures of beliefs, both available to and beyond conscious access, concerning individuals' interoceptive sensations and experiences	Self-report measures, such as questionnaires and confidence ratings, and task-based measures of (implicit) prior beliefs thought to influence interoceptive perception	IAS, BAQ, MAIA, confidence ratings during tasks of interoception
	Interoceptive Insight	Metacognitive evaluation of experience/performance	The correspondence between accuracy during an interoceptive task, and (self-reported) perceived accuracy or confidence during the task	Area under ROC curves mapping confidence onto accuracy; correspondence between behavioural and self-report measures of interoceptive accuracy, and between those of interoceptive attention
	Interoceptive Attention	Observing internal bodily sensations. Includes purposefully attending to interoceptive sensations when instructed, as well as habitual tendency to attend to interoceptive sensations, relative to exteroceptive sensations.	Neuroimaging, self-report measures	fMRI under instruction during tasks of interoceptive attention, HEP, BPQ, experience sampling methods
	Attribution of Interoceptive Sensations	Interpretation of interoceptive sensations and their causes, such as perceived threat.	Self-report measures	BSIQ, conditioning procedures
Desmedt et al. (2023)	Interoceptive Attention	Any attentional process related to internal signals	Behavioural tasks and self-reports	Tasks or self-reports that measure interoceptive attention bias, attention regulation, and distracting subfactors
	Interoceptive Sensing	The sense of internal signals by the nervous system across conscious and nonconscious levels	Behavioural tasks and self-reports	Tasks or self-reports that measure interoceptive detection, magnitude, and localisation

Interoceptive Interpretation	Any interpretation, belief, attitude, and categorization of internal signals	Behavioural tasks and self-reports	Tasks or self-reports that measure interoceptive trusting, worrying, emotional awareness, and somatosensory amplification subfactors
Interoceptive Memory	Any memory process related to internal signals	Behavioural tasks and self-reports	Tasks or self-reports that measure symptom reporting bias and internal pain memory subfactors

Note. BAQ: Body Awareness Questionnaire; BPQ: Body Perception Questionnaire; BSIQ: Body Sensations Interpretation Questionnaire; EGG: Electrogastrography; fMRI: Functional Magnetic Resonance Imaging; HEP: Heartbeat-Evoked Potential; IAS: Interoceptive Accuracy Scale; ICQ: Interoceptive Confusion Questionnaire; MAIA: Multidimensional Assessment of Interoceptive Awareness; ROC: Receiver Operating Characteristic; VAS: Visual Analog Scale; VSI: Visceral Sensitivity Index.

2.1.7. Implications of Competing Taxonomies

Whilst these taxonomies are valuable, there is no accepted consensus on the definition and constituents of interoception. To date, Garfinkel and colleagues' tripartite framework has been widely endorsed within the interoceptive field, despite evidence indicating that this model should be revised (Desmedt et al., 2023; Murphy et al., 2019). Various alternative frameworks have been proposed to address the well-described theoretical and empirical issues with this parsimonious model. Garfinkel arguably recognises the limitations of the original model, based on her involvement in the development of two frameworks that followed (Khalsa et al., 2018; Suksasilp & Garfinkel, 2022). To some degree, these frameworks propose diverse conceptualisations, arguably contributing to confusion and ambiguity regarding the definition and measurement of interoceptive constructs. Cumulatively, this undermines the consistency, comparability, and generalisability of research findings. Due to profoundly disparate conceptualisation and methodology, the application of interoceptive constructs in mental health research and treatment settings has been hindered (Khalsa et al., 2018). Accordingly, developing consistent terminology and measurement approaches is essential for advancing research in interoception. Doing so would promote greater clarity, replication, and reliability of findings across studies and enhance the translation of research findings into clinical practice, thereby establishing a basis for developing and delivering interventions targeting interoceptive processes to improve adaptive behaviour, health, and wellbeing.

2.1.8. Adaptive and Maladaptive Aspects of Interoception

Aspects of interoception can profoundly contribute to both adaptive and maladaptive outcomes. Accordingly, distinguishing between adaptive and maladaptive aspects of interoception is essential for contextualising conflicting research findings and facilitating the selection of appropriate interoception measures that complement research objectives (Trevisan et al., 2021). Some authors have discerned that evidence regarding interoceptive attention provides insights for the constituents of adaptive and maladaptive interoception on the basis of specific measures and their association with clinical outcomes (e.g., Mehling, 2016; Trevisan et al., 2021).

Interoceptive attention may form a foundational psychological mechanism of the mind-body connection, considering evidence suggesting that homeostasis and allostasis provide a basis for wellbeing (Guidi et al., 2020) and the substantial overlap of regions of the CNS involved in physiological regulation with those active during interoceptive processing (Barrett & Simmons, 2015; Craig, 2014; Kleckner et al., 2017). By directing focus towards internal bodily signals and thus facilitating conscious awareness of these sensations, interoceptive attention can subsequently stimulate motivated behaviour aimed at addressing the state of the body, particularly during states of felt homeostatic perturbation (Craig, 2003a).

Research has shown that neural regions, including the bilateral dorsal mid-anterior insula and AIC, support the orientation of attention toward bodily sensation, along with the processing and representation of bodily signals (Haruki & Ogawa, 2021; Wang et al., 2019). In a predictive processing context, interoceptive attention, subsumed by such neural regions and the salience network, is proposed to facilitate attunement of the internal model. This process can augment a greater reduction in interoceptive prediction errors (Barrett, 2017b). Interoceptive attention may promote adaptive regulation and functioning by enhancing the prediction of errors that require attention and are relevant to allostasis, making them worthy of expending energy on encoding and consolidating (Barrett, 2017b).When efficiently implemented, this process enhances future adaptive functioning in dynamic environments.

Findings from Petzschner et al. (2019) illustrate the importance of adaptive interoceptive attentional control and flexibility. They determined that interoceptive attention modulates the heartbeat evoked potential. This indicates that attention enhances the precision and salience of sensory signals, conversely increasing prediction errors for exteroceptive cues. Moreover, they reported that the strength of modulation (the difference between peak heartbeat evoked potential amplitude for interoceptive and exteroceptive cues) significantly explained variance in self-reported ANS reactivity. Accordingly, heightened perceptions of ANS dysfunction is proposed as caused by an inability to downregulate the salience of interoceptive signals where attention to the body is unnecessary.

Such findings have significant implications for clinical populations with a heightened bodily focus. An attentional bias towards interoceptive rather than exteroceptive cues may lead to heightened neural activation in response to interoceptive signals, potentially amplifying and reinforcing perceptions of severe somatic symptoms. This highlights the need for flexible interoceptive attention, which can promote better balancing of the salience of interoceptive and exteroceptive signals. Effective, flexible, interoceptive attention may serve to reduce unnecessary bodily focus and support better regulation and functioning. Conversely, maladaptive interoceptive attention and an overemphasis on bodily sensations can potentially contribute to chronic physiological dysregulation (i.e., allostatic load; Panayiotou et al., 2021). Accordingly, it becomes clear that the balance of interoceptive and exteroceptive attention is crucial for optimal regulation and functioning.

In a subjective context, adaptive and maladaptive interoceptive attention styles pertain to how individuals perceive and attend to their internal bodily sensations in ways that either promote or hinder their wellbeing and adaptive functioning (Mehling, 2016). Adaptive attention involves bodily sensations being regarded as important, confidence in the capacity to orient, sustain, and control attention to sensations, and non-judgmental acceptance of immediate experience. Such characteristics are proposed as assessable via the MAIA (Mehling, 2016). Moreover, an adaptive interoceptive attention style been regarded as encompassing propensities for mindfully attending to interoceptive cues, reflecting a virtue that involves balanced, flexible awareness of sensations (Mehling, 2016). In essence, this entails capacities for shifting or maintaining focus, based on situational contexts and individual needs. Such tendencies are proposed to facilitate effective regulation, and are regarded as healthy, adaptive, and resilience-promoting (Mehling, 2016; Trevisan et al., 2021), which can be cultivated through clinical applications of mindfulness and other meditative practices (Khalsa et al., 2018). Conversely, a maladaptive attention style tends to be conceptualised as involving hypervigilance and preoccupation with interoceptive cues—proposed as measured by the BPQ. This style can culminate in heightened searching, sensitivity, and reactivity to interoceptive stimuli (Mehling, 2016; Trevisan et al., 2021). Such propensities are associated with clinical indicators, including dispositional anxiety, rumination, and somatisation, wherein psychological distress is experienced as physical symptoms indicative of medical illness (Mehling, 2016; Trevisan et al., 2021). However, it warrants mentioning that this style can also involve dispositional avoidance of sensations (Khalsa et al., 2018; Mehling et al., 2009). For instance, one study found that patients with fibromyalgia—a functional disorder characterised by musculoskeletal pain linked to somatisation—exhibited higher propensities for noticing comfortable, neutral, and uncomfortable interoceptive sensations and distracting themselves from sensations of pain and discomfort when compared to healthy controls (Schmitz et al., 2021). This finding highlights disturbances in interoceptive attention perceptions and beliefs within this clinical population. Considered together, these perspectives and findings shed light on the vital contributions of adaptive interoceptive construals to perception and flexibility, imperative for adaptability.

2.1.9. The Importance of Self-Reported Interoception

Acuity in objective accuracy and awareness or insight is essential for maintaining optimal functioning and engenders adaptive behaviour (Trevisan et al., 2021). Although any subjective assessment inherently involves bias, strongly held beliefs regarding interoceptive abilities may influence overall interpretation of bodily sensations (Critchley & Garfinkel, 2017; Suksasilp & Garfinkel, 2022) and subsequently guide the enactment of behaviours aimed at addressing equilibrium and wellbeing. Within interoceptive research, IAcc and IAw, proposed by Garfinkel and colleagues, are dimensions of heightened interest (Khalsa et al., 2018), chiefly assessed through tasks 'cardioception', including heartbeat tracking (heartbeat discrimination task; Whitehead et al., 1977) or counting (Schandry, 1981). However, additional physiological tests are utilised, such as the water load task for gastrointestinal sensitivity or respiratory resistance load detection (Critchley & Garfinkel, 2017). Whilst these are traditionally measures of IAcc and IAw, they assess a singular bodily channel and are not generalisable to other systems (Ferentzi et al., 2018). Furthermore, the psychometric properties of popular cardiac measures are controversial and have been subject to much scrutiny (Ainley et al., 2020; Corneille et al., 2020; Desmedt et al., 2018; Ring & Brener, 2018; Ring et al., 2015; Zamariola et al., 2018; Zimprich et al., 2020). Major criticisms of these measures pertain to the influence of subjective prior beliefs on performance, feedback encouraging implicit learning over trials, heterogeneity of time intervals between trials, and a lack of predictive validity (Desmedt et al., 2018; Ring et al., 2015; Zamariola et al., 2018). Such factors cumulatively confound whether performance is valid and true to actual accuracy or awareness. Furthermore, meta-analyses have demonstrated that performance on objective cardiac tasks operationalising IAcc and IAw do not appear to be significantly associated with major indicators of wellbeing, including trait anxiety, depression, or emotion deficits (Adams et al., 2022; Desmedt, Van Den Houte, et al., 2022; Jenkinson et al., 2024).

In contrast, subjective interoceptive beliefs assessed by questionnaires seem to influence clinical outcomes amongst various psychiatric populations. This overview is provided in Paper 2. As such, interoceptive constructs assessed by self-report scales may be more suitable indicators of clinical status than brain-based measures and behavioural tasks probing performance in discrete interoceptive channels (Suksasilp & Garfinkel, 2022).

In line with such evidence, this thesis focusses on the subjective aspects of interoception accessible to consciousness and assessable via self-report scales, deducing that such aspects may form a basis for identifying appropriate psychological constituents of the mind-body connection. Despite the recent development of more valid and reliable measures of objective interoception (e.g., Larsson et al., 2021; Plans et al., 2021), evaluating accuracy, detection, awareness, or insight demands sophisticated techniques, where tasks are usually administered by specialists (Montoya-Hurtado et al., 2023). Conversely, interoceptive self-report scales provide clinicians and researchers with an economical and practical approach to assessing interoception, providing critical insights into how individuals perceive and interpret their bodily sensations. This is crucial for understanding various health conditions and informing treatment strategies aimed at holistically strengthening mind-body connections to promote adaptive physical and psychological functioning.

2.2. Emotion

At their core, emotions enable us to make meaningful sense of our internal and external experiences and are the quintessence of subjective experience (Barrett, Mesquita, et al., 2007). What an emotion *is*, however, remains controversial and fervently debated (Adolphs, 2017; Adolphs et al., 2019; Barrett, 2006a, 2006b, 2017b; Barrett, Lindquist, et al., 2007; Barrett, Mesquita, et al., 2007; Izard, 1993, 2007; LeDoux, 2012; Ortony, 2022; Panksepp, 2005, 2007, 2008, 2011). This debate may be driven, in part, by divergent assumptions which inform subsequent attempts to explain different phenomena.

Early theorists postulated that bodily states contribute to emotional experiences (James, 1894; Lange, 1885). This position was overtaken by prevailing assumptions that emotions are biologically determined (Tomkins, 1962, 1963), discrete entities (Izard, 2007; Panksepp, 2007) caused by distinct neurocircuitry (Panksepp, 2004), which are universally experienced (Ekman, 1999; Matsumoto & Wilson, 2022). In some respects, these views have regarded bodily changes as outcomes of emotions, rather than a constituent. Conversely, others propose that the interpretation of physiological sensations and changes plays a vital role in the generation of emotions, as they may form a foundation for affective states (Barrett, 2017b; Craig, 2009a, 2009b; Critchley & Garfinkel, 2017; Lindquist, 2013; Schachter & Singer, 1962; Seth, 2013).

Despite stark differences in perspectives, it is generally accepted that emotion involves an ensemble of psychological states that include subjective experience, cognitions, expressive movements and behaviours, and physiological changes (Damasio & Carvalho, 2013; Gross & Feldman Barrett, 2011; LeDoux & Hofmann, 2018), and constitutes a fundamental aspect of psychological models of the mind (Gross & Feldman Barrett, 2011). Existing theories of emotion are heterogenous and often contradict each other. Differences in perspectives are particularly notable in considerations regarding whether emotions are caused by distinct, specific processes, and exhibit universality, variability, and discreteness (Gross & Feldman Barrett, 2011). Whilst popular assumptions about emotion demonstrate various points of difference, they can be regarded as falling under several broad categories, including basic, appraisal, and psychological constructionist theories (Gendron & Barrett, 2009; Gross & Feldman Barrett, 2011; Lindquist, 2013). The following sections provide an overview of the key assumptions underlying differing perspectives in the conceptualisation of emotion.

2.2.1. Basic Theories

Basic emotion theories posit that emotions are innate, universal phenomena, triggered by relevant external stimuli which activate brain mechanisms, leading to stereotyped and obligatory responses (Wilson-Mendenhall et al., 2011). This view can be traced back to Charles Darwin (1872/1965), who postulated that emotions have evolved to serve adaptive functions, with particular mammalian behaviours reflecting inherited mental states he categorised using English emotion words (Gendron & Barrett, 2009). Typically, proponents of this view propose that there are a limited number of fundamental, discrete emotions (e.g., happiness, fear, surprise), each with distinct physiological, neural, and behavioural characteristics (Ekman, 1971; Izard, 1977, 2007; Panksepp, 2004; Plutchik, 1982; Tomkins, 1962, 1963). Each basic emotion is argued to correspond to specific neural pathways and regions (Panksepp, 2004), with distinct ANS 'fingerprints' (e.g., elevated heartrate in anger and fear; Ekman et al., 1983; Siegel et al., 2018), although variation in ANS activity is deemed epiphenomenal (Siegel et al., 2018). Basic emotions are regarded as expressed through universally recognisable facial expressions (Ekman, 1971; Ekman & Friesen, 1971; Matsumoto et al., 2008), facilitating cross-cultural understanding. These theories emphasise the evolutionary function of emotions in facilitating environmental navigation and response (Izard, 2007; Panksepp, 2004; Plutchik, 1982).

However, a body of evidence challenges basic theories. For instance, they may oversimplify emotional diversity, neglecting cultural and individual variations (Gendron et al., 2018). Emotional expressions and experiences vary significantly across cultural contexts, therein questioning their universality (e.g., Gendron, Hoemann, et al., 2020; Hoemann et al., 2024; Russell, 1991). Instead, evidence suggests that emotions exist as populations of context-dependent instances with varying features (e.g., ANS activity, expressions; Azari et al., 2020; Boiger et al., 2018; Chikazoe et al., 2014; Hoemann et al., 2020; Siegel et al., 2018;

Wilson-Mendenhall et al., 2013). Additionally, the reliability of universally recognisable facial expressions between and within cultures is weak (Barrett et al., 2019; Gendron et al., 2018; Gendron et al., 2014). Moreover, the claim of distinct neural circuits for specific emotions is also contested (Barrett, 2006a; Barrett, Lindquist, et al., 2007), as empirical evidence shows substantial overlap in brain activation patterns across emotions, suggesting a more interconnected neural network (Clark-Polner et al., 2016; Lindquist et al., 2012; Raz et al., 2016).

2.2.2. *Appraisal Theories*

Appraisal theories of emotions emphasise the significance of cognitive evaluations and subjective interpretations in shaping emotional experiences in response to various stimuli (Gendron & Barrett, 2009). Emotions are assumed to arise from appraisals of events, situations, and objects (Frijda, 1993; Roseman & Smith, 2001) and are elicited when these are appraised as salient and aligned with goals (e.g., Frijda, 1986; Lazarus, 1991; Scherer, 1984). Appraisal models emerged to encompass cognitive aspects contributing to emotional experiences (Barrett, Mesquita, et al., 2007), viewing emotions as intentional states that occur in the context of objects or situations (Gendron & Barrett, 2009). Emotions are regarded as dynamic (Scherer, 1984; Smith & Ellsworth, 1985), involving constant evaluations and responses to the environment. Each emotion is differentiated by specific patterns of cognitive appraisals (Ellsworth, 2013), explaining individual and temporal differences in emotional responses (Roseman & Smith, 2001); similar appraisal patterns in disparate situations can result in experiencing the same emotion (Barrett, Mesquita, et al., 2007; Roseman & Smith, 2001). Appraisal theories propose that emotions serve adaptive purposes, motivating responses to address and overcome challenges (Arnold, 1960; Ellsworth, 2013; Lazarus, 1991; Scherer, 1984; Smith & Ellsworth, 1985). The appraisal system is believed to have evolved to process information predicting when specific emotional reactions will facilitate coping (Lazarus, 1991; Roseman & Smith, 2001) through selection of emotional responses most likely to achieve needs in the context of prevailing conditions.

However, appraisal theories have also attracted criticism. Theories assuming that appraisals preclude emotional elicitation (e.g., Scherer, 1984) arguably view emotions as primarily involving bottom-up processing, which can delay rapid, adaptable emotional responses (Clore & Ortony, 2013). They may also insufficiently account for what people subjectively experience through aggregation of phenomenological details, which diminishes variation in emotional experiences across contexts (Barrett, Mesquita, et al., 2007). As with basic theories, Western appraisal models can neglect cultural variations in appraisal dimensions and emotional responses (Barrett, Mesquita, et al., 2007), and oversimplify emotional experiences across diverse cultures. Moreover, research methodologies used in studies of appraisal theories, often relying on recalling or imagining past emotions, are criticised for lacking ecological validity (Barrett, 2006b; Barrett, Mesquita, et al., 2007). In such applications, self-reports may rely on semantic knowledge or beliefs about emotions, instead assessing characteristics of prototypical emotional experiences rather than real-time emotional experiences.

2.2.3. Psychological Constructionist Theories

Psychological constructionist accounts do not regard emotions as discrete mental states with unique characteristics, functions, and causes compared to other mental states, such as cognition and perception (Lindquist & Barrett, 2008). Such approaches contend that emotions do not arise from dedicated mechanisms; rather, that they emerge from an ongoing, adaptable constructive process involving fundamental psychological components, brain-based processes, sociocultural influences, and conceptual knowledge (Barrett, 2006b, 2017b; Gross & Feldman Barrett, 2011; Lindquist, 2013; Lindquist & Barrett, 2008; Oosterwijk et al., 2015; Russell, 2003). In contrast to basic and appraisal theories, these accounts emphasise the role of physiology in emotion by acknowledging that bodily sensations form a crucial constituent, shaping emotional experiences. Psychological constructionist models delineate several basic 'ingredients' as contributing to emotional experiences, including affect and categorisation (Barrett, 2006b; Barrett & Bliss-Moreau, 2009; Lindquist, 2013; Lindquist & Barrett, 2008).

Affect—often termed 'core affect' in the psychological constructionist literature (Lindquist & Barrett, 2008; Russell, 2003; Russell & Barrett, 1999)—is an irreducible property of the mind and central to consciousness (Barrett, 2017b; Barrett & Bliss-Moreau, 2009; Russell, 2003). Within these accounts, affect refers to "the most elementary consciously accessible affective feelings (and their neurophysiological counterparts) that need not be directed at anything" (Russell & Barrett, 1999, p. 806). This abstract mental state can manifest as bodily sensations or symptoms, but is more commonly experienced as varying on dimensions of valence, encompassing feelings of pleasantness to unpleasantness, and arousal, involving feelings of activation to quiescence (Barrett, 2017b; Feldman et al., 2024; Lindquist, 2013). Each dimension is regarded as distinct and of equal importance (Yik et al., 1999) within subjective bodily state representations, although large variation exists with respect how individuals experience affect (Barrett, 2004; Kuppens et al., 2013). This basic mechanism engenders conscious representations of interoceptive sensations, thereby fluctuating moment-to-moment (Barrett, 2017b; Feldman et al., 2024). Lindquist et al. (2016) conducted a meta-analysis of 397 neuroimaging studies to elucidate whether bipolarity in affect is represented by significantly distinct regions in the brain. The evidence suggested there is no single region that is significantly linked to positive or negative affective processing. Rather, that the brain represents affect more generally, where it is broadly distributed amongst neural regions, including the AIC, ACC, vmPFC, amygdala, ventral striatum, and thalamus—regions also implicated in interoception, homeostasis, and allostasis

(Barrett & Simmons, 2015; Chen et al., 2021; Kleckner et al., 2017; Petzschner et al., 2021; Smith et al., 2017), thus indicating that interoceptive information transduced, transmitted, and integrated by the CNS provides the foundation for subjective affective experiences (Feldman et al., 2024).

Categorisation is also emphasised in psychological constructionist accounts (Barrett, 2006b, 2012, 2017b; Lindquist, 2013; Russell, 1991), entailing the process that transforms affect into instances of emotion, which are accrued through prior experiences (e.g., knowledge, episodic memories) and imbued with sociocultural factors (Gendron, Mesquita, et al., 2020). This is the mental process of grouping objects, instances, or events according to perceived similarities, whereas categories are distinct groupings of particular purposes or functions in a given situation.(Barrett, 2017b; Hoemann et al., 2019). Conversely, concepts are the mental representation of categories. In the context of emotion categories, these are proposed to be variable, flexible, abstract, and ad-hoc—grouped according to functional, psychological features that are situationally constructed, whereby similarity amongst instances is grounded in context, goals, and needs (Hoemann et al., 2019). Anger, as an example, may differ based on circumstance. In threatening situations, anger may be goal-directed to be effective or powerful, whereas in situations involving coordinated action (e.g., protests, boycotts), the anger category may include instances that share the functional goals of group membership, recognition, and achievement of demands.

2.2.3.1. The Theory of Constructed Emotion. One notable psychological constructionist theory is that proposed by Barrett (2017b)—the Theory of Constructed Emotion (TCE). This theory draws on predictive processing to propose that emotions are not fixed entities but are constructed by the brain based on predictions derived from prior experiences and contextual cues. Specifically, the brain is hypothesised to run an internal model that regulates the body in the service of allostasis. The internal model consists of past experiences which are implemented as concepts—in this context, a suite of embodied, whole-brain representations that predict what is about to happen in the sensory environment, identify which actions facilitate management of impending events, and their impact on allostasis.

Interoceptive prediction errors are encoded and consolidated when they are envisioned to result in physiological changes, thereby impacting upon allostasis. When prediction errors are minimised, this engenders a perception or experience. Accordingly, the prediction explains the causes of events to the perceiver and subsequently guides their actions. When the internal model generates an emotion concept for the current context, the categorisation results in the experience of an emotion. In accordance with the TCE, accurate identification of actual internal states—be it emotional or physiological—may produce more accurate predictions. This can enable effective regulation of available resources and facilitate adequate, adaptive actions that favour allostasis and the maintenance of homeostasis. For instance, accurate identification and differentiation between hunger and anger may enable more precise predictions to become accessible, thereby enabling individuals to act in situationally appropriate ways that address the predicted state (MacCormack & Lindquist, 2019)—for example, searching for food to consume (Craig, 2003a; Schulkin & Sterling, 2019) or engaging in deep breathing to downregulate autonomic reactivity (Gross, 2015). These mechanisms acting in concert engage the default mode network—active during mind-wandering and recalling past events and supporting functions such as information processing, cardiovascular function, and autonomic activity. Additionally, the salience network is involved, supporting attention, memory, emoting, integration of multimodal information, and regulating ANS activity (Barrett, 2017b; Barrett & Satpute, 2013; Kleckner et al., 2017).

The concept of the 'affective niche' also forms part of the TCE. This is derived from embodied perspectives on brain function as subserving allostasis (Gendron, Mesquita, et al., 2020). Affect alone is insufficient for driving behaviour, instead prompting the brain to search for explanations using past experiences to predict factors (i.e., objects, events, situations) that will affect allostasis, thereby causing changes in affect (Barrett, 2017a, 2017b). An individual's affective niche comprises aspects of the immediate physical and psychological environment that is relevant to an individual's allostasis (Gendron, Mesquita, et al., 2020). Factors deemed important for one's allostasis through prior experience carry higher weighting in guiding future decision-making and goal-directed behaviour. As these are representative of value, they are 'signal' in the affective niche, relative to 'noise' (factors outside of or not integrated into the niche). Thus, an affective niche can be regarded as parts of the environment that are meaningful for and relevant to an individual's wellbeing.

Accordingly, the TCE proposes emotional states are the product of the brain categorising sensory inputs as instances of specific emotions based on prior encounters of sensations and the current environment. The application of predictive processing to emotional experiences indicates that affective responses are not solely reactive, but actively constructed by the brain. This aligns with the constructionist assumption that emotions are not biologically hardwired, pre-existing categories. They are dynamically created by the brain through a process of prediction and situational interpretation of physiological changes.

2.2.4. Positive and Negative Emotions

Although positive and negative emotions are not distinctly represented in the brain (Lindquist et al., 2016), they are experienced as qualitatively distinct (Diener & Emmons, 1984; Yik et al., 1999). Whilst positive emotions are less expansive and differentiated when compared to negative emotions (Fredrickson, 1998), they can have significant momentary and long-term benefits. According to Fredrickson (1998, 2001, 2004), positive emotions (e.g., joy, interest, contentment, love) play a crucial role in the 'broaden-and-build' theory, which suggests that these emotions facilitate the cultivation of physical, intellectual, and social resources, leading to long-term psychological wellbeing. The theory emphasises the beneficial impact of positive emotions on an individual's cognitive and behavioural repertoires, as well as on their long-term wellbeing (Fredrickson, 2001). Furthermore, that positive emotions play a crucial role in expanding momentary thought-action repertoires, thereby promoting the expansion of attention and interest in the environment which encourage play and exploration—contrasted with the narrowing of thought-action tendencies and attentional focus associated with negative emotional states (Fredrickson, 1998). This broadening of momentary repertoires augments building enduring personal resources (Fredrickson, 2004), whereby resources accumulated through ongoing experiences of positive emotions enable individuals to draw upon a vaster resource reserve during challenging circumstances, thereby enhancing resilience and overall wellbeing.

Evidence reported by Tugade and colleagues (2004) demonstrates that positive emotion granularity (the tendency to represent positive emotional experiences with precision and specificity rather than as general pleasant states) and positive affectivity promote psychological resilience and adaptive coping. They determined that trait resilience exhibited a significant positive association with positive affectivity, although no significant relationship was found with negative affectivity. Moreover, individuals with higher trait resilience displayed increased happiness and interest during experimental induction of anxiety to produce cardiovascular reactivity. Notably, higher trait resilience was linked to shorter durations of cardiovascular reactivity, indicating quicker recovery from negative emotional arousal. This relationship was mediated by positive emotions, suggesting that positive emotions facilitate quicker recovery in individuals with higher trait resilience following anxiety induction. Furthermore, individuals with higher positive emotional granularity demonstrated reduced tendencies for mental self-distraction and increased behavioural disengagement, indicating propensities for reflective, momentary pausing before engaging in coping strategies. Moreover, positive emotional granularity was inversely associated with automatic coping styles and experiential engagement, suggesting that individuals with higher levels of positive emotional granularity carefully consider various behavioural options rather than relying on heuristics to guide coping behaviour. In line with such proposals and evidence, the cultivation of positive emotions may be particularly effective for the downregulation of physiological reactivity, thereby presenting a promising avenue for preventing and treating conditions rooted in negative emotionality, such as depression, anxiety, and stress-related illnesses (Fredrickson, 2000).

Negative emotions, often viewed as adverse, can also play a vital role in both physical and psychological health. Whilst positive emotions are typically associated with wellbeing (Tugade et al., 2004), negative emotions, when properly understood and managed, can also offer significant benefits. Key aspects contributing to the positive impact of negative emotions is the granularity or differentiation of these emotions. Individuals with high granularity for negative emotions can differentiate feeling angry from frustrated or irritated and other negative emotions, such as feeling nervous, fearful, upset, lethargic, ashamed, or lonely. By contrast, those with low granularity experience negative emotions in global terms, such as feeling ‘bad’ (Hoemann et al., 2021; Wilson-Mendenhall & Dunne, 2021).

High granularity for negative emotions is conceptualised as a veritable gateway to greater wellbeing through a sequence of events initiated by the experience of intense negative emotions (Kashdan et al., 2015). The sequence begins with the onset of intense, distressing emotions. Initially, the act of labelling emotions provides insight into the situation and potential courses of action. Secondly, labelled emotions become easier to manage and either lose significance or facilitate achievement of personal goals. Thirdly, effective emotion management enables individuals to pursue personal aspirations beyond altering or controlling private mental events. However, individuals experiencing intense distress may prioritise the management of their emotions over other life goals, leading to unfocused aims and use of potentially harmful coping mechanisms.

Indeed, individuals with capacities for differentiating between different types of negative emotions tend to employ adaptive strategies for managing their emotions and experience better psychological health outcomes (Barrett et al., 2001; Kashdan et al., 2015; Smidt & Suvak, 2015). Findings reported by Barrett and colleagues (2001) are particularly illuminative of the benefits of negative emotion differentiation and granularity, with results suggesting that greater differentiation and intensity in negative emotional experiences is associated with more frequent management of negative emotions, particularly amongst individuals experiencing intense emotions. Moreover, higher negative emotion differentiation and granularity has been associated with lower levels of neuroticism, depression, and negative self-esteem, highlighting its role in promoting mental health and wellbeing (Erbas et al., 2014; Schmitt et al., 2024; Willroth et al., 2020).

These lines of evidence cumulatively indicate that the cultivation both positive and negative emotions plays a significant role in promoting physiological and psychological health. Positive emotions broaden cognitive repertoires, build personal resources, and foster resilience, promoting quicker recovery from negative emotional arousal and effective coping. Conversely, high granularity for negative emotions aids in emotion management, reducing negative states and promoting goal attainment. As such, both positive and negative emotions, when represented, cultivated, and managed appropriately, contribute to overall health and wellbeing through distinct yet complementary pathways.

2.2.5. Emotional Reactivity

Whilst most theories of emotion seek to explicate the fundamental nature, components, and processes underlying emotional experiences, other accounts focus on elucidating individual differences in propensities for exhibiting heightened or attenuated emotional responses to stimuli or events. Emotional reactivity pertains to a suite of transitory states geared toward survival, which equip humans and other species to react to stimuli by discerning between positive and negative cues and prompting relevant behavioural responses (Becerra & Campitelli, 2013). Emotional reactivity is regarded as multifaceted and chronometric (e.g., Becerra & Campitelli, 2013; Becerra et al., 2019; Klonsky et al., 2019; Preece et al., 2019), whereby emotional responses are proposed to involve three key aspects: frequency of activation, intensity, and duration or persistence of emotional responses, leading to alterations in subjective experiences, behaviour, and physiology (Larsen & Diener, 1987). Examination of individual differences in emotional reactivity necessitates discrimination between phases involved in emotional responses (Davidson, 1998; Panayiotou et al., 2021).

Davidson (1998, 2015) hypothesised that four related, yet distinguishable, components encapsulate the typical properties underlying emotional experience. Individual differences are proposed as attributable to: (1) *positive and negative affect*; (2) *activation*; (3) *intensity*; and (4) *duration*. These aspects and phases are detailed in Paper 3. Individuals may exhibit distinct patterns of emotional reactivity when experiencing positive and negative emotions. Moreover, variations can arise in how strongly the emotion is experienced, the magnitude of an emotional stimulus needed to evoke a response, the duration until emotions subside, and the time taken for activation levels to return to normal. Such components encapsulate and provide parameters for the chronometric nature of differences in emotional responsivity (Davidson, 1998, 2015).

Davidson (1998) highlights that approach and withdrawal drive individual differences in emotional experiences. These factors contribute to particular affective styles and propensities for experiencing particular emotions. Drawing on evidence suggesting prefrontal asymmetry and the existence of neural circuity associated with motivation and emotion (e.g., Davidson, 1994), he proposed that activation of an approach system augments engagement with positive stimuli, thereby facilitating appetitive behaviour which fosters positive affect (e.g., pride, enthusiasm) that is generated for pursuit of and following attainment of desired goals. Conversely, activation of a withdrawal system facilitates withdrawal from aversive stimuli, concurrently generating negative affectivity (e.g., fear, disgust) that promotes distancing from the source of aversion. Deficits in the approach system is proposed to manifest as withdrawal from positive or rewarding stimuli, thereby enhancing vulnerability to psychopathological conditions such as depression (Davidson, 1994, 1998).

Others such as Panayiotou and colleagues (2018; 2021) propose that individual differences in emotional reactivity stem from adaptivity in adjusting to the affective environment, drawing on McEwen's (1998) allostatic load model. In their dynamic-phase model, flexibility is proposed to promote adaptive emotional responses that are consistent with goals, needs, and values that correspond with situational demands, which augment psychological and physiological health (Panayiotou et al., 2021). The five stages of the dynamic-phase model include anticipation, response, recovery, habituation, and rest.

Anticipation entails expectation of foreseeable challenges using cues from the environment and past experiences to optimise perception and action, which can be hindered by factors such as chronic arousal from worry or anxiety and attentional avoidance. The *response* stage involves reactions to stimuli perceived as emotional, based on how they are identified and appraised; individual differences in factors such as anxiety and can affect appraisals, leading to biases in attention, and stronger engagement or difficulty disengaging from threatening stimuli. In their view, flexible responses entail capacities for attending to significant stimuli, ignoring insignificant ones, and initiation of situationally appropriate coping. *Recovery* involves returning to resting state after the stimulus ends, which promotes energy conservation and restoration of homeostasis. *Habituation* refers to decreased reactivity towards repeated, familiar stimuli over time, the rate of which is influenced by stimulus intensity and familiarity, with less intense and more familiar stimuli leading to stronger habituation. An adaptive *resting state* involves the recuperation and conservation of resources when imminent challenges are absent and unanticipated. Together, the phases form a cascade of responses to emotional changes, evolving from initially unexpected to eventually becoming anticipated, immediate, chronic, or recurrent. Moreover, they are hypothesised to fluidly unfold in the service of goals and values, with flexibility highlighted as influencing whether emotion regulation is adaptive or maladaptive (Panayiotou et al., 2021).

Aspects of emotional reactivity can be measured using psychophysiological methods, including heartrate variability and skin conductance following presentation of emotional stimuli (Panayiotou et al., 2018; Quigley et al., 2014), although such measures present impracticalities for clinical and research purposes (Preece et al., 2019) and, arguably, should not be considered as proxy measures of emotional experience (Quigley et al., 2014) given the immense variation in physiological reactivity (Siegel et al., 2018). Conversely, self-reports are an appropriate, valid method for assessment of subjective emotional experiences (Barrett, 2004; Quigley et al., 2014). Indeed, self-report scales have been developed to capture emotional reactivity phases—particularly in terms of frequency or activation, intensity, and persistence or duration (e.g., Becerra et al., 2019; Klonsky et al., 2019; Larsen & Diener, 1987; Preece et al., 2019; Watson et al., 1988).

For instance, the Affect Intensity Measure (AIM; Larsen & Diener, 1987) is a questionnaire indexing the typical magnitude of emotional experiences, emphasising the involvement and subsequent measurement of emotional state frequency and intensity. Although useful for measuring such components, the AIM is limited as it lacks measurement of emotion duration (Becerra & Campitelli, 2013). Similarly, the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was originally designed to capture primary mood dimensions —positive affect, reflecting the extent to which individuals feel active and alert, and negative affect, representing distress and unpleasantness. Whilst the PANAS is characterised as an exemplary index of emotion (Quigley et al., 2014), the measure has been critiqued for requiring respondents to aggregate the activation, intensity, and persistence of their emotional experiences into one rating, thereby lacking granularity in the assessment of distinct reactivity phases (Klonsky et al., 2019). Two measures have been developed to address these limitations: the Perth Emotional Reactivity Scale (PERS; Becerra et al., 2019) and the Multidimensional Emotion Questionnaire (MEQ; Klonsky et al., 2019). Each questionnaire has been developed according to Davidson's (1998) emotional reactivity model and assesses typical experiences of positive and negative emotions. Several key differences exist in how the scales capture Davidson's model, which are elaborated on in Paper 3 (Chapter 6) of this thesis.

2.2.6. Emotion Regulation

Broadly, emotion regulation pertains to processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions (J. J. Gross, 1998). Emotional reactivity and the capacity to regulate emotions are closely intertwined processes that interact with each other to shape emotional experiences and responses (Panayiotou et al., 2021). Gross' (1998; 2015) process model of emotion regulation distinguishes five stages contributing to the modification of emotional experience which reflect either antecedent or response-focused regulatory processes.

Situation selection refers to prospectively taking actions and choosing situations congruent with emotional objects, driven by anticipation of emotional outcomes. *Situation modification* entails the alteration of environmental aspects to align with emotional preferences, encompassing changes in external circumstances to mitigate negative emotions or promote positive emotions. *Attentional deployment* involves the deliberate, goal-directed allocation of attentional resources towards or away from particular environmental stimuli, so as to amplify or attenuate emotional responses through directing attention towards salient cues that reinforce desired emotions or diverting attention from distressing stimuli. These three stages comprise antecedent-based regulatory methods, as they serve to promote or avert particular emotional experiences.

Conversely, *cognitive change* reflects response-focused regulation, entailing modification of initial appraisals of a situation or event to alter emotional impact. This may involve cognitive reappraisal to modify emotional significance, thereby altering affective responses. *Response modulation* encapsulates the regulatory mechanisms employed to modulate emotional experiences and expressions, encompassing physiological, experiential, and behavioural strategies aimed at influencing emotional responses after they have unfolded. Techniques ranging from deep breathing exercises to expressive suppression are utilised to modulate the intensity and outward expression of emotions.

Various emotion regulation strategies exist and tend to be conceptualised as adaptive or maladaptive based on their association with indicators of wellbeing (Aldao & Nolen-Hoeksema, 2010; Engen & Singer, 2015; Panayiotou et al., 2021; Wolgast et al., 2011). Adaptive strategies include reappraisal, problem-solving, acceptance, and self-compassion, which predict positive health and wellbeing outcomes, including enhanced positive affect generation (Engen & Singer, 2015), reduced anhedonia and anxious arousal (Aldao & Nolen-Hoeksema, 2010), and lower subjective distress, behavioural avoidance, and physiological reactivity (Wolgast et al., 2011). Conversely, avoidance, suppression, and rumination represent maladaptive strategies that are more strongly associated with psychopathology (Aldao & Nolen-Hoeksema, 2010; Oldershaw et al., 2015), proposed to arise from inflexible thinking and dysfunctional activation of executive control networks implicated in serving regulatory purposes (Uddin, 2021).

However, adaptive emotional functioning and regulation is contingent upon congruence with the current context and individual needs, goals, and values (Panayiotou et al., 2021). This necessitates flexibility in psychological, behavioural, and physiological processes and strategies that are suited to the environment as it changes, and new demands are encountered. As such, ineffective, incongruent strategy perseveration to modulate emotional experiences can deplete mental and physiological resources, especially where context and goals are ignored (Panayiotou et al., 2018; Panayiotou et al., 2021).

2.2.7. Alexithymia

A major factor hindering adaptive flexibility and employment of effective emotion regulation strategies is alexithymia (Panayiotou et al., 2021; Preece et al., 2023). Sifneos (1973) coined the term ‘alexithymia’, from the Greek stems of a—lack, *lexis*—word, and *thymos*—mood, literally encompassing ‘no words for feelings’. Alexithymia was the term established to denote characteristics consistently observed in patients with psychosomatic illnesses. Borne from the psychoanalytic tradition (Hoemann et al., 2021; Porcelli & Taylor, 2018), the most defining traits included constricted emotional functioning, impoverished fantasy life and constricted imaginal processes (reduced daydreaming), inability to find appropriate words to describe emotions, and operational thinking.

Later perspectives highlight the cognitive-emotional aspects of alexithymia (e.g., Preece et al., 2017; Preece & Gross, 2023; Taylor et al., 1991, 1999) particularly emphasising the involvement of three facets: difficulty identifying feelings (DIF), difficulty describing feelings (DDF), and externally oriented thinking (EOT). DIF is proposed to entail capacities for identifying feelings and distinguishing these from the bodily sensations that accompany emotional arousal, whereas DDF involves the inability to verbally express and communicate feelings to others. Conversely, EOT is a cognitive style reflecting an absence of internally-directed thoughts and fantasies, including low emotional expressiveness and preference for focussing on features of the physical environment (Taylor et al., 1999). Persons with high alexithymia further experience difficulties in the perception of emotional facial expressions, detection, expression, and encoding of emotive language, and processing visual stimuli of emotionally laden situations (Luminet et al., 2021).

Although these characteristics may cumulatively suggest that alexithymia renders individuals incapable of experiencing emotions, they can—and are often distressed by them (Luminet et al., 2021). However, they lack adequate and appropriate mental representations to experience them as distinctly identifiable and expressible feelings. Individuals with high alexithymia lack emotional granularity (Lee et al., 2022; Luminet et al., 2021), reflecting reduced emotion concepts. As such, they may be able to identify and express feeling 'good' or 'bad', but these are experienced and expressed in general terms. In times of emotional distress, diffuse, imprecise mental representations of emotions may lead to physical sensations accompanying emotional arousal being misconstrued as indicative of physical illness (Porcelli & Taylor, 2018; Taylor et al., 1999), suggesting a role for somatising as interacting with the construction of such representations.

Panayiotou and colleagues (2021) highlight alexithymia as indicative of impaired emotional reactivity and awareness throughout their dynamic phases of emotional functioning. Mechanisms contributing to physiological and psychological dysfunction observed in alexithymia include poor early encoding, emotion differentiation, recognition, and granularity, leading to dysfunctional reactions in emotional processing and regulation contexts. Individuals with alexithymia may inefficiently anticipate emotional stimuli due to poor encoding and consolidation, resulting in unnecessary stress and activation. Hypo- and hyperreactivity at physiological and psychological levels contribute to allostatic load (McEwen, 1998; McEwen & Gianaros, 2010), stemming from inadequate evaluations of valence and arousal.

Maladaptive responses are linked to dysfunctional attentional deployment, resulting in situationally inappropriate behaviour. Evidence indicates hypo-reactivity across physiological systems in alexithymia, resulting in inadequate stress responses such as the fight-or-flight reaction. This activates the HPA-axis and increases glucocorticoid production, which inhibits pro-inflammatory cytokines. Chronic activation can lead to deficient immune responses, increasing the risk of physical and psychiatric diseases and hindering recovery. Difficulties returning to baseline after interactions with emotional stimuli may lead to a failed shutdown, which requires flexible attentional deployment and response inhibition—notably, these are dysfunctional in alexithymia.

Compromised inhibitory and shifting capacities slow and hinder recovery from stressors, causing sustained hyperarousal and increased allostatic load. Emotion modulation relies on symbolically representing affect and connecting it to past experiences. Memory and learning deficits in alexithymia impair the ability to update emotional evaluations, such as recognising that a feared stimulus is no longer a threat. These memory deficits and difficulties in consolidating and encoding experiences may prevent habituation, causing ongoing reactivity to repeated emotional exposures. Enhanced activation during resting states, due to hypervigilance and poor inhibition, further contributes to chronic HPA-axis activation. These deficiencies lead to frequent stress and persistent use of maladaptive emotion regulation strategies, including non-acceptance, avoidance, suppression, negative coping, and negative cognitive reappraisals (Panayiotou et al., 2021). Together, these factors result in and perpetuate emotional and physiological dysfunction, increasing the risk of developing and maintaining physical and psychiatric illnesses.

Indeed, alexithymia is a transdiagnostic trait, co-occurring with a multitude of physical and psychiatric illnesses, including, but not limited to, organic neurological diseases (e.g., stroke, epilepsy; Ricciardi et al., 2015), type 2 diabetes (Martino et al., 2020), coronary heart disease (Grabe et al., 2010), medically unexplained symptoms (De Gucht et al., 2004), illness anxiety disorder (Porcelli & Taylor, 2018), functional neurological disorder (Demartini et al., 2014), somatic symptom disorder (Smakowski et al., 2024), major depressive disorder (Honkalampi et al., 2001), anxiety and related disorders (De Berardis et al., 2008), feeding and eating disorders (Westwood et al., 2017), and ASD (Kinnaird et al., 2019). Mechanisms proposed to interact with alexithymia in such illnesses include somatosensory amplification and somatisation, which contribute to and reinforce atypical illness behaviours (Porcelli & Taylor, 2018). Alexithymia is noted to influence responses following psychological interventions and adherence to treatments, with DIF and DDF facets particularly affecting such outcomes (e.g., Pinna et al., 2020; Porcelli & Taylor, 2018). Moreover, alexithymia is highlighted as a major psychological factor affecting medical conditions, as enshrined within the Diagnostic Criteria for Psychosomatic Research (Sirri & Fava, 2013), therefore indicating its relevance to the mind-body connection construct.

2.3. The Interplay Between Interoception and Emotion

This thesis concurs with the notion that a “purely disembodied human emotion is a nonentity” (James, 1884, p. 194). Psychological constructionist theories of emotion, such as the TCE (Barrett, 2017b), explicitly delineate a role for interoception in emotional experiences. In the human brain, the experience of emotions is supported by an interconnected network of cortical and subcortical structures, including prefrontal, ventral, anterior cingulate, and insula cortices, amygdala, ventral striatum, and brainstem (Lindquist et al., 2012). These regions are notably active in interoceptive processing (Carvalho & Damasio, 2021; Craig, 2014; Kleckner et al., 2017). In line with such evidence, emotional experiences are informed by capacities for sensing and interpreting fluctuations occurring from within the body (Seth, 2013). This stands in stark contrast to popular assumptions of emotion contained within basic and appraisal frameworks that are well-integrated into educational curricula, permeating broader cultural understandings of emotion.

2.3.1. Homeostatic Emotion

In certain contexts, individuals emotionally evaluate interoceptive signals, which is proposed to entail top-down regulation processes (Pollatos & Herbert, 2018b). Craig (2008) posited that emotions are closely tied to interoceptive processes, wherein interoception is implicated in generating a mental representation of homeostatic imbalance—also termed homeostatic feelings. The basic set of modalities or homeostatic feelings include temperature, itch, visceral distension, muscle ache, hunger, thirst, 'air hunger' and affective touch (Craig, 2003a). Following his crucial expansion of the neuroanatomical underpinnings of interoception (Craig, 2002), Craig (2003a) proposed the concept of homeostatic emotion, wherein emotions are viewed as mechanisms that support the maintenance of homeostasis, ensuring that the physiological needs of the body are met. Craig (2003a) argued that "[h]omeostatic afferents generate both a sensation and an affective motivation with autonomic sequelae – that is, a feeling from the body that motivates behavior" (p. 304). For example, in the context of thermoregulation, feeling cold may be an unpleasant sensation during the winter months. An individual may be motivated to take specific actions, so as to expedite feeling warmer and therefore reduce discomfort—for example, turning on a heater. This implies that autonomic effects, interoception, affect consciously experienced in response to physiological changes, and associated motivations comprise components that drive adaptive behavioural responses which tangibly attend to the physiological needs of the body. Homeostatic emotion is deeply representative of an embodied process. It characterises the nexus between body and mind, given that the detection of bodily imbalance involves a psychological appraisal of how we feel in the moment, conscious affective experiences, and behavioural expression.

2.3.2. Interoception, Emotional Reactivity, and Emotion Regulation

Interoceptive abilities may underlie individual differences in emotional awareness which could therefore influence emotion regulation processes. One subjective mechanism of interest is interoceptive attention. The quality of adaptive interoceptive attention can be conceptualised as reflective of active attention, which adjusts, filters, and augments sensory inputs from the body (Mehling et al., 2009). The MAIA was specifically developed to measure such aspects. Adaptive attention beliefs are shown to predict increased capacities for emotion identification and facilitate habitual use of adaptive emotion regulation strategies through enhanced emotional awareness (Schuette et al., 2021; Tan et al., 2023). Together, this indicates that awareness of neutral, comfortable, and uncomfortable bodily sensations engenders awareness of emotions, thus augmenting greater flexibility in the selection of emotion regulation strategies. By contrast, exaggerated and maladaptive interoceptive attention is driven by hypervigilance and negatively biased interpretations of sensations (Mehling, 2016). These characteristics are related to greater illness anxiety (Marcus et al., 2007) and increased somatisation (Trevisan et al., 2021). Such habitual tendencies may explain why poorer propensities for adaptive interoception are predictive of higher global alexithymia and emotion dysregulation (Desdentado et al., 2022).

There is a relative paucity of research explicitly examining the association between subjective interoception and emotional reactivity phases. Whilst scarce, some studies have examined how various interoceptive self-report scales are related to aggregated activation and intensity phases, as assessed by the PANAS. Previous research suggests that adaptive interoceptive attentional and regulatory components are more strongly associated with greater capacities for identifying and describing one's positive affectivity (Vig et al., 2022; Yun-Hsin et al., 2023). For instance, Vig and colleagues (2022) found that reactivity for positive emotions is positively correlated with scales proposed to assess adaptive interoceptive functions, including extero-interoceptive awareness (BAQ), and the following MAIA scales: Noticing, Attention Regulation, Emotional Awareness, Self-Regulation, Body Listening, and Trusting. Of these, Noticing, Trusting, and extero-interoceptive awareness significantly predicted increases in positive emotions, explaining 19.6% of variance. In contrast, reactivity for negative emotions was inversely correlated with interoceptive Not-Worrying, Attention Regulation, Self-Regulation, and Trusting MAIA scales, wherein Not-Worrying and Trusting were the only aspects significantly associated with reduced negative emotions, explaining 16.9% of variance. This suggests dysfunctional processing and interpretation of bodily sensations, including maladaptive, hypervigilant interoceptive attention (Mehling, 2016; Vig et al., 2022), negatively biased symptom reporting (Aronson et al., 2006), and somatosensory amplification, or tendencies to experience bodily sensations as noxious, threatening, and intense (Köteles & Witthöft, 2017).

2.3.3. Interoception and Alexithymia

Although alexithymia is traditionally viewed as involving cognitive and emotional deficits (Luminet et al., 2021; Taylor et al., 1991), contemporary proposals suggest that alexithymia is best characterised as a deficit of interoception (e.g., Brewer et al., 2016; Brewer et al., 2015; Shah, Catmur, et al., 2016; Shah, Hall, et al., 2016). Proponents of the 'interoceptive hypothesis' of alexithymia have argued that alexithymia primarily reflects a deficit in interoceptive ability rather than a multifaceted construct, which involves confusion and poor differentiation between bodily and emotional states (Brewer et al., 2016). Their studies, primarily focused on ASD, suggest that alexithymia contributes to both interoceptive and emotional deficits in this population. Cumulatively, such findings have lead proponents of this view to speculate that alexithymia cannot occur without atypical interoception, characterised by atypically low or high sensitivity to bodily sensations and changes. As such, impaired awareness and interpretation of ongoing sensations from within the body contributes to diminished recognition, articulation, and experience of emotions.

Neuroanatomical evidence further suggests an interrelation between interoception and alexithymia (Barrett, 2017a). For instance, individuals with high alexithymia exhibit reduced activity in interoceptive hubs located in the default mode network when viewing emotional stimuli (Reker et al., 2010; van der Velde et al., 2013). The default mode network is crucial for predicting with emotion concepts (Barrett, 2017a; 2017b). This process enables individuals to interpret and respond to their physiological states as emotional experiences. Accordingly, reduced activity in these interoceptive hubs suggests that alexithymic individuals may have less granular mental representations of emotions and experience difficulty using emotion concepts to predict and make sense of their bodily sensations. Findings further highlight increased activity in the dorsal ACC—an area associated with subjective reports of negativity, pain processing, and amplification of somatic symptoms (Vogt, 2005). As such, individuals with alexithymia may often report somatic symptoms and negative affect, but do not typically experience these as emotional (Porcelli & Taylor, 2018). Whilst alexithymic individuals exhibit typical interoceptive network functioning when exposed to aversive stimuli likely to evoke physiological sensations that will be experienced as unpleasant, they demonstrate reduced activation in the posterior insula and AIC in response to agreeable stimuli evoking interoceptive changes that are likely to be experienced as pleasant (Barrett, 2017a; Kano & Fukudo, 2013; Lane et al., 1997; Moriguchi & Komaki, 2013; Vogt, 2005). This suggests a neurobiological underpinning for intact, albeit biased negative processing of interoceptive and emotional stimuli observed in alexithymia.

Interoceptive beliefs and values serve as a crucial contributor to the interpretation and incorporation of physiology into ongoing experiences (MacCormack et al., 2024). Persons with high levels of alexithymia experience significant difficulties in differentiating emotions from sensations, perceiving them as similar—for example, feeling anger as pain or hunger, and vice versa (Brewer et al., 2016), which can be explained in at least two ways. Firstly, this possibly suggests a lack of regard or indifference toward valuing sensations and emotions. Secondly, this may reflect inaccurate and unreliable beliefs informing interpretation of bodily sensations. Whilst hypothetical, such characteristics may hinder categorisation and representation of bodily sensations in emotional terms and propagate reliance on external inputs to understand the cause of sensations roused by emotional stimuli (MacCormack et al., 2024; Pollatos & Herbert, 2018a)—a hallmark of EOT.

Empirical evidence suggests that aspects of self-reported interoception are predictive of alexithymia, although these relationships are stronger with DIF and DDF facets relative to EOT (Gaggero et al., 2021). Trevisan et al. (2019) previously meta-analysed the association between interoceptive dimensions and an index of global alexithymia, involving composite scores of DIF, DDF and EOT subscales from the Toronto Alexithymia Scale (TAS; Bagby et al., 1994). Their analyses demonstrated that lower perceived precision in the accurate detection of interoceptive stimuli coincides with higher alexithymia. Moreover, that IS and alexithymia are not associated when the data were aggregated, but moderated by the employed interoceptive self-report scale. Specifically, the BPQ and alexithymia were positively associated, such that heightened sensitivity for and awareness of internal bodily states related to higher alexithymia. By contrast, averaged Noticing and Emotional Awareness MAIA subscales and alexithymia were negatively associated. As such, greater awareness of comfortable, uncomfortable, and neutral body sensations (Noticing scale) and the connection between bodily sensations and emotion (Emotional Awareness scale) coincides with lower alexithymia.

Together, such findings indicate that perceived accuracy and adaptive and maladaptive interoceptive attention styles contribute to differences in capacities for identifying and describing emotions, and preferences for focusing on the physical environment. These results support the notion that individuals with self-reported beliefs in the unreliable detection of interoceptive sensations may rely on external environmental inputs to understand sensation causes in affective contexts (Pollatos & Herbert, 2018a). Moreover, they also support that heightened attention to bodily sensations may reinforce hypervigilance and somatisation, thus bolstering maladaptive interpretation of bodily sensations and chronic physiological dysregulation (Panayiotou et al., 2018). Conversely, adaptive interoceptive attention and interpretational mechanisms arguably reflect beliefs in sensations as valuable sources of information (Mehling et al., 2009), which together, may promote better representation, categorisation, and incorporation of sensations into ongoing emotional experiences (MacCormack et al., 2024). Whilst these findings are invaluable, evidence synthesising how multiple interoceptive self-report scales differentially contribute to alexithymia is currently limited.

2.4. Mind-Body Dualism: Beliefs and Implications

Dualistic and mind-body connection beliefs have yet to thoroughly be considered in interoceptive and emotional research. Certainly, negative emotionality and affect can play a dominant role in behavioural homeostatic regulation, reorienting motivation to address self-perceived bodily states (Craig, 2003a), whereas positive bodily feelings and beliefs have received less attention. Positive aspects of behavioural homeostatic regulation may include orienting attention to bodily sensations so as to regulate distress and actively attending to bodily sensations for insight (Köteles, 2021). However, these arguably represent tangential notions in the context of explicit mind-body beliefs, and potentially reflect attitudinal aspects and behavioural outcomes of such beliefs.

Explicit mind-body beliefs may significantly impact various aspects of experience, including health and wellbeing. Many endorse the belief that mental and physical wellbeing are contingent upon one another and have integrated this into their conception of the mind-body connection (Burgmer & Forstmann, 2018). For such individuals, the body must be taken care of in order to feel mentally well. Conversely, others reject this value, believing that mental wellbeing does not require nor is contingent on physical wellbeing. Rejection of this value typifies dualistic beliefs—wherein the mind and body are perceived as distinct, separate entities.

There is evidence to suggest that adults are intuitively mind-body dualists (Demertzi et al., 2009; Forstmann & Burgmer, 2015), whereby holding such views may lead individuals to perceive of their body as a 'shell' and to consequently neglect it (Forstmann et al., 2012). Research into dualistic beliefs indicates that endorsement of such views is associated with a decreased propensity towards health-promoting behaviours (Burgmer & Forstmann, 2018; Forstmann et al., 2012). These studies have shown an association between strong adherence to dualistic beliefs and a lower manifestation of health-promoting behaviours, particularly amongst individuals recruited from environments characterised by unhealthy practices. Furthermore, the adoption of dualistic perspectives appears to obscure the recognition of the significant role played by physical states in shaping mental wellbeing. Conversely, individuals endorsing an integrated view of the mind-body connection demonstrate a heightened propensity to acknowledge the impact of bodily states on psychological health. Moreover, a belief in the influence of bodily conditions on mental wellbeing positively correlates with the prioritisation of health-centric values. Collectively, such findings suggest that mind-body beliefs serve as a potential determinant of health-promoting values and behaviours (Burgmer & Fors, 2018; Forstmann & Burgmer, 2017; Forstmann et al., 2012).

Mind-body dualism permeates various healthcare practices, particularly within the framework of the biomedical model (Engel, 1992). This model primarily focuses on biological factors in understanding and treating diseases (Rocca & Anjum, 2020), emphasising the role of biological mechanisms in the development and progression of illnesses that can be cured (Lebowitz & Appelbaum, 2019; Wade & Halligan, 2017). As a consequence, the psychological and social aspects of health and illness are neglected (Engel, 1992). This reductionist approach, rooted in Cartesian dualism, can influence clinicians' treatment decisions, leading to a heightened focus on physical symptoms while overlooking psychological and social factors (Lebowitz & Appelbaum, 2019). In psychiatry, the biomedical model has led to the predominance of biological explanations and pharmacological treatments for mental disorders, emphasising brain abnormalities and genetic factors (Cohen, 1993). This approach often neglects the subjective, lived experiences of individuals, including how emotional experiences, bodily perceptions, and the salience of stimuli shape their interactions with the world (Kyzar & Denfield, 2023). As a result of this reductionism, the role of psychology has been inhibited in health research and clinical practice (Johnson, 2013). This emphasis on biology has arguably fomented the stigmatisation of mental illness amongst the public (Walker & Read, 2002), patients (Sercu & Bracke, 2017), and treating professionals (Forstmann & Burgmer, 2017).

As an example, the biomedical approach is particularly problematic for functional and medically unexplained presentations (Van den Bergh et al., 2017). Although exclusion of possible organic causes is important, exploring psychological and social factors as contributing to symptomatology is crucial. Medical investigations in the pursuit of identifying an organic cause for symptomatology may propagate atypical illness beliefs amongst patients, establishing unrealistic expectations for the person experiencing the symptoms. Embracing the mind-body connection in healthcare and research would serve to enhance holism in treatments and improve patient outcomes (Jenkinson et al., 2024).

Mind-body beliefs play a vital role in shaping how individuals conceptualise of their health and wellbeing and act to promote this. Although these have been deeply ingrained in various cultural, philosophical, and clinical contexts, research underscores the interconnectedness of the mind and body, suggesting a need to shift toward more embodied understandings of human experience and behaviour. It has previously been hypothesised that persons considering their mind to be independent of their body assume that physiological states do not impact regulation capacities as strongly as those who feel and endorse a strong connection between their mind and body (Forstmann & Burgmer, 2017). Moreover, that mind-body dualists may disregard their own bodily states when assessing how they feel. Accordingly, beliefs in mind–body dualism may alter fundamental psychological processes, such as emotional and self-regulation, and negatively affect the degree to which individuals are sensitive to aversive or pleasant bodily states. In line with this evidence, mind-body beliefs are proposed to form a psychological constituent of the mind-body connection, reflecting the degree to which individuals endorse their interconnectedness and integration and inform their perspectives on physical and mental wellbeing.

2.5. Proposed Psychological Constituents of the Mind-Body Connection

At this juncture, a review of the literature indicates that there are three salient psychological constituents underpinning the mind-body connection, which together represent and influence the links between thoughts, feelings, behaviours, and physical and mental health. These include: (1) subjective aspects of interoception, including self-reported beliefs regarding detection, attention, discrimination, and localisation; (2) the identification of feelings, description of feelings, and internally-oriented focus—reflecting the inverse qualities of alexithymia, as comprising DIF, DDF, and EOT facets, respectively; and (3) explicit mind-body integration beliefs. Interoception and emotion are processes which exemplify the mind-body connection, each carrying immense implications for physical and psychological health (Farb et al., 2015). Moreover, explicit mind-body integration beliefs are shown to predict health-related behaviours (Burgmer & Forstmann, 2018; Forstmann &

Burgmer, 2017; Forstmann et al., 2012). The overall evidence base indicates that each of these factors influence health and wellbeing perspectives and the initiation of various behaviours—whether to address physiological integrity and holistic wellbeing, or to complement and realise goals and needs. It is these factors that underscore their saliency for the mind-body connection construct. Within this framework, a healthy mind-body connection may constitute strong beliefs in capacities for and habitual tendencies to process interoceptive stimuli, adequate identification and description of such stimuli in emotional terms, an internally oriented focus, endorsement of belief in the mind-body connection, and positive values regarding wellbeing.

2.6. Psychological Measurement of the Mind-Body Connection

Self-report scales are an advantageous assessment method in psychological measurement, as they provide rich information from respondents and are immensely practical. Prima facie, interoceptive self-report scales may represent ideal tools to measure the mind-body connection. This is because they are proposed to generally assess: (i) self-reported dispositional tendency of attention toward bodily signals relevant to homeostatic needs (e.g., thirst, hunger, fatigue), and to some degree, emotional arousal; and (ii) self-perceptions of accuracy in the discrimination and interpretation of such signals (Trevisan et al., 2021). Questionnaires are suggested to offer greater insights into clinical status than behavioural or brain-based measurements (Suksasilp & Garfinkel, 2022). As such, an interoceptive self-report that could be classified as an effective measure of the mind-body connection would ideally incorporate emotion and beliefs regarding mind-body integration. To determine whether any self-report could be considered as holistically measuring these proposed psychological mind-body connection constituents, a review of existing questionnaires was undertaken.

A multitude of self-report scales putatively assessing interoception exist and are employed in mind-body research and practice, which can be regarded as either legacy measures or interoception scales (Mehling et al., 2018). Legacy measures include the Private scale of the Body Consciousness Scale (PBCS; Miller et al., 1981), Interoceptive Awareness scale of the Eating Disorder Inventory (EDI-IAw; Garner et al., 1983), Body Awareness Questionnaire (BAQ; Shields et al., 1989), and Body Perception Questionnaire (BPQ; Cabrera et al., 2018; Porges, 1993). Measures developed to specifically assess interoception include the Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2018; Mehling et al., 2012), Self-Awareness Questionnaire (SAQ; Longarzo et al., 2015), Interoceptive Confusion Questionnaire (ICQ; Brewer et al., 2016), Interoceptive Sensory Questionnaire (ISQ; Fiene et al., 2018), and Interoceptive Accuracy Scale (IAS; Murphy et al., 2020). Within interoceptive research, these scales are typically subsumed under descriptive umbrella terms such as IS (Desmedt, Heeren, et al., 2022). This section reviews what these scales propose to measure and whether emotion and mind-body integration beliefs are captured.

2.6.1. What do Interoceptive Self-Report Scales Measure?

Subjective interoceptive beliefs and IS, assessed through self-report scales, provide critical insights into how individuals perceive and experience interoceptive sensations. Relative to accuracy and awareness, subjective interoceptive domains are understudied. Promisingly, scrutiny has recently extended to interoceptive self-report scales typically proposed to measure the IS construct (Desmedt, Heeren, et al., 2022; Desmedt et al., 2023; Ferentzi et al., 2021; Todd et al., 2022; Vig et al., 2022). While this is an emerging area, accumulating evidence strongly suggests that these self-reports are tapping into relatively distinct aspects of subjective interoception.

The PBCS is a 5-item subscale that measures awareness of internal sensations, encompassing awareness of interoceptive feedback, dispositional focus on internal bodily sensations, and sensitivity to bodily state changes (Miller et al., 1981). This subscale is frequently employed in interoceptive research (Desmedt, Heeren, et al., 2022). In the original sample, the PBCS was not associated with emotionality, hypochondriasis, or social anxiety. The subscale has been assessed as demonstrating acceptable internal consistency reliability and excellent validity (Mehling et al., 2009). The PBCS is used in various clinical populations, including alcohol use disorder (Jakubczyk et al., 2019) wherein high PBCS scores are associated with more severe sleep problems and symptoms of anxiety due to increased focus on internal bodily sensations. Amongst the suite of existing interoceptive self-report scales, PBCS moderately correlates with the BPQ, MAIA, and BAQ (Desmedt, Heeren, et al., 2022).

The EDI-IAw is a 10-item subscale reflecting a "lack of confidence in recognising and accurately identifying emotions and sensations of hunger or satiety" (Garner et al., 1983, p. 18). The authors characterise this as a deficiency in interoceptive labelling, which reflects understandings of interoception at the time of scale development (Ceunen et al., 2016). This subscale introduced the term 'interoceptive awareness' to the field (Khalsa et al., 2018). Recent studies have classified the EDI-IAw as a measure of self-reported interoceptive accuracy (Robinson et al., 2021; Trevisan et al., 2019), and qualitative review suggests elements of interoceptive (in)accuracy are captured amongst the items (e.g., *'I get confused as to whether or not I am hungry'*), albeit demonstrating overlap with the DIF facet of alexithymia (e.g., '*I have feelings I can't quite identify'*). In developing the TAS, several items were indeed taken from the EDI-IAw to reflect a domain capturing difficulty identifying and distinguishing between feelings and bodily sensations (Taylor et al., 1985), which has been deemphasised, subsequent to scale revisions (Bagby et al., 1994; Fournier et al., 2019).

The BAQ is an 18-item scale that was developed to capture body awareness—defined as self-reported sensitivity and attentiveness to normal and non-emotive body processes (Shields et al., 1989). With respect to factors assessed by the BAQ, these include sensitivity to body cycles and rhythms, ability to detect small changes in normal functioning, and ability to anticipate bodily reactions. The BAQ is noted to demonstrate strong psychometric properties (Mehling et al., 2009). The questionnaire includes items may indicate illness anxiety and somatisation propensities if scored high (Trevisan et al., 2021). The questionnaire positively correlates with the MAIA and PBCS, relative to the BPQ and SAQ, where negative correlations are observed (Desmedt, Heeren, et al., 2022).

Porges (1993) developed the original BPQ to assess the subjective experiences of the function and reactivity of organs and structures that are innervated by ANS. Totalling 122 items, the questionnaire originally assessed body awareness, autonomic nervous system reactivity, stress responses, stress response styles, and health history. Due to its length and lack of evidence for validity and reliability (Mehling et al., 2009), the BPQ underwent revision to consist of *Body Awareness* (BPQ-BA) and *Autonomic Reactivity* (BPQ-R) scales (Cabrera et al., 2018). The revised BPQ-BA consists of 26 items capturing sensitivity for and awareness of internal bodily functions, whereas the BPQ-R contains 20 items assessing autonomic stress response activation, expressed as supra- and subdiaphragmatic symptoms. Both subscales are strongly related to somatosensory amplification and stress reactivity. The BPQ is argued to measure interoceptive attention to symptoms associated with anxiety, wherein high scores are indicative of hypervigilance, propensities for somatisation, and maladaptive attention (Mehling, 2016; Trevisan et al., 2021). The BPQ is a recommended assessment mode for IS (Garfinkel et al., 2015) and self-reported interoceptive attention

(Murphy et al., 2020). In particular, the BPQ-BA is frequently administered in interoceptive research (Desmedt, Heeren, et al., 2022) whereas the BPQ-R is seldom used. BPQ-BA most strongly correlates with the PBCS and SAQ relative to the MAIA and BAQ (Desmedt, Heeren, et al., 2022).

Although most of these questionnaires were not designed to assess interoception in a contemporary context, they have been adopted as measures of IS in the field. Moreover, measures such as the BAQ, BPQ, and PBCS have been characterised as limited to proxy symptoms of anxiety or lacking incorporation of the regulatory component of interoception (Mehling, 2016; Mehling et al., 2018), hence the development of measures designed to encapsulate various aspects of interoception not assessed by legacy scales.

Due to the observed lack of measures capturing various aspects of interoception, Mehling and colleagues (2012) developed the eight-scale MAIA. The scales include: (1) *Noticing*: awareness of uncomfortable, comfortable, and neutral body sensations; (2) *Not-Distracting* (MAIA-ND): tendency not to ignore or distract oneself from sensations of pain or discomfort; (3) N*ot-Worrying* (MAIA-NW): tendency not to worry or experience emotional distress with sensations of pain or discomfort; (4) *Attention Regulation* (MAIA-AR): ability to sustain and control attention to body sensations; (5) *Emotional Awareness* (MAIA-EA): awareness of the connection between body sensations and emotional states; (6) *Self-Regulation* (MAIA-SR): ability to regulate distress by attention to body sensations; (7) *Body Listening* (MAIA-BL): active listening to the body for insight; and (8) *Trusting*: experience of one's body as safe and trustworthy. Due to poor reliability observed for ND and NW scales, additional items were added and validated, thus producing the MAIA, Version 2 (MAIA-2; Mehling et al., 2018). Together, these scales are proposed to facilitate measurement and identification of adaptive and maladaptive attentional styles and regulatory functions underpinning IS compared to existing measures (Mehling, 2016). This is advantageous, as a nuanced, multifaceted understanding of an individual's interoceptive beliefs is gained. However, psychometric properties have been subject to scrutiny (e.g., Desmedt, Heeren, et al., 2022; Ferentzi et al., 2021; Todd et al., 2020; Todd et al., 2022), particularly in terms of inconsistent factor structures across studies. Despite this, positive correlations with the BAQ and IAS have been observed; a negative correlation with the ICQ has been shown, with equivocal evidence for a relationship with the revised BPQ scales (Desmedt, Heeren, et al., 2022; Gaggero et al., 2021).

The SAQ is a 28-item scale, developed to address limitations of existing questionnaires which lacked evaluation of a wide range of bodily sensations (Longarzo et al., 2015). The SAQ is based on the 'How do you feel questionnaire' administered by Grossi et al. (2014) and derives items from other available questionnaires, including the BPQ. The SAQ consists of two factors: Factor 1 relates to visceral sensations (e.g., burning sensation in the stomach), and Factor 2 pertains to somatosensory sensations (e.g., sweaty palms). The SAQ is positively related to alexithymia and hypochondriasis. The measure shows adequate reliability and moderately correlates with BPQ-BA and PBCS, is weakly related to BAQ, and is not significantly related to the MAIA (Desmedt, Heeren, et al., 2022).

The ICQ is a 20-item measure, specifically assessing the perceived ability to detect interoceptive states (Brewer et al., 2016). The questionnaire was developed due to limitations of existing self-reports including the confounding of subjective interoceptive sensitivity perceptions with the extent to which they are experienced (BPQ), and the assessment of multiple aspects with few items that adequately assessed IS (MAIA). The authors conducted an exploratory factor analysis of the Interoceptive Confusion Questionnaire with 653 participants, revealing an unclear two-factor solution and low Cronbach's alpha, despite good test-retest reliability over 12 months. Although they found significant positive correlations between alexithymia and ICQ, they recommended interpreting these findings with caution.

The ISQ s a 20-item self-report questionnaire assessing interoceptive processing challenges and confusion about bodily states unless they are extreme (Fiene et al., 2018). This questionnaire has been validated for use in the ASD population. Significant and large differences have been observed between ASD and typically developed adult samples. The ISQ positively relates to higher neuroticism and alexithymia and is negatively related to agreeableness, conscientiousness, extraversion, and the following MAIA subscales: AR, EA, SR, and BL. The scale has been described as measuring subjective aspects of interoceptive accuracy and neutral or adaptive attention (Trevisan et al., 2021).

The IAS is a 21-item questionnaire that specifically assesses self-reported beliefs in abilities for accurately perceiving interoceptive signals (Murphy et al., 2020). This scale was developed to overcome limitations of the ICQ and includes items relating to sensations that have been described as interoceptive or associated with insula activation. The IAS is designed to be neither adaptive nor maladaptive, but rather to specifically distinguish between the subjective accuracy and attention dimensions of interoception (Murphy et al., 2020; Murphy et al., 2019; Trevisan et al., 2021). Evidence suggests that the scale is internally consistent and temporally reliable. Moderate to high negative correlations have been shown with the ICQ (Gaggero et al., 2021; Murphy et al., 2020), supporting the notion that the IAS and ICQ are measures of self-reported interoceptive accuracy (Murphy et al., 2019). The IAS is further shown to positively relate to the BPQ-BA and MAIA, whereas negative correlations have been found with BPQ-R (Gaggero et al., 2021).

2.6.2. Incorporation of Emotion and Mind-Body Beliefs in Interoceptive Self-Report Scales

As delineated in Section 2.6, I propose that the salient psychological constituents of the mind-body connection include subjective interoception, identification and description of feelings and internal focus, and explicit mind-body connection beliefs. Considering the suite of interoceptive self-report scales, this required further assessment regarding whether the available questionnaires assess these constituents or whether they have limitations that warrant the development of a new self-report. Table 2.2 provides an overview of this.

Table 2.2

Assessment of Interoceptive Self-Report Scales as Measures of the Mind-Body Connection.

Self-Report Scale and Subscales	Number of Items	Scale Description	Sample Item	Mind-Body Connection Constituents: Interoception	Alexithymia and/or Emotion	Mind-Body Beliefs
EDI-IAw	10	The ability to discriminate between sensations and feelings, and between the sensations of hunger and satiety.	*I get confused as to whether or not I am hungry.*	x	x	
BAQ	18	Self-reported attentiveness to normal non-emotive body processes (e.g., ability to detect small changes in normal functioning).	*I am always aware of changes in my energy level when I eat certain foods.*	x		x
BPQ (Revised)	46			x		
BPQ-BA	26	Sensitivity for and awareness of internal bodily functions.	*During most situations, I am aware of muscle tension in my arms and legs.*	x		
BPQ-R	20	Experiences of symptoms in organs innervated by the ANS.	*When I breathe, I feel like I cannot get enough oxygen.*	x		
PBCQ	5	Awareness of internal sensations.	*I know immediately when my mouth or throat gets dry.*	x		
IAS	21	Beliefs regarding the accurate perception of interoceptive sensations.	*I can always accurately perceive when my blood sugar is low.*	x		
ICQ	20	Self-perceived trait interoceptive accuracy	*I cannot tell when my muscles are sore or tight.*	x	x	x
ISQ	20	Confusion about interoceptive bodily states unless these states are extreme	*I tend to rely on visual reminders (e.g. times on the clock) to help me know when to eat and drink.*	x		s
MAIA-2	37					
Noticing	4	Awareness of uncomfortable, comfortable, and neutral body sensations	*I notice where in my body I am comfortable.*	x		
ND	6	Tendency not to ignore or distract oneself from sensations of pain or discomfort	*When I feel unpleasant body sensations, I occupy myself with something else so I don't have to feel them.*	x		
NW	5	Tendency not to worry or experience emotional distress with sensations of pain or discomfort	*When I feel physical pain, I become upset.*	x	x	
AR	7	Ability to sustain and control attention to body sensations	*I can maintain awareness of my inner bodily sensations even when there is a lot going on around me.*	x		
EA	5	Awareness of the connection between body sensations and emotional states	*I notice how my body changes when I am angry.*	x	x	x
SR	4	Ability to regulate distress by attention to body sensations	*I can use my breath to reduce tension.*	x		x
BL	3	Active listening to the body for insight	*I listen for information from my body about my emotional state.*	x	x	x
Trusting	3	Experience of one's body as safe and trustworthy	*I trust my body sensations.*	x		x
SAQ	28	Interoceptive awareness of visceral and somatosensory sensations.	*I feel pain extremely.*	x		

Within this suite of questionnaires, various aspects of subjective interoception were assessed as being measured, including self-reported interoceptive sensing (e.g., detection, discrimination; BAQ, EDI-IAw, IAS, ICQ, ISQ), attention (BPQ-BA, MAIA-AR, MAIA-ND, MAIA-SR), and interpretation (BPQ-R, MAIA-EA, MAIA-NW, SAQ).

In terms of alexithymia and inverse emotional capacities as proposed mind-body constituents, this is disparately captured within the reviewed interoceptive self-report scales. Most scales do not contain items expressly pertaining to emotional processes. However, aspects of DIF are measured in items from the EDI-IAw and ICQ, whereas the inverse—identification of feelings—is considered within several MAIA scales, including NW, EA, and BL. Amongst these scales is a focus on capacities for linking bodily sensations to discrete emotions. This forms an important element of emotional experience within a psychological constructionist context (e.g., Barrett, 2017b; Lindquist, 2013) and the alexithymia construct (Preece et al., 2017; Preece & Gross, 2023). Completely omitted, however, is the complementary DDF component. Considering the ubiquity of questions, such as 'How are you feeling?' in various settings, verbal expression of this association seems equally important for wellbeing, as capability can augment effective engagement with others and ensure individual needs are acknowledged, understood, and met. Regarding EOT and its inverse counterpart 'internally oriented thinking', these were assessed as implicitly captured amongst the self-reports (e.g., MAIA-AR) rather than explicit preferences for focussing on internal experiences being measured.

Regarding mind-body beliefs, these are primarily contained within adaptive interoceptive self-report scales, such as the BAQ and MAIA scales, although ICQ and ISQ items were noted as capturing maladaptive aspects of this. Mind-body connection beliefs amongst this suite are considered to pertain to behavioural homeostatic regulation, promoting motivational reorientation to address self-perceived bodily states, particularly when adaptive.

As evidence indicates that mind-body integration values coincide with heightened propensities for acknowledging the impact of bodily states on psychological health, health-sustaining behaviours, and the prioritisation of health-centric values (Burgmer & Forstmann, 2018; Forstmann et al., 2012), existing interoceptive scales are regarded as tacit measures of this proposed constituent, possibly forming behavioural outcomes of integrated mind-body beliefs.

2.7. Rationale for the Current Thesis

An enduring theoretical tradition supported by extant research strongly indicates that interoception and emotion are inexorably connected, with the evidence base revealing that they should be regarded as functions exemplifying a mind-body connection. Relative to objective measurements, a multitude of interoceptive self-report scales capture appraisals across multiple channels by nature of definition and design, assessing various factors available to conscious access. Interest in the measurement of subjective interoceptive processes is evidently increasing, considering the expansion of self-report scales specifically designed to capture interoception. However, prevalent and more recent interoceptive self-report scales are limited in measurement of emotional processes and traits that theoretically and empirically relate to interoception. Although it is acknowledged that these questionnaires may not have been explicitly designed to include emotional dimensions, this omission complicates the holistic conceptualisation and measurement of these processes within a mind-body framework when employing interoceptive self-reports.

Whilst various aspects of emotion are underpinned by interoceptive functions, alexithymia is a multidimensional transdiagnostic characteristic typifying a mind-body disconnection. The trait is related to dysfunctional physiological and psychological reactivity and regulation (Panayiotou et al., 2018; Panayiotou et al., 2021), and further conceptualised to arise from interoceptive deficits (Brewer et al., 2016; Shah, Hall, et al., 2016). Despite evidence suggesting commonalities and convergence (Fournier et al., 2019; Ventura-Bort et al., 2021), no current existing self-report concurrently and completely measures these constructs. Although aspects of mind-body beliefs are captured, more explicit beliefs regarding their connection are not, nor are values pertaining to physical and mental wellbeing, which may affect health-promoting beliefs and behaviours (Burgmer & Forstmann, 2018; Forstmann et al., 2012). Omission of these salient factors impinges on classifying pre-existing scales as replete questionnaires of the mind-body connection. The current thesis addresses these limitations of pre-existing self-reports through the development, preliminary evaluation and subsequent validation of a self-report questionnaire capturing interoception, alexithymia, and mind-body values and behaviours in two separate samples of typically developed adults.

Despite formative insights into how interoception relates to emotion and wellbeing, it must be acknowledged that interoceptive research is fraught with issues pertaining to conceptualisation and assessment. Recent scrutiny has highlighted the subjective measurement of interoception is especially inconsistent and confusingly subsumed under umbrella terms, such as '*interoceptive sensibility'* (Desmedt et al., 2023; Köteles, 2021; Trevisan et al., 2021). Investigations into the structure of self-reported interoception suggest that this complex facet is comprised of diverse proficiencies and propensities (Desmedt, Heeren, et al., 2022; Ferentzi et al., 2021; Todd et al., 2022; Vig et al., 2022). Despite a convincing body of evidence indicating that self-report scales measure distinct, dissociable aspects of subjective interoception, the field persists with employing imprecise umbrella terms to capture this nuanced, multifaceted construct (Desmedt et al., 2023). This lack of specificity has immense implications for the reliability, validity, and generalisability of clinically meaningful interpretations.

The consequences of such issues are especially evident in previous meta-analytic endeavours concerning the association between self-reported interoception and alexithymia (Trevisan et al., 2019)—factors theoretically implicated in the cultivation of an adaptive—or maladaptive—connection with body and mind. Although results demonstrated significant associations, previous findings are ultimately clouded by the profound lack of convergence between interoceptive domains and employed assessments in research. Clarifying this association is imperative, as these mechanisms explicitly involve brain-body communications and are implicated in the manifestation and maintenance of physical and psychiatric illnesses (Bonaz et al., 2021). Although efforts to elucidate key differences between interoceptive self-report scales have commenced (e.g., Desmedt, Heeren, et al., 2022; Murphy et al., 2020; Trevisan et al., 2021), consideration of these differences in the context of alexithymia at global and facet levels has yet to be thoroughly operationalised. The current thesis addresses these gaps by synthesising the association between specific interoceptive self-report scales and alexithymia at global and facet levels through systematic review and meta-analysis.

Additionally, there is a paucity of research examining mind-body connection constituents and their relationship with emotional reactivity. Where this association has been explored, variables of interest have included aspects of self-reported interoception and aggregated measures of positive and negative affectivity, where statistical analysis has involved employment of correlational and regression-based techniques (e.g., Edwards & Lowe, 2021; Vig et al., 2022) that do not consider heterogeneity within samples. Conversely, only one study has examined the association between interoceptive clusters and emotional reactivity as conceptualised by Davidson (1998), whereby clusters consisted of adaptive aspects of self-reported interoception only (Yun-Hsin et al., 2023). Whilst these methodologies have provided a foundation for understanding how adaptive and maladaptive beliefs regarding subjective interoception influence typical emotional experiences, these studies and clusters have not considered alexithymic traits nor explicit mind-body connection beliefs. In particular, the incorporation of alexithymia is critical given its association with emotional reactivity and emotion regulation (Luminet et al., 2021; Panayiotou et al., 2018; Panayiotou et al., 2021; Preece et al., 2023). The current thesis addresses these gaps in the literature in two ways: first, it identifies distinct self-reported mind-body connection profiles, according to interoception, emotional identification and expression, and body-mind values; and secondly, it explores how emergent mind-body connection profiles are associated with emotional reactivity components and emotion regulation.

This thesis extends on previous research which has provided evidence indicating that subjective IAcc is negatively associated with alexithymia, and that the association between IS and alexithymia is moderated by the employed interoceptive self-report scale (Trevisan et al., 2019). Regarding IAcc, self-reports capturing neutral interoceptive accuracy and inaccuracy were pooled—some which negatively correlate (Murphy et al., 2020)—thereby drawing into question the estimated effect in terms of directionality and strength. Moreover, Trevisan and colleagues (2019) highlighted some adaptive and maladaptive interoceptive attention percepts linked to global alexithymia; however, their analysis was limited to the BPQ and only two of eight MAIA scales which were combined. As the current thesis examined the association between specific interoceptive questionnaires and alexithymia at global and facet levels (DIF, DDF, EOT) through systematic review and meta-analyses, clearer insights pertaining to which elements of self-reported interoception empirically relate to global and facet-level alexithymia are gained, providing an opportunity to make recommendations for the employment of specific questionnaires assessing more precise constructs based upon their differential associations with alexithymia—relationships previously drawn upon to delineate adaptive and maladaptive interoceptive attention styles according to measurement (Trevisan et al., 2021).

This thesis also contributes a promising questionnaire for mind-body researchers and clinicians that may facilitate the delivery of more targeted psychological interventions. The current thesis concerns the development, evaluation, and validation of a new, parsimonious self-report questionnaire assessing the mind-body connection in two separate samples of typically developed adults. Moreover, the thesis is the first to provide classification of different mind-body connection abilities and provides a basis for individualising interventions based on the profile of the presenting patient to promote adaptive emotional reactivity and selection of regulation strategies.

The overarching research questions guiding this thesis were:

1. *What are the salient psychological constituents contributing to the mind-body connection?*
2. *What is the impact of mind-body connection constituents on typical emotional experiences?*

Accordingly, the current thesis aimed to:

1. Elucidate the salient psychological constituents of the mind-body connection.
2. Clarify the association between specific aspects of self-reported interoception and alexithymia.
3. Develop and validate a new self-report questionnaire to measure the hypothesised psychological constituents of the mind-body connection.
4. Examine how mind-body connection constituents influence typical experiences of positive and negative emotions.

This thesis by publication provides specific aims and hypotheses in Paper 1, Paper 2, and Paper 3.

Chapter 3. General Methodology

3.1. Development of the Body-Mind Connection Questionnaire

Drawing upon best practice recommendations for scale development (e.g., Boateng et al., 2018; McCoach et al., 2013; Morgado et al., 2018; Oppenheim, 1992; Worthington & Whittaker, 2006) and previously developed scales measuring multidimensional interoceptive constructs (Mehling et al., 2012), the section provides further information regarding the development and iterative refinement of the Body-Mind Connection Questionnaire (BMCQ). This involved: (i) review of theory, literature and pre-existing scales related to interoception and emotion to identify key domains for mind-body connection measurement; (ii) item generation based on such reviews; (iii) screening for item redundancy relative to existing scales; (iv) determining measure structure, (v) panel and target population review of drafted items; (vi) synthesis and integration of feedback and assembly of measure for field test, and (vii) revision of scale labels following peer review of Study 2.

3.1.1. Domain Identification

The identification of domains is a critical preliminary phase in scale development, as it encourages specification of the boundaries of the domain and facilitates item generation. It is imperative that domains underlying a latent construct are articulated, as this clarifies constructs of relevance to the measure and enables researchers to operationalise and measure them (Boateng et al., 2018; McCoach et al., 2013). Clearly delineated domains establish working knowledge of the constructs being studied, define its scope, and facilitate the generation of items and validation of content. According to McCoach and colleagues (2013), *a priori* domain identification requires a comprehensive literature review, which informs all stages of determining salience in operationalisation. The literature review facilitates specification of the purpose of the domain to be developed. They further stress the confirmation of no pre-existing measures that adequately measure the constructs of interest. Where a measure exists, justification for why the development of a new instrument is appropriate and how it will differ from existing instruments is required. Following this, description of the domain and a preliminary conceptual definition is provided, with any subdomains specified. In line with best practice recommendations, domains were determined and defined prior to the generation of any questionnaire items (Boateng et al., 2018).

3.1.1.1. Interoceptive Identification. This domain entailed the detection of and attendance to internal bodily sensations, the capacity to localise sensations to specific channels, and discriminate between discrete sensations. The domain was conceptualised as foundational component the mind-body connection, as the capacity to discern physiological sensations should form the basis of the concomitant affect which biases regulatory behaviour (Craig, 2003a; Lindquist, 2013). Such domains have been delineated as forming facets of conscious interoceptive awareness (Khalsa et al., 2018).

Four subdomains were distinguished: (i) *detection*—identifying the presence or absence of an interoceptive stimulus; (ii) *attention*—allocation of attention to interoceptive sensations, directed in bottom-up and top-down manners; (iii) *localisation*—identification of interoceptive sensations occurring within specific physiological systems or bodily regions; and (iv) *differentiation*—distinguishing discrete sensations from other sensations, or relative to external contexts.

3.1.1.2. Emotional Awareness. This domain broadly involved the ability to connect and mentally represent the experience of physiological sensations with emotions. The key construct informing development of this domain was alexithymia, which can profoundly impact upon allostasis, interoceptive interpretation, and adaptive processing and regulation of emotions (Panayiotou et al., 2018; Trevisan et al., 2019; Trevisan et al., 2021) and has been conceptualised as a deficit of interoception (Brewer et al., 2016; Murphy et al., 2017). This domain was also identified considering that the homeostatic sensorimotor system underpinning interoception is crucially involved in the generation of feelings and adaptive, emotional behaviour (Craig, 2002; Craig, 2003a; Strigo & Craig, 2016). Although pre-existing interoceptive self-reports capture the ability to identify the connection between sensations and emotional states, capacities for describing this connection are not assessed, nor are explicit preferences for an internal or external focus. Moreover, alexithymia scales previously incorporated a domain capturing difficulty identifying and distinguishing between feelings and bodily sensations (Taylor et al., 1985). However, scale revisions have resulted in this aspect being deemphasised (Bagby et al., 1994; Fournier et al., 2019).

In an attempt to bridge past and contemporary measurement of alexithymia (Bagby et al., 1994; Fournier et al., 2019; Taylor et al., 1985) in a mind-body connection context, three subdomains were distinguished, representing the inverse of DIF, DDF, and EOT facets of alexithymia: (i) *sensation-emotion identification*—identification of the association between sensations and emotions; (ii) *sensation-emotion description*—articulation of the association between sensations and emotions; and (iii) *internally oriented thinking*—preference for focusing on the internal environment, relative to features of the external environment.

3.1.1.3. Beliefs and Behaviours. This domain entailed the perception of bodily sensations deemed relevant for survival, and prioritisation of physical and mental wellbeing, which may promote goal-directed behaviour aimed at restoring or maintaining physiological integrity. Conceptualisation drew on the affective niche concept delineated in the TCE, whereby environmental and psychological factors may promote or disrupt an individual's allostasis (Barrett, 2017b; Gendron & Barrett, 2009; Gendron, Mesquita, et al., 2020). Various existing interoceptive questionnaires capture attitudinal tendencies and regulatory behaviours pertaining to bodily cues (e.g., Mehling et al., 2018; Mehling et al., 2012). However, explicit mind-body integration beliefs (i.e., dualism cf. embodiment) and attitudes pertaining to whether physical and mental wellbeing are important and prioritised are not measured.

Three subdomains were determined: (i) *mind-body integration*—beliefs regarding body-mind integration relative to disconnection from or ambivalence toward valuing the embodied self; (ii) *prioritisation of wellbeing*—values regarding the importance and prioritisation of physical and mental wellbeing; and (iii) *bodily-motivated behaviour*—the enactment of regulatory behaviours aimed at expediting homeostasis based upon interoceptive identification. Collectively, these subdomains were envisioned to capture sensory and psychological components serving as relevant for an individual's wellbeing.

3.1.2. Item Generation

Following the delineation of domains, an item pool can be generated. Hinkin (1995) proposed that inductive and deductive methods facilitate the identification of suitable items. The deductive method is driven by the description of salient domains and the identification of items (Boateng et al., 2018). This is achieved through literature review and assessment of pre-existing scales and indicators of the domain of interest (Hinkin, 1995). To bolster effectiveness of deductive approaches, it is recommended that items are developed through triangulation of existing theory, content analysis of the literature review, and empirical studies examining the construct of interest (Boateng et al., 2018). Conversely, the inductive method involves the generation of items based on responses from individuals, whereby qualitative data are obtained through observation and interview-based methodologies (Boateng et al., 2018; Hinkin, 1995; Morgado et al., 2018). Inductive and deductive methods were employed to develop the mind-body connection questionnaire, as this is considered best practice (Boateng et al., 2018; Morgado et al., 2018). Although the literature review establishes a theoretical framework for understanding the domains, qualitative methods extend on this, transitioning the domains from abstract concepts to operationalisable constructs (Boateng et al., 2018).

It is imperative that the domains are thoroughly conceptualised and defined, as this may contribute to the development of poor items and scales, and contamination, whereby the domain overlaps with existing constructs in the field (Boateng et al., 2018). As such, an iterative approach was employed, which resulted in ongoing revisions to the domains. This was adopted to circumvent these pitfalls in scale development.

With respect to the size of the item pool, it is recommended that the number of items should be twice as long as the desired scale (Boateng et al., 2018; Kline, 2013; Schinka et al., 2013). Moreover, in developing items, the form, wording, and responses that the question seeks to elicit should be thoroughly considered. As such, items should capture the lived experience of the construct by the target population (Schinka et al., 2013).

Existing theories and frameworks informed the development of domains and generation of items, which included the homeostatic emotion hypothesis (Craig, 2003a), TCE (Barrett, 2017b), and expanded framework of interoceptive awareness developed by Khalsa and colleagues (2018). Such theories were considered in light of mind-body literature and empirical studies examining interoception, emotion, and their associations. Whilst such methods provided a solid theoretical basis for item generation, the research team regularly convened to generate items, drawing on their lived and living experience of the constructs.

Employing deductive and inductive approaches resulted in an initial pool of 60 positively and negatively worded items that were generated to capture *interoceptive identification* (17 items), *emotional awareness* (22 items), and *body-mind values* subdomains (21 items). This item pool was named the Body-Mind Connection Questionnaire (BMCQ).

3.1.3. Item Screening and Determination of Measure Structure

Following generation of the full item pool, each were selected for inclusion by the research team following several methods. First, the 60 generated items were screened for redundancy. A total of 38 items were identified as replicating items from or constructs (e.g., detection, localisation) assessed by existing questionnaires (e.g., ISQ, MAIA) and were removed. Appendix A contains details regarding retainment and removal of items. The remaining items were assessed for issues pertaining to grammatical complexity, technical jargon, and double-barrelled or leading questions. Where identified, these were rephrased to reduce any potential cognitive demands on respondents and enhance understanding. The BMCQ was subsequently reduced to 22 items that were generated to reflect Interoceptive Attention, Emotional Competency, and Beliefs and Behaviours subdomains. The Interoceptive Identification scale was renamed at this stage, as removal of items generated for this domain indicated that the construct of interest was Interoceptive Attention. At this stage, the Emotional Awareness domain was also relabelled 'Emotional Competency' to avoid confusion with the MAIA scale, as the BMCQ captures different constructs.

As the BMCQ items assessed beliefs, attitudinal positions, and appraisals of mind-body connection constituents, the scale was presented in a traditional self-report format to enable a sense of familiarity and encourage ease of interpretation amongst respondents. It is recommended that manualised instructions and anchor points are provided for respondents (Morgado et al., 2018). Instructions should be concise and free of confusion to ensure that respondents are free of anxiety. Instructions were developed to accompany the BMCQ which considered conciseness and discouraged anxiety amongst respondents:

> *This questionnaire asks you to indicate how applicable a series of statements regarding your body and mind are to you generally. By that, we mean how they apply to you most of the time. Some of these will be a series of statements related to bodily sensations*

(e.g., hunger, thirst, need for air, etc.) and/or emotions. There are no right or wrong answers.

3.1.4. Expert Panel and Target Population Reviews

Content validity entails the extent to which a scale effectively evaluates the specific areas under consideration (Hinkin, 1995), and requires evidence of content relevance, representativeness, and technical quality (Boateng et al., 2018). Expert panel and target population review phases are critical for scale development, as they facilitate evaluation of content validity, thus enabling the validity, reliability, and relevance of the instrument being created (Boateng et al., 2018). Although evaluation by experts occurs more frequently than target population reviews, the use of at least expert judges is recommended where resources are constrained (Boateng et al., 2018).

The expert panel review phase involves experts in the field relevant to the questionnaire's subject matter evaluating its content, wording, and structure. These experts can include researchers, practitioners, or individuals with specific expertise related to the topic, and should be independent to those who developed the conceptual framework and item pool (Boateng et al., 2018). Judgements can be quantified using formalised scaling and statistical procedures, such as Cohen’s coefficient kappa for determining inter-rater agreement (Cohen, 1960). Conversely, the Delphi method can be employed amongst experts to reach consensus on which questions reflect constructs of interest. It can be understood as a technique “for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem” (Linstone & Turoff, 1975, p. 3). To accomplish structured communication, feedback regarding individual contributions, assessment of the group view, opportunity to revise views, and anonymity for individual contributions is provided (Okoli & Pawlowski, 2004).

The target population review phase is recommended to ascertain whether respondents accurately interpret the items as intended, as they are experts at evaluating face validity (Boateng et al., 2018). Face validity is an aspect of content validity pertaining to the degree to which respondents perceive the items of an assessment instrument as appropriate for the targeted construct and assessment objectives (Haynes et al., 1995). This can be achieved through a pre-testing phase, which is recommended to ensure that items are meaningful to the target population and minimise misunderstanding and measurement error prior to wide-scale administration (Boateng et al., 2018). Pre-testing consists of two stages: (1) examination of which items reflect the domains of interest, and (2) examination of whether items produce valid measurements. Cognitive interviews can assist with determining whether items capture the domains, which involves providing the target population with the drafted items and asking them to articulate the mental processes involved in providing responses (Boateng et al., 2018). This approach aids in determining if the items are eliciting the intended information by ensuring that respondents comprehend the items as intended, and that respondents can answer in ways that authentically reflect their experiences (Beatty & Willis, 2007). Complementing this qualitative approach is item analysis. This has been employed in previous scale development studies to identify whether specific items demonstrate problematic characteristics necessitating possible revision or removal, according to means, standard deviations, and skewness and kurtosis statistics (Mehling et al., 2012).

Although this phase of the research was conducted during COVID-19 restrictions, it was determined that conducting expert panel and target population reviews was an appropriate method for determining whether the BMCQ adequately captured the mind-body connection, operationalised as involving Interoceptive Attention, Emotional Awareness, and Beliefs and Behaviours domains.

3.1.4.1. Panel Review and Scale Revision. The assembled panel of experts consisted of four academic researchers with specialisations in biological and cognitive psychology, and familiarity with interoception. Although various methods for establishing content validity exist, drawing on the Delphi method was deemed appropriate for enabling the iterative revision of the questionnaire. Prior to reviewing the BMCQ, the panel were provided with the conceptual framework. Each panel member independently reviewed the generated items and provided their interpretation of whether items related to the conceptual framework and captured the mind-body connection. Criteria used for retention, modification, and deletion of items included clarity of expression, face validity, and appropriateness for the construct. The panel agreed that the BMCQ captured the described subdomains underlying the mind-body connection and was easy to follow. Where there were differences in opinion, open discussions were held to explain perspectives which facilitated consensus being reached amongst the research team and panel members. Following discussions and suggestions for improving item clarity, several items were refined. Appendix B provides the items prior to and following the expert review. Ultimately, the BMCQ item pool was collectively deemed to be relevant to the hypothesised constructs. This review resulted in a retained 22 item pool to assess Interoceptive Attention, Emotional Competency, and Beliefs and Behaviours.

3.1.4.2. Target Population Review. Due to time constraints and implemented COVID-19 restrictions during this phase, face-to-face interviews were not conducted. The BMCQ was administered online through Qualtrics (www.qualtrics.com) to assess face validity from the perspective of respondents: typically developed adults aged 18 to 50. Target population respondents were encouraged to provide their insights as they completed the questionnaire, inclusive of clarity of items and aspects of experience not considered. Textboxes were provided for participants to record their experiences and observations, but they were not obligated to report this. The link to the study hosted on Qualtrics was circulated through the researcher's social media platforms (e.g., Facebook) and amongst members of the Cognitive Psychological Assessment Research Team at Victoria University. Twenty-five individuals known to the researchers participated in the review.

3.1.5. Synthesis of Feedback and Assembly of Measures for Field Testing

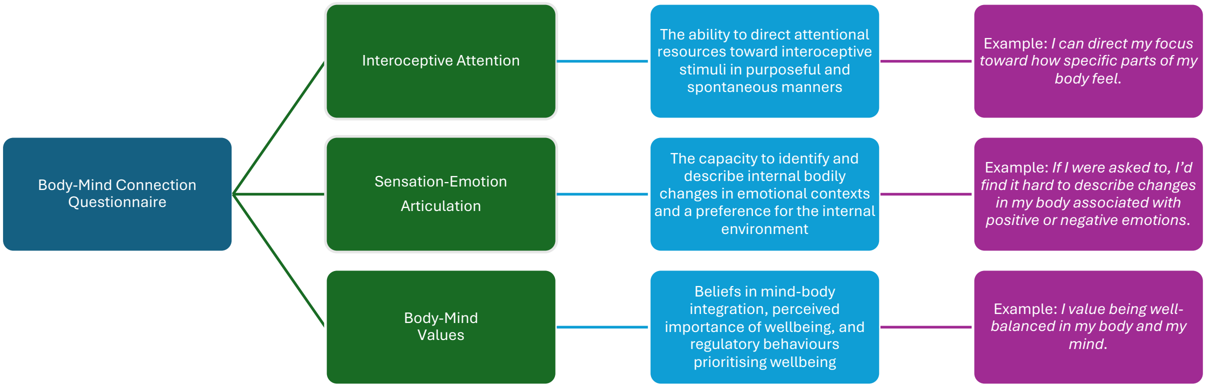
The results of the target population review were subsequently reviewed and synthesised. Few participants provided qualitative feedback on their experience responding to the BMCQ but indicated that the questionnaire was clear and easy to follow. Item analysis indicated that the means for the 22 BMCQ items amongst target respondents ranged from 3.16 to 5.16. Skewness and kurtosis statistics fell within the acceptable range of ±3.29 (Tabachnick & Fidell, 2013), with no individual items indicating non-normality. These values are reported in Appendix C. In summary, the expert panel review and item analysis phases suggested that the 22-item BMCQ could be retained and administered for field testing.

3.1.6. Revision Following Peer Review

Due to the iterative approach, the overarching domains and subdomains captured by the BMCQ were continually updated. Following feedback received from reviewers during peer review for Paper 2 (https://bmcpsychology.biomedcentral.com/articles/10.1186/s40359-023-01302-3/peer-review), Emotional Competency and Beliefs and Behaviours domains were further refined and revised. These were renamed to Sensation-Emotion Articulation and Body-Mind Values, respectively. Figure 3.1 provides a schematic overview of the refined BMCQ domains to measure salient mind-body connection constituents.

Figure 3.1

Finalised Domains for the Body-Mind Connection Questionnaire.



3.2. Participants

Ethical approval for the study was obtained from the Victoria University Human Research Ethics Committee (Application ID: HRE21-001, see Appendix D). The participants included in Studies 2 and 3 were conveniently recruited through the Prolific recruitment service (www.prolific.com). Although various paid recruitment services exist to accommodate for the rise of conducting studies online, the Prolific participant pool has been highlighted as providing high quality submissions (Palan & Schitter, 2018), and company policies ensure that participants are not penalised for withdrawal from a study. This platform and recruitment method was suitable for bolstering generalisability and maintaining ethical integrity. To be included in Studies 2 and 3, participants were required to be:

1. Aged 18-50, to limit the effects of aging on physical health, including beliefs and practices (Deeks et al., 2009).
2. Fluent in the English language.
3. Reside in Australia, Canada, New Zealand, the United Kingdom, or the United States.

4. Free of a current chronic pain condition (e.g., fibromyalgia, severe arthritis), to limit the effects of chronic pain on subjective processing of homeostatic factors (e.g., Staud & Rodriguez, 2006).

Except for a current diagnosis of a chronic pain condition, there were no specific criteria to exclude individuals with a current diagnosis of other health conditions. Participants were requested to disclose whether they were currently diagnosed with a physical and/or psychiatric condition, as literature indicates an association with altered interoceptive and emotional functioning (Bonaz et al., 2021; Critchley & Garfinkel, 2017; Khalsa et al., 2018; Khalsa & Lapidus, 2016).

An *a priori* sample size of 220 participants was determined to be the absolute minimum, as this would provide a ratio of 10:1 respondents per item for the BMCQ administered for field testing (Boateng et al., 2018). However, 417 participants were recruited for preliminary evaluation of the BMCQ in Study 2 and 401 participants were recruited for confirmation of the BMCQ in Study 3. Recruitment of a larger sample was based on scale development and item reduction requiring larger samples for more stable factor solutions (Tabachnick et al., 2013).

Across the two studies, participants were requested to disclose of a current psychiatric diagnosis. In Study 2, this totalled 101 participants, and in Study 3, 92 participants disclosed of this. Upon consideration of the size and diverse conditions represented in this subset of the sample, these participants were removed from certain analyses to ensure that investigation into the factor structure of the BMCQ concerned a relatively heterogenous sample of typically developed adults. Removal was based on consideration that conditions may differentially influence interoceptive and emotional interpretations (Khalsa & Lapidus, 2016; Paulus & Stein, 2010), which could potentially produce different factor structures. Accordingly, Study 2 included only individuals with no self-reported diagnosis (n = 316).

Study 3 excluded this sample subset for the confirmatory investigation of the BMCQ (n = 309) but included a pooled sample (n = 401) when investigation concerned emotional reactivity and regulation.

Table 3.1 displays demographic information describing for Sample 1 and Sample 2 across Paper 2 and Paper 3, respectively. Results of chi-square goodness of fit tests for categorical data and independent samples t-tests analyses for continuous data to establish whether the samples significantly differed are also reported.

Table 3.1

Comparison of Demographic Characteristics of Samples Recruited for Paper 2 and Paper 3 (N=818).

	Sample 1, Paper 2 (n = 417)	Sample 2, Paper 3 (n = 401)		
Characteristic	N (%)	N (%)	Statistic	p
Age	M = 29.95, SD = 8.23	M = 30.62, SD = 7.28	-1.19	.236
18-19	28 (8.9%)	19 (4.8%)	5.20	.158
20-29	119 (37.7%)	179 (44.8%)		
30-39	117 (37.0%)	138 (34.5%)		
40-50	51 (16.1%)	64 (16.0%)		
Gender				
Male	124 (39.2%)	195 (48.6%)	13.19	.004
Female	189 (59.8%)	197 (49.1%)		
Another term (e.g., non-binary)	2 (0.6%)	6 (1.5%)		
Prefer not to answer	1 (0.3%)	3 (0.7%)		
Country of Residence			8.02	.091
Australia	9 (2.8%)	11 (2.9%)		
Canada	26 (8.2%)	6 (1.5%)		
New Zealand	8 (2.5%)	19 (4.7%)		
United Kingdom	225 (71.2%)	286 (71.3%)		
United States	48 (15.2%)	79 (19.7%)		
Level of Education			6.14	.523
Year 10 or lower	6 (1.9%)	4 (1.0%)		
Year 12	121 (38.3%)	152 (37.9%)		
Bachelor’s Degree	111 (35.1%)	140 (34.9%)		
Honours	15 (4.7%)	16 (4%)		
TAFE or vocational training	11 (3.5%)	27 (6.7%)		

Masters	41 (13.0%)	51 (12.7%)		
PhD or Doctorate	6 (1.6%)	5 (1.2%)		
Graduate Certificate	5 (1.6%)	6 (1.5%)		
Body Mass Index (BMI)*	M = 27.50, SD =8.91	M = 27.18, SD = 8.17	0.53	.600
Underweight (<18.5)	15 (3.6%)	10 (2.5%)	1.21	.753
Normal (18.5-24.9)	177 (42.4%)	180 (44.9%)		
Overweight (25-29.9)	99 (23.7%)	94 (23.4%)		
Obese (30+)	103 (24.7%)	99 (24.7%)		
Smoking Status			0.10	.752
Smoker	50 (12.0%)	33 (10.4%)		
Non-Smoker	367 (88.0%)	283 (89.6%)		
Alcohol Consumption			5.60	.231
0-1 times per week	302 (72.4%)	224 (70.9%)		
1-2 times per week	69 (16.5%)	56 (17.7%)		
2-3 times per week	22 (5.3%)	19 (6.0%)		
3-4 times per week	11 (2.6%)	7 (2.2%)		
4 or more times per week	13 (3.1%)	10 (3.2%)		
Sport or Exercise Engagement			.011	.744
Yes	270 (64.7%)	208 (65.8%)		
No	147 (35.3%)	108 (34.2%)		
Yoga Practice			1.69	.194
Yes	72 (17.3%)	52 (16.5%)		
No	345 (82.7%)	264 (83.5%)		
Meditation and Mindfulness Practice			1.25	.263
Yes	113 (27.1%)	75 (23.7%)		
No	304 (72.9%)	241 (76.3%)		
Psychiatric Diagnosis†			0.04	.850
Yes	100 (24.0%)	92 (22.9%)		
No	317 (76.0%)	309 (77.1%)		

*Calculated based on self-reported height and weight (Study 2 n = 394; Study 3 n = 391).

†Self-reported.

As can be seen in Table 3.1, the samples exhibited similarities across most demographic factors except for gender, as Study 2 recruited a higher proportion of persons identifying as female when compared to Study 3.

3.3. Materials

To test for convergent and discriminant validity in Paper 2, a questionnaire battery to accompany the BMCQ was assembled. The battery consisted of published measures related to the mind-body connection construct. Each self-report was selected according to theoretical relatedness to identified domains that informed BMCQ item generation. The battery included the BPQ, BAQ, MAIA-2, Perth Alexithymia Questionnaire (PAQ), and the Highly Sensitive Person Scale (HSPS). In Paper 3, the aims of the research were to validate the BMCQ in a new sample and examine how BMCQ factors representing salient psychological constituents of the mind-body connection influenced typical experiences of positive and negative emotions. Accordingly, the BMCQ and MEQ were employed for this study.

The details regarding the BMCQ and the associated materials, including their validity, reliability, and descriptive statistics, are provided in different chapters for the two samples. The details regarding the BMCQ and the associated questionnaire information, including their validity, reliability, and descriptive statistics, are provided in the papers for two samples. Paper 2 (Chapter 5) provides this information for the BMCQ, and the following questionnaires administered to Sample 1: BAQ, BPQ, MAIA-2, PAQ, and HSPS. Paper 3 (Chapter 6) provides this information for the BMCQ and the MEQ administered to Sample 2.

3.4. Data Management

3.4.1. Data Preparation for Meta-Analysis

Details regarding how the data were prepared for meta-analysis are provided in the meta-analysis pre-registration (https://osf.io/ky3qf) and Paper 1.

3.4.2. Data Screening and Cleaning – Paper 2 and Paper 3

To reliably evaluate data, it is imperative that discrepancies and issues are identified and resolved (Tabachnick & Fidell, 2013). Data cleaning and screening was undertaken prior to conducting any analyses. Firstly, this involved reviewing accuracy of the data files. For this, descriptive statistics were examined to determine whether observed ranges, means, and standard deviations were plausible amongst continuous variables. An issue was identified with the range and scoring anchors for MAIA items when the data were exported into SPSS (1 to 6), which was resolved through recoding of items to reflect specified MAIA scoring (0 to 5). Categorical variables were also screened to ensure that there were no out-of-range numbers indicating data entry errors, of which none were identified. For the self-reported psychiatric diagnosis data, initially, values were recorded as 1 (diagnosis) and 2 (no diagnosis). These values were recoded to 0 to represent no diagnosis and 1 to represent diagnosis, thus ensuring that the variable was dummy coded. As diagnoses were self-reported, further review was conducted to determine whether participants had reported a diagnosis in textboxes but selected 'no'. Where identified, these were resolved by updating the dataset to reflect that a diagnosis was self-reported. In order to determine the prevalence of particular disorders within the samples and whether secondary analyses could be performed according to specific diagnosis, clinical categorisations were manually made according to categories included in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013).

It is also essential to consider and evaluate missing data. Where substantiative, missing data can be deleterious for analyses strengthened by larger sample sizes. Unhandled missing data may eliminate so many responses that an inadequate sample size is subsequently produced (Hair et al., 2010). With respect to how much missing data is tolerable and ignorable, there appears to be no firm guideline. Hair et al. (2010) proposed that missing data under 10% for an individual observation can generally be ignored unless the missing data is deemed to be due to a specific or systematic non-random pattern. Tabachnick and Fidell (2013) advise that the overarching pattern of missingness is more serious than the degree of missingness, which can be classified as either missing completely at random (MCAR), missing at random (or ignorable non-response), or missing not at random. This is quantified through missing value analysis (MVA). Through MVA, the overall degree of randomness is evaluated through Little's MCAR test, which examines the pattern of missing data on all variables and compares it with an expected pattern (Little, 1988), where a non-significant value (i.e., $p > .05$) is desirable and indicates that data are MCAR (Hair et al., 2010).

Regarding the BMCQ, no missing data were identified for Paper 2 nor Paper 3. However, review of descriptive statistics identified that there were missing data for validity measures employed in Study 2 (BAQ, BPQ-BA, MAIA, HSPS, PAQ) and positive and negative emotion outcomes for Study 3 (MEQ – Frequency, Intensity, Persistence, Regulation). For Paper 2, missingness ranged from 0.9 to 2.2% amongst validity measures – most frequently for the BAQ. However, the results of Little's MCAR test suggested that the data were MCAR, χ^2=12.56, p = .765. Missing data were therefore ignored and omitted from Study 2 analyses through pairwise deletion. For Paper 3, missingness ranged from 4.5 to 5.0% for emotion outcomes, with substantial amounts of data missing from individual cases (i.e., ≥ 50.0%). Despite this, Little's MCAR test indicated that these data were MCAR, χ^2=12.22, p = .662. Accordingly, these missing data were deemed ignorable and left untreated.

3.5. Analyses Employed in the Current Thesis

3.5.1. Systematic Review and Meta-Analysis

The review of literature is indispensable, as it provides researchers with a comprehensive understanding of existing knowledge in their field, identifies gaps, trends, and inconsistencies, guides the formulation of research questions and hypotheses, provides a framework for contextualising findings, and informs methodological decision-making (Paré et al., 2015; Thomas et al., 2023). Different methodological approaches exist for formalising literature reviews and quantifying evidence bases, including scoping reviews, systematic reviews, and meta-analyses.

Scoping reviews map the breadth and scope of existing literature on a topic (Arksey & O'Malley, 2005; Tricco et al., 2018). This approach involves a systematic search and synthesis of identified evidence to identify key concepts, theories, sources, and gaps in knowledge (Arksey & O'Malley, 2005; Paré et al., 2015; Tricco et al., 2018). Conversely, systematic reviews focus on addressing specific research questions through a meticulous collation, synthesis and comparison of available evidence (Page et al., 2021). Methodologically rigorous, this involves a systematic search of multiple databases, stringent screening criteria, data extraction, and synthesis of findings (Gurevitch et al., 2018; Snyder, 2019). They can provide summaries of knowledge, facilitate identification of future research priorities, highlight issues requiring rectification in future studies, and contribute to the generation or evaluation of theories regarding causes for phenomena (Page et al., 2021). One approach to synthesising findings is through narrative synthesis, which primarily uses text to summarise and explain the findings (Popay et al., 2006). While not intrinsically contingent upon meta-analysis, systematic reviews may incorporate this technique where studies include sufficient, amenable data (Gurevitch et al., 2018; Page et al., 2021). Meta-analysis, as a quantitative synthesis method, aggregates data from multiple studies to derive overall effect size estimates, employing statistical techniques to assess heterogeneity amongst studies (Gurevitch et al., 2018; Page et al., 2021).

In essence, the methodological approaches of scoping review, systematic review, and meta-analysis distinctively contribute to the synthesis of literature. Although scoping reviews provide a vista of extant research, systematic reviews and meta-analyses provide a focused, quantitative clarification of research questions and outcomes. The selection of a specific methodological approach therefore depends upon research objectives, resources, and the evidence under scrutiny.

The study detailed in Paper 1 commenced in January 2022, initially involving a scoping review of the association between subjective interoception and aspects of emotion (e.g., affect, alexithymia, emotion regulation). The aim was to map how the literature defined and measured these constructs and to identify whether there appeared to be an empirical association. All articles were screened and coded for inclusion with data extracted. Upon interpretation of the association between subjective interoception and 17 emotion constructs, I identified that the evidence base was largely heterogenous in May 2022. A reformulation of the study was required that addressed the aims and intentions of the thesis—to substantiate the inclusion of emotional processing in self-reports grounded in subjectively processed interoceptive sensations.

I subsequently refined the study to focus on the relationship between subjective interoception and alexithymia through systematic review. This decision was informed by two factors: firstly, the extracted data indicated greater homogeneity than other constructs at the interpretation stage of the scoping review; and secondly, due to its inclusion as a key construct informing development of the BMCQ. This necessitated refining the search strategy and eligibility criteria. The protocol for a systematic review of the relationship between interoceptive self-report scales and alexithymia employing narrative synthesis was pre-registered on PROSPERO in July 2023 (identification number: CRD42023437654, accessible online at https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42023437654).

Database searches, formal screening of search results against eligibility criteria, and data extraction were completed for the systematic review. Upon completion of data extraction, I identified that meta-analysis was appropriate, as the data were sufficient and amenable to statistical analysis. The PROSPERO record could not be updated to reflect this change in analytic approach. Accordingly, the meta-analysis protocol was pre-registered in March 2024 (accessible at https://osf.io/3nsyc/).

Acknowledgement and reconsideration of interoceptive self-report scales as representing distinct constructs that contribute to differential relationships with alexithymia could enhance the validity and reliability of clinically meaningful interpretations. Embedding such values in research should facilitate clarification of which interoceptive constructs are measured, thus enabling recommendations for the employment of appropriate, specific interoceptive self-reports in mind-body research and practice. Furthermore, rigorous synthesis of evidence regarding the association between self-reported interoception and alexithymia can bolster arguments for considering interoception in the measurement of alexithymia, and to substantiate their inclusion as salient constituents in the mind-body connection construct. Therefore, Paper 1 conducted a systematic review employing narrative synthesis to establish how self-reported interoception was defined and operationalised in included studies. As an adjunct, meta-analysis was performed to determine whether the association between self-reported interoception and alexithymia differed as a function of the employed interoceptive self-report scale. Considering accumulating evidence indicating that measures of self-reported interoception do not assess the same construct (Desmedt, Heeren, et al., 2022; Todd et al., 2022; Vig et al., 2022), interoceptive self-report scales were disaggregated to provide an overall summary of their effects with alexithymic outcomes.

As previously described, meta-analysis aggregates data from multiple studies to derive overall effect size estimates—essentially, a weighted average of the effect size (Field & Gillett, 2010). In meta-analysis, the estimate can be obtained with either a fixed-effect or random-effects model. The fixed-effect model assumes that the studies included in the meta-analysis are derived from a population whereby the average effect is fixed, as they share a common or true effect size (Borenstein et al., 2009; Field & Gillett, 2010). As such, factors that may influence the effect size are homogenous across studies, and the true effect size is consequently the same (Borenstein et al., 2009). Conversely, the random-effects model assumes that variability in effect sizes among studies may vary between studies study due to heterogeneity, including sample characteristics (Dettori et al., 2022; Field & Gillett, 2010). Accordingly, the true effect amongst the studies is assumed to have been sampled from a distribution of true effect (Borenstein et al., 2009). Each model applies different weights in the calculation of overall estimated effect sizes; these are more balanced under the random-effects model (Borenstein et al., 2009). Fixed-effect models are suitable for inferences extending to studies included in the meta-analysis, whereas random-effect models enable more generalisable inferences beyond the included studies (Field & Gillett, 2010). In accordance with these underlying assumptions, fixed-effects models were selected for Paper 1, due to various sources of heterogeneity noted to contribute to self-reported interoception and alexithymia (e.g., measurements, clinical status, culture; Gaggero et al., 2021; Gaggero et al., 2022; Ma-Kellams, 2014; Ryder et al., 2018; Sekely et al., 2018; Trevisan et al., 2019).

Although various estimation methods exist, the conservative Sidik-Jonkman estimator was employed (Sidik & Jonkman, 2006). This method estimates model error variance and is robust to errors in the estimated marginal variances. Due to the employed disaggregation approach, it was anticipated that meta-analyses would involve a small number of effects. This estimation method is particularly effective for such circumstances (Kontopantelis & Reeves, 2012).

Quantifying heterogeneity is an essential component of meta-analysis. Variation of effect sizes between studies includes both true variance and random error; isolation of true variance involves a comparison of the observed dispersion with the amount expected, should the studies share a common effect size (Borenstein et al., 2009). The excess portion is assumed to reflect real differences amongst studies and is used to create measures of heterogeneity. Several tests can be used to discern whether population effects are fixed or variable, including *Q* and I^2 statistics (Borenstein et al., 2009; Field & Gillett, 2010). A *Q* statistic assesses whether dispersion is greater across or within studies and is calculated by summing the weighted squared differences between the effect sizes of each study and the fixed-effect estimate, where p <.05 suggests that studies do not share a common effect size. I^2 indicates the percentage of variation in effect sizes across studies attributable to heterogeneity rather than chance, where values of 25%, 50% and 75% can be considered as representing low, moderate, and high heterogeneity, respectively. Where significant, high heterogeneity is observed, potential sources are often probed through subgroup analysis or meta-regression (Borenstein et al., 2009). Subgroup analyses were performed according to measure, clinical status, and geographical region of samples when this was identified and amenable.

Meta-analysis should also consider publication bias, whereby significant findings are more likely to be published than non-significant findings, thus potentially skewing the estimated effect (Borenstein et al., 2009; Field & Gillett, 2010). Methods have been developed for assessing publication bias, including funnel plot inspection and Egger's test (Borenstein et al., 2009; Egger et al., 1997; Field & Gillett, 2010; Lin & Chu, 2018). However, they do not offer methods for correcting bias (Field & Gillett, 2010). The trim-and-fill procedure tests for publication bias, further adjusting the estimated effect size (Duval & Tweedie, 2000). All three metrics were considered in Study 1 of this thesis. Egger's test and trim-and-fill were interpreted in analyses where $k \geq 10$, as this provides sufficient power to distinguish real publication bias from chance (Higgins & Green, 2008).

3.5.2. Exploratory Factor Analysis (EFA)

It was statistically appropriate to adopt an exploratory approach in scale development, where EFA was employed (Worthington & Whittaker, 2006). This statistic is utilised to discern the underlying structure or patterns within a set of variables. It aids in comprehending relationships among many variables and helps to identify the underlying constructs, or factors, that explain these relationships. (Kline, 2016; Tabachnick & Fidell, 2013). EFA is therefore beneficial in the initial stages of scale development, uncovering the underlying factor structure of an item pool without imposing a preconceived model, thus facilitating identification of factors best representing represent the data structure and ensuring that items group meaningfully together.

In EFA, aspects facilitating this identification include extraction and rotation. Extraction is an initial step in EFA, which facilitates extraction of factors from the correlation matrix. Various methods exist and assist with determining the relationships between observed variables and the latent factors they represent. Selection of an extraction method primarily depends upon whether total or common variance is of interest (Hair et al., 2010). Where total variance is of interest, a principal component analysis (PCA) is most appropriate. This method is especially useful for data reduction and produces components, focusing on the minimum number of components required to account for the maximum proportion of total represented variance (Hair et al., 2010; Tabachnick & Fidell, 2013). Other EFA methods provide factors and focus on shared variance. These methods are appropriate where the objectives are to identify latent constructs within the original variables and eliminate error variance, thus providing a salient solution. One such method is principal axis factoring (PAF), which estimates communalities through elimination of unique and error variance from variables submitted to EFA (Hair et al., 2010; Tabachnick & Fidell, 2013).

Regarding rotation, this process makes the factor solution more easily interpretable without altering the underlying mathematical properties (Tabachnick & Fidell, 2013). Orthogonal and oblique rotations are the two general classes that exist. Each function differently and carry differing assumptions. Orthogonal rotation assumes that the factors are independent and uncorrelated, whereas oblique rotation is best employed where it is assumed that the factors are correlated (Costello & Osborne, 2005; Hair et al., 2010; Tabachnick & Fidell, 2013). In the context of psychological phenomena, there is typically a strong likelihood that factors are correlated. As such, employment of oblique rotation techniques, including Direct Oblimin. and Promax, are suggested.

Researchers employing EFA are confronted by competing paradigms pertaining to the application of specific extraction and rotation techniques. Consequently, multiple guidelines and recommendations for conducting EFA exist (Costello & Osborne, 2005; Hair et al., 2010; Tabachnick & Fidell, 2013). Tabachnick and Fidell (2013) encourage the employment PCA to reduce data, assist with identification of redundant variables, and indicate the number of factors that the final analysis will likely yield. Then, to conduct EFA to identify a parsimonious factor solution. Paper 2 followed this suggested methodology to determine the underlying factors as contributing to the mind-body connection construct. Moreover, oblique rotation (direct oblimin.) was deemed suitable, as it was acknowledged that items and factors were likely to co-vary. Further information regarding factor identification methods is provided in Paper 2.

3.5.3. Correlational Analyses

Psychological measurement hinges upon the validity of assessment tools, which necessitates scrutiny of their construct validity. Of utmost importance is determining whether there is evidence for convergent and discriminant validity. Convergent validity underscores the coherence between measures ostensibly assessing related constructs, while discriminant validity indicates the distinctiveness of the construct under scrutiny from unrelated ones (Campbell & Fiske, 1959). For this undertaking, correlations serve as an appropriate statistic, providing empirical evidence regarding relationships between measures, thereby elucidating their construct validity. Correlations were therefore suitable for a preliminary evaluation of psychometric properties of the BMCQ provided in Paper 2. They were also conducted to determine relationships between BMCQ subscales and emotion outcomes in Paper 3, which was important for establishing whether there were relationships between the study measures, and further in assessing multicollinearity amongst dependent variables in multivariate analyses (Tabachnick & Fidell, 2013).

3.5.4. Confirmatory Factor Analysis (CFA)

In the context of scale development, CFA is an additional method of psychometric assessment (Boateng et al., 2018). CFA facilitates the systematic comparison of a hypothesised factor structure based on systematic fit assessment procedures, estimating the association between latent constructs that have been corrected for measurement error. This specialised form of structural equation modelling thus enables confirmation of questionnaire factor structures identified through EFA. Accordingly, CFA was utilised in Paper 3 to validate the factor structure of the BMCQ, identified in Paper 2. Information regarding systematic fit procedures is detailed in Paper 3.

3.5.5. Latent Profile Analysis (LPA)

Person-centred approaches embrace heterogeneity within samples. Indeed, identification of subgroups of individuals sharing similar attributes and characteristics within larger samples is a common cross-disciplinary method. Several methods for determination of subgroups exist, including clustering and latent profiling methods. Cluster analysis is a traditional statistical method, enabling identification of meaningful subgroups of individuals (Hair et al., 2010). Whilst this method can provide indications regarding the existence of distinct clusters and membership, several caveats arise in determining certainty of cluster numbers and in membership. LPA is a latent model-based method, regarding profile membership as an unobserved categorical variable, wherein membership indicates which profile an individual belongs to with a degree of certainty (Bauer, 2022; Spurk et al., 2020). Compared to traditional clustering methods, LPA is advantageous in several ways. Firstly, individuals are classified, based upon membership probabilities estimated directly from the model, variables can be continuous or categorical, and demographic factors can be incorporated into profiles (Spurk et al., 2020). LPA is an appropriate technique when there is a theoretical basis to believe that a latent construct is categorical (Bauer, 2022). Considering the impact of the mind-body connection in health and wellbeing, it was tenable that categorical differences in mind-body connections exist within the population. Accordingly, LPA was employed in Study 3, concerned with evaluating how many different response patterns would emerge in a typically developed adult sample, and examining how these profiles influence emotional reactivity and ease of regulation—indicators of emotional functioning. Information regarding systematic fit criteria and determination for LPA is provided in Paper 3.

3.5.6. Analysis of Variance (ANOVA)

ANOVA is a commonly employed statistic, enabling examination of whether mean differences between groups on a single dependent variable (DV) are likely to have occurred by chance (Field, 2018). This technique was accordingly appropriate for determining how mind-body connection constituents were responded to across the distinct profiles identified through LPA in Paper 3. Further, in evaluating significant differences amongst profiles on individual aspects of emotional reactivity.

3.5.7. Analysis of Covariance (ANCOVA)

ANCOVA is an extension of ANOVA, in that main effects and interactions of independent variables (IVs) are assessed after DVs are adjusted for differences associated with covariates—variables that are correlated with the DV (Field, 2018; Tabachnick & Fidell, 2013). Accordingly, ANCOVA determines whether mean differences amongst groups on the adjusted DV are likely to have occurred by chance. The LPA conducted in Study 3 involved a pooled clinical and non-clinical sample. It was therefore essential to control for reported psychological disorders, so as to isolate the effect of mind-body connection profiles on the regulation of positive and negative emotions. ANCOVA was an appropriate statistic for evaluating whether mean differences between mind-body connection profiles on emotion regulation outcomes were due to chance, following adjustment for self-reported psychological disorder.

3.5.8. Multivariate Analysis of Covariance (MANCOVA)

MANCOVA is the multivariate extension of ANCOVA, wherein there are multiple DVs of interest (Tabachnick & Fidell, 2013). In this statistic, a new DV maximising group differences is created from the combination of DVs. Specifically, MANCOVA enables determination regarding whether there are significant differences between groups after adjusting the new DV for differences in covariates. In Paper 3, key outcomes of interest included emotional reactivity, a latent factor comprised of frequency, intensity, and persistence facets. As such, conceptualising these separate outcomes as comprising reactivity for positive and negative emotions, respectively, complemented the requirements and aims of MANCOVA. As with the use of ANCOVA, determining the impact of different mind-body connection profiles on emotional reactivity, following adjustment for self-reported disorder, was paramount. Thus, MANCOVA was deemed an appropriate statistic, complementing the aims addressed by Study 3.

3.6. Assessment of Statistical Assumptions

Statistical assumptions constitute foundational prerequisites for the application of inferential statistical techniques (Hair et al., 2010). These assumptions encompass a spectrum of criteria, including normality, homoscedasticity, independence, and linearity, among others. Adherence to these assumptions is imperative for ensuring the accuracy and generalisability of statistical analyses. This section provides a summary of the statistical assumptions assessed for each of the performed analyses in this thesis.

Table 3.2 reports an overviewed assessment of statistical assumptions for the EFA (Tabachnick & Fidell, 2013), also provided in Paper 2. As can be seen in Table 3.2, the assumptions underlying EFA were primarily met, except for absence of multivariate outliers. Details regarding management are provided in Paper 2. (Tabachnick & Fidell, 2013)

Table 3.2

Assessment of Statistical Assumptions for EFA in Paper 2.

Assumption	Test of Assumption	Result	Interpretation
Sample size	Ratio of variables to sample	Following removal of outliers, 14 respondents per item.	Sample size adequate for EFA.
Normality	Skewness and Kurtosis	For skewness, individual variables ranged from -0.97 to -0.01. For kurtosis, individual variables ranged from -1.33 to 1.21.	Skewness and kurtosis statistics within acceptable range for all variables. Normality assumed.
Linearity	Scatterplot inspection	Linear relationships between BMCQ items observed.	Linearity observed between items. Linearity assumed.
Absence of univariate outliers	Histogram inspection	No major outliers identified.	Absence of univariate outliers assumed.
Absence of multivariate outliers	Mahalanobis' distance	12 datapoints > 48.27 (p <.001)	Presence of multivariate outliers. Removed from analysis; absence subsequently assumed.
Multicollinearity	Squared multiple correlations	All <1.0: range of 0.13 to 0.64.	Satisfactory, indicating absence of multicollinearity.
Factorability	Anti-image correlation matrix	Diagonal values >0.50	Satisfactory, indicating factorability.
	KMO	0.85	> 0.60, indicating factorability.
	Bartlett's test of sphericity	$\chi^2(231) = 2430.63$, p <.001	<.05, indicating factorability.
	Correlation matrix	Intercorrelations ≥ 0.32 between 18 of 22 items.	Satisfactory, indicating factorability.
	Communalities	≥ 0.32 following PCA.	Satisfactory, indicating factorability.

Note. KMO: Kaiser-Meyer-Olin measure of sampling adequacy.

Table 3.3 reports a summarised assessment of statistical assumptions for the CFA (Tabachnick & Fidell, 2013), also provided in Paper 3. As can be seen in Table 3.3, the assumptions of CFA were mostly met, except for absence of multivariate outliers. Details regarding how these were managed are provided in Paper 3.

Table 3.3

Assessment of Statistical Assumptions for CFA in Paper 3.

Assumption	Test of Assumption	Result	Interpretation
Sample size	Ratio of variables to sample	Following removal of outliers, 23 participants per item.	Sample size adequate for CFA.
Missing data	Little's MCAR test	No missing data amongst sample.	No missing data.
Normality	Skewness and kurtosis	For skewness, individual variables ranged from -0.97 to -0.01. For kurtosis, individual variables ranged from -1.33 to -0.14.	Skewness and kurtosis statistics within acceptable range for all variables. Normality assumed.
Linearity	Inspection of scatterplots.	Linearity observed.	Satisfactory, indicating linearity.
Absence of outliers	Mahalanobis' distance	10 datapoints >34.53 (p <.001)	Presence of multivariate outliers. Removed from analysis; absence subsequently assumed.
Multicollinearity	VIF	> 10	Satisfactory, indicating absence of multicollinearity.
	Correlations between predictor variables	Intercorrelations < 0.80	Satisfactory, indicating absence of multicollinearity.

Note. MCAR: Missing completely at random; VIF: Variance inflation factor.

Table 3.4 presents the assessment of statistical assumptions for ANOVAs where mind-body connection profiles served as the IV and BMCQ subscales as the DVs (Field, 2018; Tabachnick & Fidell, 2013). As shown in Table 3.4, normality and homogeneity of variance for these analyses were assumed. Following LPA, large discrepancies in profile classifications were noted. As major discrepancies can contribute to unequal group variances and group sizes, Welch’s ANOVAs were conducted, which is robust to these factors (Field, 2018). Games-Howell post-hoc tests were subsequently interpreted to identify significant differences between each profile, enabling determination of key characteristics within them.

Table 3.4

Assessment of Statistical Assumptions for ANOVA in Paper 3.

Assumption	Test of Assumption	Result	Interpretation
Normality	Skewness	BMV = -0.61 SEA = -0.08 IAtt = -0.98	Skewness and kurtosis statistics within acceptable range for all variables. Normality assumed.
	Kurtosis	BMV = 0.24 SEA = -0.33 IAtt = 1.81	
Homogeneity of variance	Levene's test	BMV p = .151 SEA p = .010 IAtt p = .291	p >.05 for BMV and IAtt. Homogeneity of variance assumed

Note. BMV: Body-Mind Values, SEA: Sensation-Emotion Articulation, IAtt: Interoceptive Attention.

Table 3.5 provides an assessment of assumptions for ANCOVA (Field, 2018; Powers & Xie, 2008; Tabachnick & Fidell, 2013), where the DVs were regulation of positive and negative emotions.

Table 3.5

Assessment of Statistical Assumptions for ANCOVA in Paper 3.

Assumption	Test of Assumption	Result	Interpretation
Normality	Skewness	P-Reg = 0.43 N-Reg = -0.27	Skewness and kurtosis statistics within acceptable range for all variables. Normality assumed.
	Kurtosis	P-Reg = 0.10 N-Reg = -0.08	
Absence of outliers	Histogram inspection	Visual inspection indicated no major outliers.	Satisfactory, indicating absence of outliers.
Homogeneity of variance	Levene's test	P-Reg p = .486 N-Reg = .504	p >.05. Homogeneity of variance assumed.
Normality of residuals	Histogram inspection	Visual inspection indicated no major outliers.	Satisfactory, indicating normality of residuals.
	Normal Q-Q plot inspection	Visual inspection of residuals showed that the residuals closely followed the reference line	Satisfactory, indicating normality of residuals.

Homogeneity of regression slopes	Interaction term	*p*s <.05	*p* <.05, indicating that disorder varies across profiles. Assumption violated.

Note. P-Reg: Regulation of positive emotions, N-Reg: Regulation of negative emotions.

As Table 4.4 indicates, assumptions underlying ANCOVA were assessed as mostly met. However, interaction terms were significant, indicating that homogeneity of regression slopes could not be assumed. Given this violation, the Johnson-Neyman procedure was considered, as it is recommended when such violations occur (D'Alonzo, 2004). The Johnson-Neyman procedure is particularly appropriate when all other ANCOVA assumptions have been met. Specifically, the procedure is used to identify the point(s) along a continuous moderator where the relationship between the IV and the outcome variable (regulation of positive and negative emotions) transition(s) between being statistically significant to nonsignificant, and vice versa. The Johnson-Neyman procedure can be implemented when the IV is either dichotomous or continuous (Montoya, 2016). As the IV in these ANCOVAs was multi-categorical, involving distinct mind-body connection profiles, alternative methodology was required. The Omnibus Groups Regions of Significance (OGRS) is a tool developed by Montoya (2016) that facilitates this analysis. OGRS probes interactions between a multi-categorical IV and a dichotomous or continuous moderator. It implements the Johnson-Neyman procedure to identify when the association between multi-categorical IVs and outcome variables transition from significant to non-significant at varying levels of the moderator. Accordingly, the OGRS tool was deemed appropriate and employed rather than the planned ANCOVAs. Further details regarding how this tool was utilised are provided in Paper 3.

Table 3.6 provides the assessment of assumptions for MANCOVA (Tabachnick & Fidell, 2013), where the DVs were reactivity for positive and negative emotions, consisting of frequency, intensity, and persistence factors. As can be seen in Table 4.5, the assumptions for MANCOVA were satisfied. Due to the unevenness between profiles, Pillai's trace was interpreted for both analyses, as this is robust to such occurrences (Tabachnick & Fidell, 2013).

Table 3.6

Assessment of Statistical Assumptions for MANCOVA in Paper 3.

Assumption	Test of Assumption	Result	Interpretation
Normality	Normal Q-Q plot inspection	Visual inspection of residuals showed that the residuals closely followed the reference lines.	Satisfactory, indicating multivariate normality.
	Skewness and kurtosis	± 3.29 across all reactivity variables.	Skewness and kurtosis statistics within acceptable range for all variables. Univariate normality assumed.
	Box's M test		p >.05, indicating multivariate normality.
Homogeneity of variance-covariance matrices	Box's M test	P-React p = .419 N-React p = .734	p >.05, indicating homogeneity of variance-covariance matrices.
Homogeneity of variance between groups	Levene's test	P-React ps > .05 N-React ps > .05	ps >.05, indicating homogeneity of variance between groups.
Homogeneity of regression slopes	Interaction term	ps > .05	p >.05, indicating homogeneity of regression slopes.
Absence of outliers	Histogram inspection	Visual inspection indicated no major outliers.	Satisfactory, indicating absence of outliers.
Multicollinearity	Correlations between DVs	< 0.90	Satisfactory, indicating absence of multicollinearity.

Note. P-React: Reactivity for positive emotions, N-React: Reactivity for negative emotions.

Chapter 4. A Systematic Review and Meta-Analysis of The Relationship Between Subjective Interoception and Alexithymia: Implications for Construct Definitions and Measurement

Paper 1 presents a systematic review and meta-analysis of the association between self-reported interoception, as assessed by specific questionnaires, and alexithymia at global and facet levels (DIF, DDF, EOT). This study clarifies the association between various facets of subjective interoception and alexithymia and provides recommendations for assessment of specific constructs, according to a maladaptive and adaptive construct validity framework, involving interoceptive sensing, attention, interpretation, and memory propensities. The findings highlight the relevance of interoception to alexithymia, underscoring the need to concurrently assess interoceptive schemas and alexithymia in research and practice. Together, these findings substantiated the inclusion of domains capturing inverse alexithymic traits and adaptive interoceptive attention beliefs in the development of the self-report questionnaire (BMCQ), detailed in Paper 2 (Chapter 5) of this thesis. Online supplemental materials accompanying this paper are provided at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0310411 and Appendix E. The following information accompanying this paper is available at https://osf.io/3nsyc/: pre-registered meta-analysis plan, full results for the primary and secondary meta-analyses on global alexithymia, DIF, DDF, and EOT outcomes, and forest and funnel plots.

Citations as at 25/01/2025 0

PLOS ONE

RESEARCH ARTICLE

A systematic review and meta-analysis of the relationship between subjective interoception and alexithymia: Implications for construct definitions and measurement

Kristen Van Bael*, Jessica Scarfo[☯], Emra Suleyman[☯], Jessica Katherveloo[‡], Natasha Grimble[‡], Michelle Ball[☯]

Institute for Health and Sport, Victoria University, Melbourne, VIC, Australia

☯ These authors contributed equally to this work.
‡ JK and NG also contributed equally to this work.
* kristen.vanbael@vu.edu.au

Check for updates

OPEN ACCESS

Citation: Van Bael K, Scarfo J, Suleyman E, Katherveloo J, Grimble N, Ball M (2024) A systematic review and meta-analysis of the relationship between subjective interoception and alexithymia: Implications for construct definitions and measurement. PLoS ONE 19(11): e0310411. https://doi.org/10.1371/journal.pone.0310411

Editor: Carlos Miguel Martins Campos, School of Health, Polytechnic University of Porto (ESS-P. Porto), PORTUGAL

Received: May 4, 2024

Accepted: August 30, 2024

Published: November 7, 2024

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: https://doi.org/10.1371/journal.pone.0310411

Data Availability Statement: We confirm that the submission contains all raw data required to

Abstract

Although research indicates that self-reported interoception is associated with deficits in identifying and describing emotional experience, and externally oriented thinking styles (alexithymia), this relationship appears moderated by how interoception is measured. A systematic review and meta-analyses examined the association between self-reported interoception and alexithymia, investigating how different interoceptive questionnaires relate to alexithymia at global and facet levels. PsychINFO, PubMed, Scopus, and Web of Science databases were searched with predefined terms related to self-reported interoception and alexithymia. Three reviewers independently assessed articles, extracted data, and undertook risk of bias assessment. Thirty-two cross-sectional studies published between 1996 and 2023 were included. Random-effects meta-analyses and narrative synthesis indicated that global alexithymia was positively associated with measures of interoceptive confusion, autonomic nervous system reactivity, and heightened interoceptive attention, and inversely associated with interoceptive accuracy and adaptive interoception, indexed by composite Multidimensional Assessment of Interoceptive Awareness scores, but particularly interoceptive trusting, self-regulation, and attention regulation. These patterns were observed for alexithymic facets and stronger in magnitude for difficulty identifying feelings and difficulty describing feelings, relative to externally oriented thinking. Overall, results suggested that the association between self-reported interoception and alexithymia differs as a function of the interoceptive self-report. The review highlighted issues with construct definition and operationalisation and determined that existing interoceptive self-reports broadly capture maladaptive and adaptive sensing, attention, interpretation, and memory. The findings underscore the importance of specifying interoceptive constructs and using appropriate assessments to improve convergence between constructs and measurements, further suggesting potential clinical utility in using existing self-reports to measure interoception and alexithymia, facilitating interventions targeting mind-body connections.

replicate the results of the meta-analyses and systematic review. They are available in Files S4 and S7 to S9 of the Supporting Material submitted with the revised manuscript. The data are freely accessible, as all extracted data for the study are provided in published studies and/or pre-print articles.

Funding: The author(s) received no specific funding for this work.

Competing interests: The authors declare that no competing interests exist.

Introduction

Alexithymia represents a multifaceted trait typified by diminished capacities for identifying and describing emotions, which may be accompanied by tendencies for focusing on features of the external environment [1–3]. Such deficits are associated with various maladaptive processes and outcomes, including somatisation [4], emotion regulation strategies characterised by avoidance and withdrawal [5], inefficient coping [6], and heightened physiological and psychological stress [7]. Whilst traditional views of alexithymia propose the involvement of cognitive and emotional deficits [2], contemporary proposals place deficits in the perception and integration of internal bodily signals—interoception—at its core [8]. Such views postulate that impaired awareness and interpretation of ongoing sensations from within the body may coincide with diminished recognition, articulation, and experience of emotions.

Interoception encompasses unconscious and conscious experiences of internal bodily signals, crucial for maintaining homeostasis and wellbeing [9, 10]. The psychological context in which interoceptive stimuli are processed influences ongoing perceptions and adaptive responsivity [11], wherein efficient physiological regulation necessitates conscious attention and accurate interpretation of the signal [12, 13]. These signals are transmitted from peripheral systems to the insula [10], supporting emotional, mental, and physical wellbeing—core components of the mind-body connection [12, 14]. Adaptive interoceptive processing accordingly entails healthy attention to signals and accurate detection of their meaning in context, which can facilitate behaviours aimed at maintaining physiological integrity, particularly during states of felt perturbation [13, 15, 16]. This is contrasted with maladaptive processing, entailing dysfunctional attention (e.g., hypervigilance, avoidance), and impaired accuracy, which may hinder effective regulation and adaptive decision-making. There is recognition that strongly held interoceptive beliefs can influence clinical symptoms [17]; moreover, that self-reports capturing interoceptive beliefs and interpretations may yield greater insight into clinical status than brain-based or behavioural measures [17, 18]. Indeed, various conditions have increasingly been characterised by atypical interoceptive and emotional processing, including anxiety [19], autism spectrum disorder [12, 20], feeding and eating disorders [21, 22], depression [13, 19], and somatic symptom and related disorders [23, 24]. As such, examining the relationship between subjective interoception, measured by self-report, and alexithymia may facilitate the delivery of targeted interventions and treatments aimed at cultivating adaptive mind-body integration.

Trevisan et al. [25] previously meta-analysed the association between self-reported interoceptive constructs and global alexithymia. Although significant associations were identified, previous findings are ultimately clouded by both a lack of convergence between interoceptive constructs and employed measures in research and the consideration of alexithymia as a global characteristic. Whilst efforts to elucidate key differences between interoceptive self-report scales have commenced [e.g., 12, 26, 27], consideration of these differences in the context of alexithymia at global and facet levels has yet to be operationalised. This study therefore employs a systematic review and meta-analytic approach to examine the association between specific interoceptive self-report scales and alexithymia at global and facet levels.

Interoception is now conceptualised as a multidimensional function. Prior to 2015, various terminologies and measurements for interoceptive processes existed. To encourage consistency in construct definitions and operationalisation of interoceptive abilities, Garfinkel and colleagues [28] proposed a parsimonious three-dimensional model of interoception. 'Interoceptive accuracy' was defined as involving objective accuracy in detecting internal bodily sensations, with performance gauged via behavioural paradigms, such as heartbeat detection or discrimination tasks. By contrast, the purely subjective 'interoceptive sensibility' construct was defined as the "self-perceived dispositional tendency to be internally self-focused and interoceptively cognisant" (p. 67), where self-reports probing perceived aptitude, such as the Body Perception Questionnaire (BPQ) [29], were recommended for assessment. Lastly, 'interoceptive awareness' was defined as metacognitive awareness of accurate detection of internal bodily sensations, where measurement involved the correspondence between objective performance and subjective performance appraisal.

Alternative interoceptive taxonomies have since been proposed, similarly demarcating objective and subjective interoceptive dimensions. With respect to subjective dimensions, various constructs have been suggested, including 'interoceptive sensibility' [9, 28, 30], 'interoceptive self-report scales' [9], 'self-reported interoceptive attention', 'self-reported interoceptive accuracy' [27], and 'self-report of interoception and beliefs' [17]. To date, Garfinkel and colleagues' [28] three-dimensional framework is most frequently cited across the literature [26, 31] despite evidence indicating that this model should be revised [27, 31]. Moreover, although 'interoceptive sensibility' was initially specified to involve self-perceived tendencies for focusing on and detecting bodily sensations, consistency in how the construct is operationalised via self-report is notably lacking in research [26, 32].

Interoceptive self-report scales are proposed to generally assess: i) self-reported dispositional tendency of attention toward bodily signals relevant to homeostatic needs, such as hunger, fatigue, illness, and injury, and to some degree, emotional arousal, and ii) self-perceptions of accuracy in the discrimination and interpretation of such signals [12]. A systematic review identified that frequently administered measures, including the multifactorial BPQ [29, 33], the eight-scale Multidimensional Assessment of Interoceptive Awareness (MAIA) [34, 35], Body Awareness Questionnaire (BAQ) [36], and Self-Awareness Questionnaire (SAQ) [37], tend to be subsumed under the 'interoceptive sensibility' umbrella term in the literature [26]. Recent findings reveal major issues with this approach, as the measures do not converge and assess relatively distinct constructs [26, 32, 38]. Furthermore, evidence indicates that the MAIA measures may be better conceptualised as capturing three interoceptive constructs (adaptive interoception, interoceptive not-distracting, interoceptive not-worrying) rather than eight [26, 32, 38, 39]. Considering these factors, operationalisation appears to be in a state of relative detachment from interoceptive construct definitions [26, 31]. Such discrepancies pose a major challenge to empirical interpretation and complicate future replication attempts.

These issues are exemplified by previous meta-analytic findings reported by Trevisan et al. [25] concerning the association between interoceptive dimensions and global alexithymia. They determined that alexithymia was inversely associated with 'subjective interoceptive accuracy'; however, analysis for this construct consisted of pooled self-reports capturing neutral interoceptive accuracy and inaccuracy—some which negatively correlate [40]. Meta-analysis further demonstrated no overall significant relationship between 'interoceptive sensibility' and alexithymia when interoceptive self-report data were aggregated. Additional analysis, however, indicated that this relationship is significantly moderated by employed measures. Specifically, the BPQ and alexithymia were positively associated, such that heightened awareness of internal bodily sensations related to higher alexithymia. By contrast, averaged Noticing and Emotional Awareness MAIA subscales and alexithymia were negatively associated. In other words, greater awareness of comfortable, uncomfortable, and neutral body sensations (Noticing scale) and the connection between bodily sensations and emotion (Emotional Awareness scale) were related to lower alexithymia [25]. As such, subjective interoception is seemingly related to alexithymia, but the direction and strength of this association depends upon the construct measured by the administered interoceptive self-report measure.

Extending on these findings within the context of differentiated interoceptive styles [11], Trevisan et al. [12] proposed that the MAIA captures healthy, adaptive interoceptive attention styles that facilitate regulatory behaviour, and adequately differentiates between adaptive and maladaptive attention. Conversely, the BPQ was proposed as capturing maladaptive attention, characterised by anxiety-driven hypervigilance toward bodily sensations and somatisation. Furthermore, that the BAQ potentially taps into maladaptive interoceptive attention, given that items assess sensitivity to body cycles and rhythms, detection of subtle deviation in typical functioning, and anticipation of body reactions in addition to self-reported attentiveness to normal non-emotional bodily processes. Relatedly, Murphy et al. [27, 40] have offered specific measures, according to whether subjective accuracy or attention is the interoceptive construct of interest. They recommended employment of the BPQ to measure interoceptive attention beliefs and the Interoceptive Accuracy Scale (IAS) or Interoceptive Confusion Questionnaire (ICQ) to assess interoceptive accuracy beliefs. More recently, Desmedt et al. [31] proposed a hierarchical framework consisting of interoceptive factors, which are comprised of subfactors denoting what aspect is being measured, according to specific interoceptive self-report scales. This includes 'interoceptive sensing' (the sense of internal signals by the nervous system across conscious and nonconscious levels; e.g., IAS), 'interoceptive attention' (any attentional process related to internal signals; e.g., MAIA-Attention Regulation, MAIA-Not-Distracting, Interoceptive Attention Scale), 'interoceptive interpretation' (any interpretation, belief, attitude, and categorisation of internal signals; e.g., MAIA-Emotional Awareness, MAIA-Not-Worrying, MAIA-Trusting, Somatosensory Amplification Questionnaire), and 'interoceptive memory' (any memory process related to internal signals).

Considered together, there are key differences in existing interoceptive self-report measures proposed to capture overarching constructs, including subjective interoceptive accuracy, attention, and interpretation. However, various self-report scales used in interoceptive research have not been thoroughly considered. Determining what these key differences are, based on their relationships with alexithymia and in the context of extant frameworks, may facilitate identification of a construct validity framework and promote employment of measures that capture specific interoceptive constructs, thereby enhancing the validity and reliability of clinically meaningful interpretations.

Interest in subjective interoception is increasing, as evidenced by the development of self-report scales measuring interoceptive perceptions and beliefs, including the ICQ [41], IAS [40], Interoceptive Attention Scale (IATS) [42], Interoceptive Sensory Questionnaire (ISQ) [43], Interoceptive Sensitivity and Attention Questionnaire (ISAQ) [44], and Three-Domain Interoceptive Sensations Questionnaire (THISQ) [45]. Although previous meta-analytic findings provide evidence for some adaptive and maladaptive interoceptive percepts linked to global alexithymia, analysis of interoceptive scale subsets has been limited to the BPQ and two MAIA scales [25]. As such, the relationship between subjective interoception, as measured by various self-report scales, and alexithymic facets beyond global measurement requires further interrogation. Alexithymia involves various constituents that differentially affect treatment outcomes [46]. If particular interoceptive constructs and beliefs—captured via self-report—indeed relate to particular alexithymic facets, then clarifying these relationships may shed light on interoceptive and alexithymic mechanisms that could be targeted in mind-body therapies.

We heed warnings regarding issues with aggregating these data for the purposes of meta-analysis [26, 31]. However, it is of theoretical interest to examine how specific interoceptive self-report measures relate to alexithymia. The aim of this pre-registered systematic review and meta-analysis was to examine the relationship between various interoceptive self-report scales and alexithymia. This was adopted to clarify key differences in interoceptive self-report scales contributing to different relationships with alexithymia [12]. Through this, we anticipated identifying which interoceptive measures could broadly be conceptualised as tapping into 'adaptive' and 'maladaptive' interoceptive self-appraisals, based upon how the scales relate to alexithymia. This could assist with improving construct definitions and operationalisation of self-reported interoception, as meta-analytic approaches should enable the quantification of associated constructs in conjunction with recommendations for suitable measurements. Further, examining an empirical association between subjective interoception and alexithymia may bolster arguments for considering interoception in the measurement of alexithymia, particularly in the context of co-occurring clinical conditions [47]. Accordingly, the following research question was developed:

Does the relationship between subjective interoception and alexithymia differ as a function of different interoceptive self-report scales?

Methods

Design

The systematic literature search was conducted according to the 2020 Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines [48; see S1 File]. The protocol was registered on the PROSPERO database (identification number: CRD42023437654), accessible online at https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42023437654.

Following data extraction for the systematic review, we identified that meta-analysis was more appropriate. As the PROSPERO record could not be updated to reflect this change in analytic approach, the meta-analysis protocol was pre-registered at https://osf.io/3nsyc/.

Search strategies

A search strategy was developed using the following terms: (interoceptive sensibility OR interoceptive self-report OR self-reported interoception OR subjective interoception OR interoceptive evaluation OR interoceptive beliefs OR subjective interoceptive attention OR subjective interoceptive accuracy OR self-reported interoceptive attention OR self-reported interoceptive accuracy) AND (alexithymia or alexithymic or alexithym*). The search was conducted from 13 July to 01 October 2023, and restricted wherever possible to titles, abstracts, and key words identified within PsychINFO, PubMed, Scopus, and Web of Science databases. Additional sources were identified through reference list screening for included articles and Google Scholar. All sources were imported into Covidence, a web-based collaboration software platform that streamlines the production of systematic and other literature reviews.

Eligibility criteria

Inclusion criteria. Studies were included if they: (i) were written in English; (ii) had samples aged 18 years and older; (iii) were published in a peer-reviewed journal or uploaded to a pre-print database that was accessible through online databases through the authors' institutional library or via interlibrary loans; (iv) measured subjective interoception using a validated self-report scale; (v) measured alexithymia using a validated self-report scale; (vi) quantitatively measured the relationship between subjective interoception and alexithymia; and (vii) reported statistics that enabled interpretation of the strength and direction of the relationship between subjective interoception and alexithymia. Studies examining clinical samples were considered, as the previous meta-analysis identified a moderating effect for clinical conditions [25].

Exclusion criteria. Studies were excluded if: (i) the sample was aged 17 years or younger; (ii) the interoceptive self-report scale was deemed to assess constructs other than subjective interoception; (iii) measurement of alexithymia was not a validated self-report scale; and (iv) the study did not report statistics that enabled interpretation of the relationship between subjective interoception and alexithymia.

Data extraction. A data extraction form was developed in Covidence. Three reviewers (KVB, JK, NG) independently extracted the following data: author and year; country; study design; sample characteristics; sample size; percent of sample identifying as female; clinical status; investigated interoceptive construct; interoceptive self-report scale; analysed interoceptive scales; alexithymia self-report; analysed alexithymia scales; covariates or controlled variables; results; effect sizes (correlation coefficients–*r*). Extraction was completed in Covidence and exported to Excel. We did not contact authors for unreported effect sizes, based on described poor response rates for previous meta-analyses [49, 50]. Disagreements between reviewers were resolved through open discussions to reach consensus.

Analysis approach

Primary meta-analyses. See https://osf.io/ky3qf for the pre-registered analysis plan. Correlation coefficients were extracted from each study to represent the effect size magnitude of the relationship between self-reported interoception and alexithymia. We performed Fisher's *Z* transformations in Excel using the following equation on *r* values to improve normality:

$$z = 0.5 \times \text{In}\left(\frac{1+r}{1-r}\right)$$

Variance of Fisher's *Z* was calculated in Excel as:

$$Vz = \frac{1}{(n-3)}$$

Fisher's *Z* was converted back to *r* values in text and tables for summary statistics, whereas Fisher's *Z* transformed values are reported in figures at https://osf.io/3nsyc/. Per Trevisan and colleagues' [25] approach, we did not convert standardised betas to simple correlations as this may introduce bias in summary effect size estimation.

Considering evidence demonstrating that measures of self-reported interoception do not assess the same construct [26, 39], we did not aggregate interoceptive data. Data were split according to interoceptive self-report scale. Separate meta-analyses were conducted according to specific interoceptive scales and four alexithymic outcomes (global alexithymia, difficulty identifying feelings, difficulty describing feelings, and externally oriented thinking) where the number of effects (*k*) per scale and alexithymic outcome was $\geq$2. In several instances, the same participants from a study contributed multiple effect sizes (i.e., studies included more than one alexithymia scale). In line with the method of Robinson et al. [50], we divided the total number of study participants by the number of effect sizes the study contributed to the meta-analysis to provided adjusted sample sizes. Several studies reporting findings from the same samples were also noted. Only one of the study's effects were included to ensure independence of observations.

The meta-analyses were conducted using SPSS Statistics, Version 29. The conservative Sidik-Jonkman estimator was applied. Random effects models were employed for all analyses, which assumes that variability in effect sizes among studies may vary between studies due to heterogeneity, including sample characteristics [51]. Heterogeneity was investigated for each meta-analysis, and *Q* and I^2 statistics are reported. Publication bias was also assessed. Funnel plots were produced to show the relationship between effect sizes and standard error. Egger's tests were used to assess the asymmetry of the funnel plot where there were sufficient studies included ($k \geq 10$). Influence analysis using the leave-one-out method was used to assess the influence of individual studies on pooled effect sizes. Cohen's [52] recommendations were used for effect size interpretation (weak: $r = 0.00$ to 0.29, moderate: $r = 0.30$ to 0.49, strong: $r \geq 0.50$). Pooled effects were interpreted as significant where $p < .05$.

Secondary analyses. If outliers or influential effects were identified in primary analyses, they were removed for secondary analyses. Where high heterogeneity was observed, we conducted subgroup analysis according to clinical status, as this was expected to contribute to variance [25]. Some studies pooled clinical and typically developed participants into a single group for correlational analyses. Following the approach of Trevisan et al. [25], we considered these samples as representing a clinical category to maximise statistical power. Subgroup analysis was conducted where indicated, based on the region where the sample was located (Asia, Australasia, Europe–UK, Europe–Other, North America), as several interoceptive self-reports, such as the MAIA, have been translated from English into other languages [35] and culture can shape interoceptive and emotional conceptualisations [e.g., 53, 54]. As global alexithymia was indexed using three scales across the included studies, we conducted subgroup analysis according to alexithymic measure.

Risk of bias assessment. To assess for risk of bias, the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist for cross-sectional studies [55] was utilised. The three reviewers independently evaluated all studies for risk of bias based on whether the 22 STROBE checklist items indicated low, medium, or high risk of bias. Articles, online supplements, and study pre-registrations were consulted for these assessments. Disagreements were resolved through consensus. For reviewer agreement regarding risk of bias, see the S2 File. The S3 File contains assessment results with ratings according to STROBE items.

Results

Study selection

The search parameters yielded the following (Fig 1).

The search strategy identified an initial 232 articles via database searching. Following Covidence removal of duplicates ($n = 97$), the remaining 135 studies were screened against title and abstract. Following title and abstract screening, 103 papers were collectively deemed as not meeting inclusion criteria; 31 papers subsequently remained and were assessed for full-text eligibility. Fifteen studies were excluded and a total of 16 studies identified through database searches were included. Google Scholar searches yielded 797 results. Of these, 58 studies were retrieved. Eleven studies identified via Google Scholar were deemed eligible and relevant; included studies then totalled 27. Reference lists for these studies were scanned for additional sources, of which five were identified. These were screened against eligibility criteria and included. We identified that one study was ineligible following screening, as results concerned the same sample [56]. To maintain independence of observations, the study was excluded. The number of articles included in final reporting was therefore 32. At all review stages, fair consistency was observed amongst reviewers (>65%), with conflicts resolved through discussions. Inter-rater reliability amongst reviewers is provided in the S2 File.

Study characteristics

Full study characteristics are reported in the S4 File. Publication dates ranged from 1996 [57] to 2023 [58–63]. Most studies were conducted in Western countries, most frequently in the United Kingdom ($n = 10$). Most studies used a cross-sectional design ($n = 35$); one used

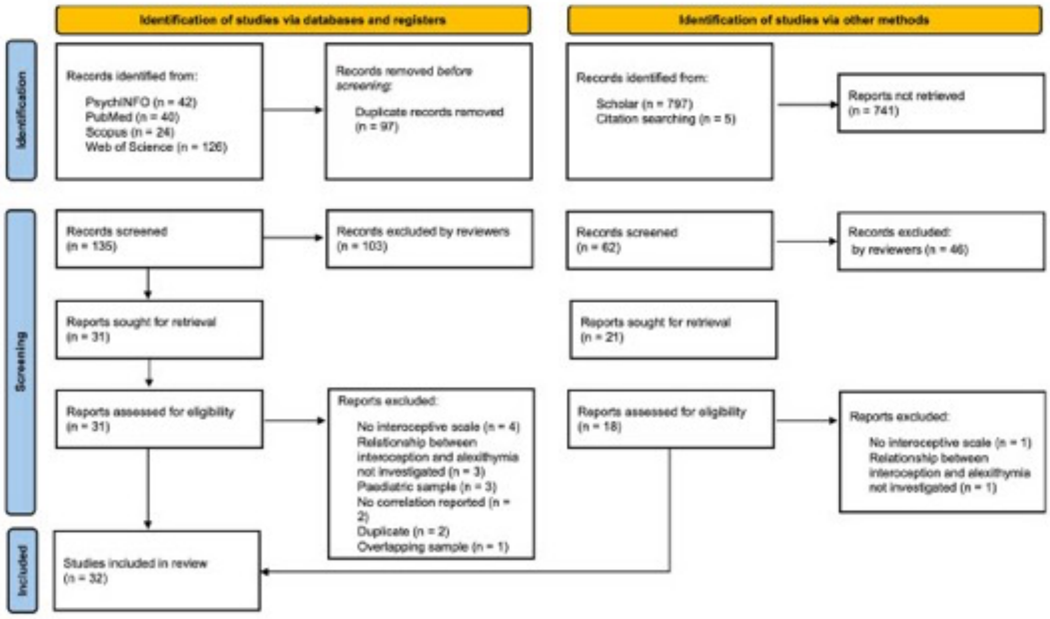


Fig 1. PRISMA flow diagram of study inclusion.

https://doi.org/10.1371/journal.pone.0310411.g001

randomised experimental design and conducted a cross-sectional analysis of self-reported interoception and alexithymia following mood induction [64].

Overlapping samples were noted for three studies based in Germany and Austria [65–67]. All studies included students from the University of Potsdam recruited by Ventura-Bort et al. [67]; findings reported by Brand et al. [65] and Tünte et al. [66] pertained to the same Vienna and Potsdam samples, where employed materials were similar. To ensure independence of observations, the decision was made to include Brand et al. [65] findings for the MAIA, BPQ, ICQ, BPQ, IAS and alexithymia in the meta-analyses. Tünte et al. [66] however, reported findings for the IATS with alexithymia in two samples. As such, these IATS findings were included in analysis. Findings for a principal components analysis (PCA) of interoception and alexithymia scales reported by Ventura-Bort [67] was included in narrative synthesis.

Participants

Across the 32 included studies, the total number of participants was 7819 with a minimum number of 18 [68] and a maximum number of 759 [63]. Most studies recruited males and females (91.67%), although women tended to be disproportionately represented. The remaining studies recruited women [64, 69] or men only [58]. Participants' ages ranged from 18 to 91 [40]. Most commonly, samples were non-clinical, and drawn from general communities or primarily university students and/or staff. With respect to clinical conditions of interest, autism spectrum disorder (ASD) was most frequently investigated (n = 4) [43, 58, 59, 70]. The relationship between subjective interoception and alexithymia was also examined in patients with anorexia nervosa (AN) [57], fibromyalgia [71], functional motor disorders (FMD) [72], irritable bowel diseases (IBD) such as Crohn's disease (CD) and ulcerative colitis (UC) [62], and individuals who self-reported an existing psychiatric diagnosis [40].

Investigated interoceptive constructs

Various interoceptive constructs were investigated across the included studies. In order of frequency, these were: 'interoceptive sensibility' (n = 12), 'interoceptive awareness' (n = 11), 'self-reported interoceptive accuracy' (n = 4), 'self-reported interoceptive attention' (n = 3), 'interoception' (n = 1), 'interoceptive challenges' (n = 1), 'interoceptive confusion' (n = 1), 'interoceptive impact' (n = 1), 'self-reported interoception' (n = 1), 'and 'subjective interoception' (n = 1). Where umbrella terms such as 'sensibility' were employed, consistency in construct operationalisation was notably lacking. By contrast, investigation of more specific constructs, such as 'self-reported interoceptive accuracy', related to administration of specific measures.

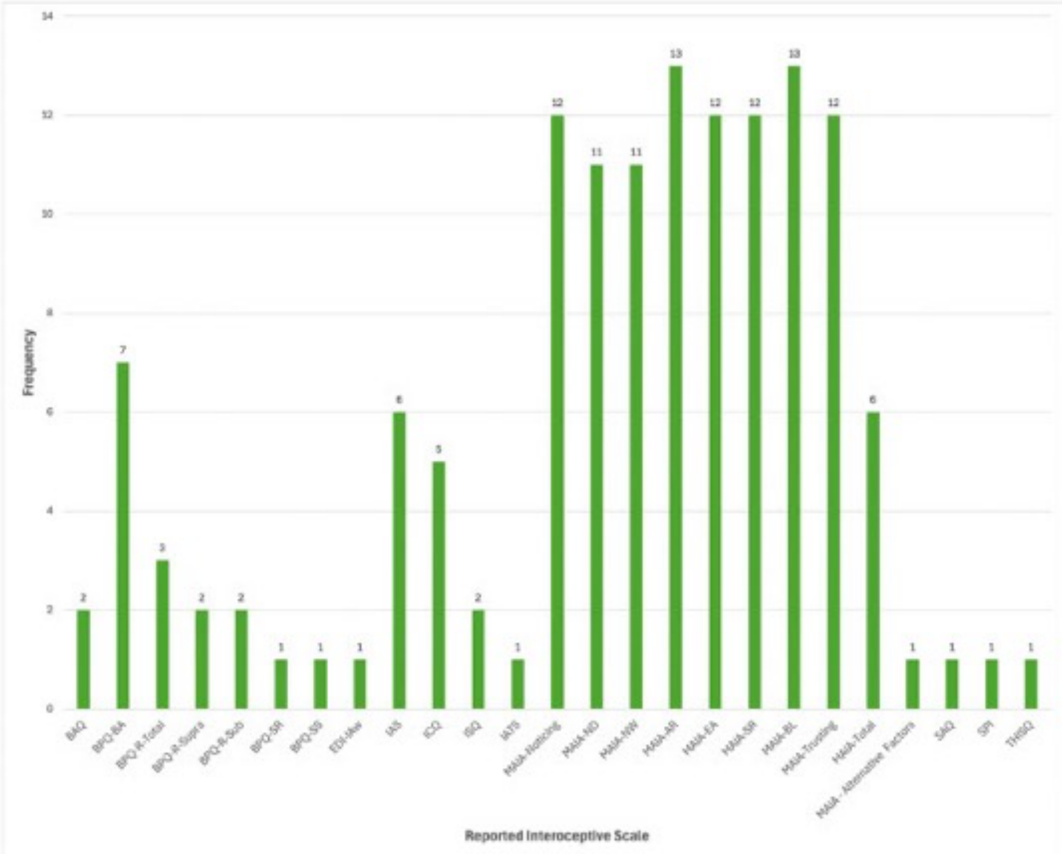
Since at least 2018, there was an observed trend toward consistent application of the term 'interoceptive sensibility', as defined by Garfinkel et al. [28]. 'Interoceptive awareness' was also investigated frequently, despite the tendency for researchers to ascribe the 'sensibility label' to self-reported interoception. This prompted evaluation of reasons for using the term. Of the 11 studies investigating this construct, three predated publication of the 3-factor framework from Garfinkel et al. [28] that proposed 'interoceptive sensibility' [37, 57, 68]. Five studies that employed the MAIA defined 'interoceptive awareness' based on Mehling and colleagues' [34, 35] conceptualisations [63, 70, 73–75] in contrast to the 'interoceptive awareness' domain proposed by Garfinkel et al. [28]. One study cited Craig [10] in defining 'interoceptive awareness' as "the conscious perception of internal bodily states that emanate from the autonomic nervous system" [76]. One study cited Khalsa et al. [9] to define the construct as "the perception and integration of signals related to body states" [64]. One study drew on previous findings to define 'interoceptive awareness' as "the capacity to attune to physiological experiences" [61].

More recent studies investigated self-reported interoceptive accuracy and attention, as proposed by Murphy et al. [27], employing self-reports assessing these constructs [40, 65, 66, 77]. Several papers proposed alternative terms that capture specific interoceptive constructs according to what the self-report scale measures, such as 'interoceptive impact', proposed to encompass the "the influence of interoception on everyday life" [78] and 'interoceptive challenges', involving impaired processing of "interoceptive signals that report the moment-to-moment condition of the body" [43].

Administered measures

Interoceptive self-report scales. Most studies administered one scale to measure self-reported interoception (n = 26); six studies administered multiple measures [40, 65–67, 79, 80]. An overview of the interoceptive self-report scales employed in included studies, including acronyms and scale descriptions, is provided in the S5 File.

The Multidimensional Assessment of Interoceptive Awareness (MAIA) and MAIA, Version 2 (MAIA-2) was most frequently employed to measure self-reported interoceptive constructs (n = 18). Other measures included the Body Perception Questionnaire (BPQ; n = 7), Interoceptive Accuracy Scale (IAS; n = 6), Interoceptive Confusion Questionnaire (ICQ; n = 5), Body Awareness Questionnaire (BAQ; n = 2), Interoceptive Sensory Questionnaire (ISQ; n = 2), the Interoceptive Awareness scale of the Eating Disorder Inventory (EDI-IAw n = 1), Interoceptive Attention Scale (IATS; n = 1), Self-Awareness Questionnaire (SAQ; n = 1), Sensory Profile: Interoception (SPI; n = 1), and Three-Domain Interoceptive Sensations Questionnaire (THISQ; n = 1). Although Brewer et al. [41] reported mixed psychometric evidence for the ICQ, these findings were included in the present review, as other studies



BAQ: Body Awareness Questionnaire; **BPQ**: Body Perception Questionnaire; **BPQ-BA**: Body Awareness Scale; **BPQ-R-Total**: Autonomic Reactivity Scale; **BPQ-R-Supra**: Autonomic Reactivity - Supradiaphragmatic; **BPQ-R-Sub**: Autonomic Reactivity - Subdiaphragmatic; **BPQ-SR**: Stress Response; **BPQ-SS**: Stress Style; **EDI-IAw**: Interoceptive Awareness Scale of the Eating Disorder Inventory; **IAS**: Interoceptive Accuracy Scale; **IATS**: Interoceptive Attention Scale; **ICQ**: Interoceptive Confusion Questionnaire; **ISQ**: Interoception Sensory Questionnaire; **MAIA**: Multidimensional Assessment of Interoceptive Awareness; **ND**: Noticing; **NW**: Not-Distracting; **NW**: Not-Worrying; **AR**: Attention Regulation; **EA**: Emotional Awareness; **SR**: Self-Regulation; **BL**: Body Listening; **Trusting**: Trusting; **SAQ**: Self-Awareness Questionnaire; **SPI**: Sensory Profile: Interoception; **THISQ**: Three-Domain Interoceptive Sensations Questionnaire.

Fig 2. Frequency of reported interoceptive self-report scales in the included studies.

https://doi.org/10.1371/journal.pone.0310411.g002

administered this measure [40, 65, 79]. The frequency of reported scales in analyses across these studies is displayed in Fig 2 at the end of this section.

Body awareness questionnaire (BAQ). Two studies administered the BAQ [36] to measure' 'interoceptive sensibility' [72, 80]. Both studies analysed BAQ-Total scores.

Body perception questionnaire (BPQ). The BPQ [29, 33] was employed by seven studies to measure 'interoception' [59], 'interoceptive awareness' [68], 'interoceptive sensibility' [81–83], 'self-reported interoceptive attention' [40, 65, 66, 77], and 'subjective interoception' [79].

Seven studies used the complete or abbreviated Body Awareness scale (BPQ-BA) [40, 59, 65, 68, 77, 79, 81]. Three studies analysed total scores from the Autonomic Reactivity scale

(BPQ-R-Total), consisting of supra- and sub-diaphragmatic symptoms subscales (BPQ-R-Supra, BPQ-R-Sub, respectively) [68, 77, 79]. Two studies analysed scores for specific BPQ-R-Supra and BPQ-R-Sub scales [65, 79].

Interoceptive awareness scale of the eating disorder inventory (EDI-IAw). One study administered the EDI-IAw [84] to measure 'interoceptive awareness' [57]. This study analysed total EDI-IAw scores.

Interoceptive accuracy scale (IAS). Six studies administered the IAS [40] to measure 'self-reported interoceptive accuracy' [40, 65, 66, 77, 85], 'interoceptive sensibility' [67], and 'subjective interoception' [79]. IAS-Total scores were analysed, according to results from original and subsequent validation studies [40, 65]. One study included the IAS in their PCA to determine salient components in interoceptive and emotional conceptualisation [67].

Interoceptive confusion questionnaire (ICQ). Five studies employed the ICQ [41] to measure 'interoceptive sensibility' [41, 67], 'self-reported interoceptive accuracy' [40, 65] and 'subjective interoception' [79]. All studies analysed and reported on ICQ total scores, according to scoring methods reported by Brewer et al. [41]. One study ran a PCA to determine salient factors in interoceptive and emotional conceptualisation, which included the ICQ [67].

Interoception sensory questionnaire (ISQ). Two studies administered the ISQ [43] to measure 'interoceptive confusion' [58] and 'interoceptive challenges' [43]. The ISQ was designed for and validated in adults with ASD. These studies analysed ISQ total scores, based on the factor structure determined by Fiene et al. [43].

Interoceptive attention scale (IATS). One study administered the IATS [42] to measure 'self-reported interoceptive attention' and analysed total IATS scores [66].

Multidimensional assessment of interoceptive awareness (MAIA). The MAIA was the most frequently employed self-report scale amongst the included studies. Two versions of the MAIA exist: the 32-item version [34] and the revised MAIA-2, consisting of 37-items that improved internal consistency reliability of the scales [35]. The eight scales include Noticing, Not-Distracting (ND), Not-Worrying (NW), Attention Regulation (AR), Emotional Awareness (EA), Self-Regulation (SR), Body Listening (BL), and Trusting. Eighteen studies administered the MAIA or MAIA-2 to assess 'interoceptive awareness' [61, 63, 64, 70, 73–76], 'interoceptive sensibility' [56, 60, 62, 69, 71, 86, 87], and 'subjective interoception' [79].

Seven studies administered translated versions for French [73], Spanish [86], Italian [79], German [71], Greek [62], Portuguese [76], and Taiwanese [87] samples. Despite an English version being validated and published in 2018, two studies involving participants fluent in English employed the 32-item version [64, 69]. Data collection dates were not provided, and it is therefore unclear whether they commenced following publication of the MAIA-2.

Eleven studies reported the eight scales separately [60, 62, 65, 69, 71, 73, 74, 79, 80, 86, 87]. Two studies reported specific MAIA scales (Noticing, AR, EA, BL, Trusting [67]; AR, SR, BL [63]). Six studies computed and reported MAIA total scores, consisting of either the average of scores on the eight scales [60, 79] or summed raw scores [61, 64, 75, 76]. One study conducted multidimensional scaling analyses to produce and score three clusters they labelled 'Attention Regulation' (AR scale), 'Active and Reactive Strategies' (ND, NW, SR, BL scales), and 'Awareness' (Noticing, EA, Trusting scales) [70]. One study ran a PCA to determine salient factors in interoceptive and emotional conceptualisation, which included MAIA scales [67].

Self-awareness questionnaire (SAQ). One study developed, validated, and administered the SAQ to measure 'interoceptive awareness' [37]. This study reported on SAQ-Total scores, SAQ-F1 (, and SAQ-F2 scores following factor analysis to determine SAQ factor structure.

Sensory profile: Interoception (SPI). One study developed, validated, and administered the SPI to measure 'interoceptive impact' [78]. This study reported on four scales following analysis to determine factor structure: Registration, Avoiding, Sensitivity, Seeking.

Three-domain interoceptive sensations questionnaire (THISQ). One study developed, validated, and administered the THISQ to measure self-reported perception of neutral respiratory, cardiac, and gastroesophageal sensations [45]. The included sensations were designed to differentiate between awareness of neutral sensations and attention to negatively valenced bodily sensations (e.g., dyspnea). This study reported four indices following analyses that determined underlying factor structure: total scores (THISQ-Total), cardiorespiratory activation (THISQ-CRA), cardiorespiratory deactivation (THISQ-CRD), and gastro-esophageal sensations (THISQ-GES).

Excluded interoceptive self-report scales. Two studies administered measures that had not been validated. Brewer et al. [41] administered the State-Emotion Similarity Questionnaire, whereby reported psychometric evidence was unclear; accordingly. these findings were excluded, although the study was retained as they included the ICQ and alexithymia scales. Zamariola et al. [80] reported findings related the Interoceptive Awareness Questionnaire (IAQ). Boegarts et al. [44] recently validated this questionnaire—now named the Interoceptive Sensitivity and Attention Questionnaire. Newer findings indicate a different factor structure to that initially reported [80]. As such, IAQ findings were excluded, but the study was overall retained as they employed the MAIA, BAQ, and alexithymia scales.

Alexithymia scales. Three scales were administered to measure the alexithymia construct: the Bermond-Vorst Alexithymia Questionnaire (BVAQ) [88], Perth Alexithymia Questionnaire (PAQ) [89], and the Toronto Alexithymia Scale, 20-item version (TAS-20) [90].

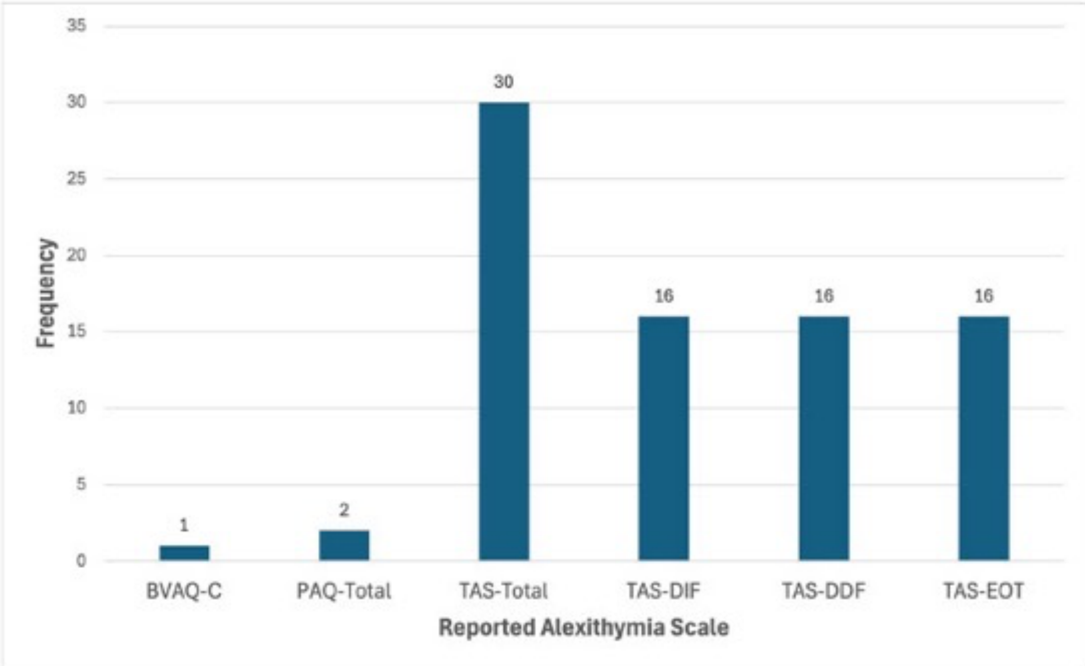
Most studies administered the TAS-20 ($n = 31$) to measure alexithymia. The TAS scales include Difficulty Identifying Feelings (DIF) capturing difficulty identifying and distinguishing between feelings and bodily sensations, Difficulty Describing Feelings (DDF) measuring the ability to communicate feelings to other people, and Externally Oriented Thinking (EOT) capturing preferences for focusing on external events rather than inner experiences, with total scores (TAS-Total) reflecting overall alexithymia. Over half of the studies reported findings relevant to TAS-Total only ($n = 17$, 53.1%). Thirteen studies reported on TAS-Total, DIF, DDF, and EOT. Two studies reported on only facet-level alexithymia using the three TAS-20 scales [45, 67].

Two studies administered the PAQ and utilised PAQ-Total scores to index global alexithymia, consisting of DIF, DDF, and EOT facets [63, 78]. One study administered the BVAQ to measure alexithymia, computing cognitive (BVAQ-C) and affective (BVAQ-A) domains [79]. BVAQ-C measures the degree to which individuals can define arousal states, describe or communicate emotional reactions, and seeking out explanations of emotional reactions, whereas BVAQ-A assesses inclinations to fantasise, imagine, or daydream, and degrees to which someone is emotionally aroused by emotion inducing events.

We investigated whether there was convergent evidence for these alexithymia measures assessing the same construct. Preece et al. [89] reported that TAS-Total and PAQ-Total were strongly correlated ($r = 0.76$, $p < .001$). Zahid et al. [63] similarly found a strong correlation between the scales ($r = 0.67$, $p < .001$). Gaggero et al. [79] reported significant correlations between and TAS-Total and BVAQ-C ($rs = 0.68$ to 0.85, $p < .001$). Accordingly, TAS-Total, PAQ-Total, BVAQ-Total, and BVAQ-C scores were considered to assess global alexithymia. Gaggero et al. [79] reported correlations between TAS-20 scores and BVAQ-A, which indicated distinctness ($rs = 0.07–0.14$, $ps > .05$). Accordingly, BVAQ-A findings were not incorporated into this review. Fig 3 displays the frequency of reported alexithymia scales.

The relationship between subjective interoception and alexithymia

The relationship between subjective interoception and alexithymia was interpreted, according to each interoceptive self-report scale and its relationship with global alexithymia, DIF, DDF,



BVAQ-C: Bermond-Vorst Alexithymia Questionnaire, Cognitive domain; **PAQ**: Perth Alexithymia Questionnaire; **TAS**: Toronto Alexithymia Scale; **DIF**: Difficulty Identifying Feelings; **DDF**: Difficulty Describing Feelings; **EOT**: Externally Oriented Thinking.

Fig 3. Frequency of reported alexithymia scales in the included studies.

https://doi.org/10.1371/journal.pone.0310411.g003

and EOT, where $k \geq 2$. Results in the following sections are discussed according to the strength and directionality of these associations. Due to the number of analyses performed, results have been summarised. Subgroup analyses were performed but have been omitted, due to the small sample sizes within many subgroups. An overview of these analyses is provided at https://osf.io/ywg8z. Data and study details are provided in the S6–S9 Files. Full results for primary and secondary meta-analyses and forest and funnel plots are available at https://osf.io/3nsyc/. Fig 4 provides a workflow of the primary and secondary analyses performed.

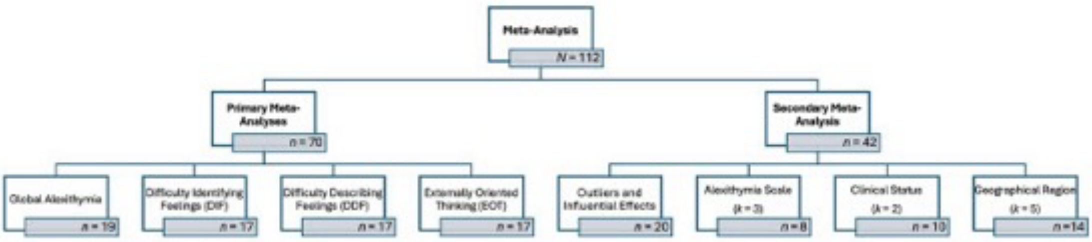


Fig 4. Workflow of performed meta-analyses.

https://doi.org/10.1371/journal.pone.0310411.g004

Table 1. Associations between interoceptive self-report scales and global alexithymia.

Interoceptive Scale	*k*	*Sample Size*	*r*	*z*	*p*	95% CI Lower	95% CI Upper	Heterogeneity *Q*	*df*	*p*	I^2 (%)	Publication Bias Egger's Test *t*	*p*	Trim-and-Fill No. Imputed Studies
BAQ	2	315	-0.17	-3.12	.002	-0.27	-0.06	0.14	1	.708	0.9			
BPQ-BA	13	2107	-0.05	-0.29	.181	-0.12	0.09	14.31	12	.281	66.6	-0.12	.906	0
BPQ-R-Total	8	1347	0.36	7.97	< .001	0.28	0.44	7.77	7	.354	59.2			
BPQ-R-Supra	7	1167	0.34	9.23	< .001	0.27	0.40	8.24	6	.221	51.5			
BPQ-R-Sub	7	1157	0.22	7.53	< .001	0.16	0.27	4.45	6	.617	21.9			
EDI-Aw	4	312	0.26	3.90	< .001	0.11	0.40	4.48	3	.214	43.0			
IAS	11	2263	-0.30	-9.82	< .001	-0.35	-0.24	6.13	10	.804	44.0	-2.63	.027	0
IATS	2	581	0.22	5.55	< .001	0.14	0.30	0.12	1	.912	0.0			
ICQ	9	2355	0.57	12.32	< .001	0.49	0.63	38.92	7	< .001	76.3			
ISQ	2	68	0.53	4.70	< .001	0.33	0.71	0.11	1	.737	0.6			
MAIA-AR	20	4279	-0.26	-13.05	< .001	-0.30	-0.22	16.15	19	.623	27.0	-4.64	< .001	0
MAIA-BL	19	3942	-0.23	-9.73	< .001	-0.28	-0.19	0.16	18	.674	0.2	-2.22	.043	0
MAIA-EA	17	3183	-0.18	-8.11	< .001	-0.23	-0.14	0.53	16	.465	34.2	-3.11	.007	1
MAIA-ND	18	3520	-0.21	-7.87	< .001	-0.26	-0.16	28.77	17	.037	51.4	-3.88	.001	2
MAIA-Noticing	17	3183	-0.18	-6.99	< .001	-0.23	-0.13	21.89	16	.147	45.4	-2.48	.025	0
MAIA-NW	17	3183	-0.17	-5.28	< .001	-0.22	-0.09	37.61	16	.002	63.6	-1.29	.217	2
MAIA-SR	17	3183	-0.28	-11.34	< .001	-0.32	-0.23	20.55	16	.197	40.5	-4.13	< .001	1
MAIA-Trusting	18	3520	-0.34	-15.76	< .001	-0.38	-0.30	17.17	17	.443	33.9	-6.58	< .001	2
MAIA-Total	10	1488	-0.41	-13.10	< .001	-0.46	-0.35	10.83	9	.287	35.0	-4.47	.002	4

k: number of effects; *r*: pooled correlation, CI: confidence interval; BAQ: Body Awareness Questionnaire; BPQ-BA: Body Perception Questionnaire-Body Awareness Scale; BPQ-R-Total: Body Perception Questionnaire-Autonomic Reactivity Scale; BPQ-R-Supra: Body Perception Questionnaire-Supradiaphragmatic Symptoms subscale; BPQ-R-Sub: Body Perception Questionnaire-Subdiaphragmatic Symptoms subscale; EDI-IAw: Interoceptive Awareness subscale of Eating Disorder Inventory; IAS: Interoceptive Accuracy Scale; IATS: Interoceptive Attention Scale; ICQ: Interoceptive Confusion Questionnaire; ISQ: Interoceptive Sensory Questionnaire; MAIA: Multidimensional Assessment of Interoceptive Awareness; MAIA-AR: Attention Regulation subscale; MAIA-BL: Body Listening subscale; MAIA-EA: Emotional Awareness subscale; MAIA-ND: Not-Distracting subscale; MAIA-NW: Not-Worrying subscale; MAIA-SR: Self-Regulation subscale.

https://doi.org/10.1371/journal.pone.0310411.t001

Meta-analyses of interoceptive self-report scales and global alexithymia. In Table 1, we report the results for each applicable self-report scale in relation to global alexithymia, indexed by TAS-20, PAQ, and BVAQ-C total scores. We observed significant effects for 18 interoceptive scales which ranged from large to small in strength and varied in directionality (see Table 1). Data and study details are reported in the S6 File. Full results and plots are available at https://osf.io/ecjdx.

Meta-analysis demonstrated a strong positive association for the ICQ and alexithymia, $r(9) = 0.57$, $p < .001$, suggesting greater struggles to interpret non-affective interoceptive states coincides with difficulties identifying and describing feelings, and a preference for externally oriented thinking. A strong positive effect was further observed between the ISQ and alexithymia, $r(2) = 0.53$, $p < .001$, indicating that greater difficulty registering or interpreting interoceptive sensations relates to higher alexithymia. A moderate positive effect was identified for BPQ-R-Total, $r(8) = 0.36$, $p < .001$, suggesting that heightened autonomic stress response activation, experienced as frequent somatic symptoms, coincides with higher alexithymia. This moderate effect extended to BPQ-R-Supra and alexithymia $r(7) = 0.34$, $p < .001$, indicating that more frequent somatic symptoms above the diaphragm (e.g., breathing problems) relates to higher alexithymia. The association was weaker for reactivity for symptoms below the diaphragm (BPQ-R-Sub), $r(7) = 0.22$, $p < .001$. Other weak associations were identified. The

IATS and alexithymia were positively associated, $r(2) = 0.26$, $p < .001$, indicating that greater self-reported attention to internal signals was associated with increased alexithymia. Moreover, a weak positive correlation was found between EDI-IAw and alexithymia, $r(4) = 0.26$, $p < .001$, suggesting that poorer discrimination between sensations and feelings, and hunger and satiety is associated with higher alexithymia.

Contrastingly, we identified a moderate negative association between MAIA-Total scores and alexithymia, $r(10) = -0.41$, $p < .001$, suggesting that adaptive interoception relates to lower alexithymia. We further found that MAIA-Trusting and alexithymia were moderately negatively associated $r(18) = -0.34$, $p < .001$, indicating that experiencing one's body as safe and trustworthy is associated with lower alexithymia. A medium negative correlation between the IAS and alexithymia was also identified, $r(11) = -0.30$, $p < .001$, indicating that stronger perceived capacities for accurately perceiving interoceptive signals is associated with decreased alexithymia. Negative, albeit, weaker associations with alexithymia were identified for MAIA-AR, $r(20) = -0.26$, $p < .001$, and MAIA-SR, $r(17) = -0.28$, $p < .001$, suggesting that stronger abilities for sustaining and controlling attention to body sensations and regulation of distress through bodily attention coincides with lower alexithymia. Weak effects with alexithymia were also identified for MAIA-BL, $r(19) = -0.23$, $p < .001$, and MAIA-ND $r(18) = -0.22$, $p < .001$, indicating more active listening to the body for insight and not ignoring or distracting oneself from pain or discomfort and is associated with decreased alexithymia. Weaker negative associations were shown for alexithymia and MAIA-Noticing, $r(17) = -0.18$, $p < .001$, MAIA-EA, $r(17) = -0.18$, $p < .001$, MAIA-NW, $r(17) = -0.17$, $p < .001$, and the BAQ $r(2) = -0.17$, $p < .001$. Collectively, this suggests that lower alexithymia relates to higher awareness of neutral, comfortable, and uncomfortable body sensations, and the connection between body sensations and emotional states, not worrying or experiencing emotional distress with pain or discomfort, and greater attention to non-affective bodily states. However, we did not identify a significant association between BPQ-BA and alexithymia, $r(13) = -0.05$, $p = .181$.

Meta-analyses of interoceptive self-report scales and difficulty identifying feelings (DIF). In Table 2, results for each applicable self-report scale in relation to DIF are reported, showing significant effects for 15 interoceptive scales. For data and study details, see the S7 File. Full results and plots are provided at https://osf.io/6qw7u.

Meta-analysis demonstrated a strong positive pooled correlation for the ICQ and DIF, $r(3) = 0.51$, $p < .001$, suggesting greater interoceptive confusion is associated with difficulties in distinguishing between different emotions and insufficient realisation that physical sensations may be the manifestation of emotions. A moderate positive correlation was further identified for BPQ-R-Total, $r(3) = 0.48$, $p < .001$, suggesting that heightened autonomic stress response activation coincides with greater DIF. This moderate effect was further observed for BPQ-R-Supra, $r(4) = 0.40$, $p < .001$, and BPQ-R-Sub $r(4) = 0.30$, $p < .001$, indicating that frequent experiences of somatic symptoms above and below the diaphragm relates to more pronounced DIF. A positive association was also observed for IATS and DIF, but weaker in strength, $r(2) = 0.26$, $p < .001$, indicating that greater self-reported attention to internal signals is associated with increased DIF.

Conversely, we identified a moderate negative association between MAIA-Total scores and alexithymia, $r(6) = -0.34$, $p < .001$, suggesting that more adaptive interoceptive percepts relate to less DIF. We also found that MAIA-Trusting and alexithymia were moderately negatively associated $r(10) = -0.33$, $p < .001$, indicating that experiencing one's body as safe and trustworthy is associated with less DIF. An overall negative correlation between the IAS and alexithymia was also identified, $r(5) = -0.29$, $p < .001$, indicating that stronger perceived capacities for accurately perceiving interoceptive signals is associated with lower DIF. Negative, albeit weaker, associations with alexithymia were identified for MAIA-NW, $r(9) = -0.27$, $p < .001$,

Table 2. Associations between interoceptive self-report scales and Difficulty Identifying Feelings (DIF).

Interoceptive Scale	k	Sample Size	r	z	p	95% CI Lower	95% CI Upper	Heterogeneity Q	Heterogeneity df	Heterogeneity p	Heterogeneity I^2 (%)	Publication Bias: Egger's Test t	Egger's Test p	Trim-and-Fill No. Imputed Studies
BAQ	2	315	-0.07	-1.28	.201	-0.17	0.03	0.03	1	.855	0.1			
BPQ-BA	6	1478	0.00	-0.06	.635	-0.07	0.15	3.42	5	.635	26.3			
BPQ-R-Total	3	814	0.48	10.31	< .001	0.4	0.55	3.70	2	.157	52.3			
BPQ-R-Supra	4	1428	0.40	5.14	< .001	0.25	0.52	20.52	3	< .001	86.5			
BPQ-R-Sub	4	1428	0.30	4.40	< .001	0.17	0.43	24.69	3	< .001	84.8			
IAS	5	1633	-0.29	-9.99	< .001	-0.35	-0.24	3.01	4	.557	27.0			
IATS	2	581	0.27	6.87	< .001	0.20	0.34	0.19	1	.687	1.5			
ICQ	3	1178	0.51	18.53	< .001	0.45	0.55	0.20	2	.907	0.05			
MAIA-AR	10	2677	-0.25	-6.12	< .001	-0.32	-0.17	23.10	9	.006	72.9	-3.57	.007	0
MAIA-BL	11	2849	-0.12	-2.55	< .001	-0.21	-0.03	12.70	10	.241	81.8	-2.55	.071	3
MAIA-EA	10	2833	-0.08	-2.91	.004	-0.13	-0.02	11.39	9	.250	41.7	-0.62	.554	0
MAIA-ND	10	2599	-0.17	-5.22	< .001	-0.24	-0.11	10.60	9	.304	58.5	-2.77	.024	0
MAIA-Noticing	11	2849	-0.11	-4.07	< .001	-0.15	-0.06	12.50	10	.253	42.8	2.63	.027	2
MAIA-NW	9	2356	-0.27	-10.16	< .001	-0.32	-0.22	8.60	8	.378	32.0			
MAIA-SR	11	2849	-0.26	-6.15	< .001	-0.31	-0.16	22.05	10	.015	72.6	-3.74	.005	0
MAIA-Trusting	10	2619	-0.33	-6.41	< .001	-0.44	-0.26	22.51	9	.007	83.3	-6.35	< .001	0
MAIA-Total	6	1360	-0.34	-11.36	< .001	-0.41	-0.30	2.89	5	.716	23.9			

k: number of effects; r: pooled correlation, CI: confidence interval; BAQ: Body Awareness Questionnaire; BPQ-BA: Body Perception Questionnaire-Body Awareness Scale; BPQ-R-Total: Body Perception Questionnaire-Autonomic Reactivity Scale; BPQ-R-Supra: Body Perception Questionnaire-Supradiaphragmatic Symptoms subscale; BPQ-R-Sub: Body Perception Questionnaire-Subdiaphragmatic Symptoms subscale; IAS: Interoceptive Accuracy Scale; IATS: Interoceptive Attention Scale; ICQ: Interoceptive Confusion Questionnaire; MAIA: Multidimensional Assessment of Interoceptive Awareness; MAIA-AR: Attention Regulation subscale; MAIA-BL: Body Listening subscale; MAIA-EA: Emotional Awareness subscale; MAIA-ND: Not-Distracting subscale; MAIA-NW: Not-Worrying subscale; MAIA-SR: Self-Regulation subscale.

https://doi.org/10.1371/journal.pone.0310411.t002

MAIA-AR, $r(10) = -0.25$, $p < .001$, and MAIA-SR, $r(11) = -0.26$, $p < .001$, suggesting that not worrying or experiencing emotional distress with pain or discomfort, alongside stronger abilities for sustaining and controlling attention to body sensations and regulation of distress through bodily attention coincides with reduced DIF. Weak effects with DIF were further identified for MAIA-ND $r(10) = -0.17$, $p < .001$, MAIA-BL, $r(11) = -0.12$, $p < .001$, MAIA-Noticing, $r(11) = -0.11$, $p < .001$, and MAIA-EA, $r(10) = -0.08$, $p = .004$. Together, this suggests that less DIF relates to not distracting or ignoring painful or uncomfortable sensations, active listening to the body for insight, awareness of neutral, comfortable, and uncomfortable body sensations, and the connection between body sensations and emotional states, and greater attention to non-affective bodily states. However, DIF was not significantly associated with BPQ-BA, $r(6) = 0.00$, $p = .635$, or the BAQ, $r(2) = -0.07$, $p = .201$.

Meta-analyses of interoceptive self-report scales and difficulty describing feelings (DDF). In Table 3, results for each applicable self-report scale in relation to DDF are reported, showing significant effects for 16 interoceptive scales, ranging from moderate to weak in strength and varying in directionality. For data and study details, see the S8 File. Full results and plots are available at https://osf.io/weab3.

Meta-analysis demonstrated a moderate positive association for the ICQ and DDF, $r(4) = 0.40$, $p < .001$, suggesting greater interoceptive confusion is associated with difficulties in verbally expressing emotions. A moderate positive correlation was further identified for BPQ-R-Supra, $r(4) = 0.31$, $p < .001$, indicating that frequent experiences of somatic symptoms

Table 3. Associations between interoceptive self-report scales and Difficulty Describing Feelings (DDF).

Interoceptive Scale	k	*Sample Size*	r	z	p	95% CI Lower	95% CI Upper	Heterogeneity Q	Heterogeneity df	Heterogeneity p	Heterogeneity I^2 (%)	Publication Bias: Egger's Test t	Egger's Test p	Trim-and-Fill No. Imputed Studies
BAQ	2	315	-0.14	-2.52	.012	-0.25	0.03	0.0320	1	.571	4.2			
BPQ-BA	8	2095	0.04	0.60	.949	-0.17	0.10	22.72	7	.002	85.7			
BPQ-R-Total	3	814	0.25	4.24	< .001	0.14	0.36	6.48	2	.039	67.0			
BPQ-R-Supra	4	1428	0.31	5.19	< .001	0.19	0.40	15.65	3	< .001	78.1			
BPQ-R-Sub	4	1428	0.19	4.76	< .001	0.11	0.27	6.61	3	.085	53.2			
IAS	5	1633	-0.21	-6.17	< .001	-0.22	-0.14	5.04	4	.283	41.7			
IATS	2	581	0.19	4.65	< .001	0.11	0.26	0.27	1	.603	3.1			
ICQ	4	1428	0.43	8.75	< .001	0.34	0.51	8.75	3	< .001	71.9			
MAIA-AR	11	2849	-0.22	9.08	< .001	-0.27	-0.02	5.02	10	.890	19.6	-3.04	.014	0
MAIA-BL	11	2849	-0.19	6.31	< .001	-0.25	-0.12	16.72	10	.081	55.4	-1.99	.078	1
MAIA-EA	11	2849	-0.12	-4.76	< .001	-0.17	-0.07	11.76	10	.301	40.9	-1.69	.140	1
MAIA-ND	11	2849	-0.19	-5.44	< .001	-0.26	-0.12	30.08	10	< .001	67.4	-3.38	.008	4
MAIA-Noticing	10	2833	-0.10	-3.17	.002	-0.17	-0.04	19.79	9	.009	67.3	-2.08	.071	0
MAIA-NW	10	2543	-0.14	-3.22	< .001	-0.22	-0.05	12.18	8	.203	74.0	-1.93	.090	1
MAIA-SR	11	2849	-0.20	-7.07	< .001	-0.26	-0.15	17.99	10	.055	51.7	-3.04	.014	2
MAIA-Trusting	11	2849	-0.28	-13.13	< .001	-0.32	-0.24	6.56	10	.766	18.9	-4.40	.002	1
MAIA-Total	6	1360	-0.32	-10.03	< .001	-0.37	-0.28	5.09	5	.405	30.0			

k: number of effects; *r*: pooled correlation, CI: confidence interval; BAQ: Body Awareness Questionnaire; BPQ-BA: Body Perception Questionnaire-Body Awareness Scale; BPQ-R-Total: Body Perception Questionnaire-Autonomic Reactivity Scale; BPQ-R-Supra: Body Perception Questionnaire-Supradiaphragmatic Symptoms subscale; BPQ-R-Sub: Body Perception Questionnaire-Subdiaphragmatic Symptoms subscale; IAS: Interoceptive Accuracy Scale; IATS: Interoceptive Attention Scale; ICQ: Interoceptive Confusion Questionnaire; MAIA: Multidimensional Assessment of Interoceptive Awareness; MAIA-AR: Attention Regulation subscale; MAIA-BL: Body Listening subscale; MAIA-EA: Emotional Awareness subscale; MAIA-ND: Not-Distracting subscale; MAIA-NW: Not-Worrying subscale; MAIA-SR: Self-Regulation subscale.

https://doi.org/10.1371/journal.pone.0310411.t003

above the diaphragm relates to more pronounced DDF. Although they were weaker in magnitude, positive associations were also observed for BPQ-R-Total, $r(3) = 0.25$, $p < .001$, BPQ-R-Sub $r(4) = 0.19$, $p < .001$, and IATS, $r(2) = 0.21$, $p < .001$, suggesting that heightened autonomic stress response activation, frequently felt somatic symptoms below the diaphragm, and greater self-reported attention to internal signals relate to increased DDF. Although positive in direction, we found that DDF was not significantly associated with BPQ-BA, $r(8) = 0.04$, $p = .949$.

By contrast, a moderate negative association between MAIA-Total scores and DDF was identified, $r(6) = -0.32$, $p < .001$, indicating that more adaptive interoceptive percepts relate to lower DDF. DDF was further found to be negatively associated with MAIA-Trusting $r(11) = -0.28$, $p < .001$, MAIA-AR, $r(11) = -0.22$, $p < .001$, MAIA-SR, $r(10) = -0.20$, $p < .001$, and the IAS, $r(10) = -0.21$, $p < .001$. Together, this suggests experiencing one's body as safe and trustworthy, stronger abilities for sustaining and controlling attention to body sensations and regulation of distress through bodily attention, and stronger perceived capacities for accurately detecting interoceptive signals coincides with reduced DDF. Negative associations were also identified between DDF and MAIA-BL $r(11) = -0.19$, MAIA-ND, $r(11) = -0.19$, $p < .001$. This indicates that lower DDF is related to active listening to the body for insight, and not ignoring or distracting oneself from painful or uncomfortable sensations. The weakest negative effects were shown for MAIA-Noticing $r(11) = -0.10$, MAIA-EA, $r(11) = -0.12$, MAIA-NW, $r(10) = -0.14$, and the BAQ $r(2) = -0.14$. Collectively, this suggests that awareness of neutral,

Table 4. Associations between interoceptive self-report scales and Externally Oriented Thinking (EOT).

						95% CI		Heterogeneity				Publication Bias		
Interoceptive	*k*	*Sample*	*r*	*z*	*p*	Lower	Upper	*Q*	*df*	*p*	I^2 (%)	Egger's Test		Trim-and-Fill
Scale		*Size*										*t*	*p*	No. Imputed Studies
BAQ	2	315	-0.19	-3.31	.012	-0.30	-0.08	0.57	1	.449	11.4			
BPQ-BA	8	2095	0.02	0.25	.352	-0.12	0.15	26.14	7	< .001	84.9			
BPQ-R-Total	2	489	0.17	3.83	.048	0.00	0.32	3.83	2	.050	80.7			
BPQ-R-Supra	3	1103	0.14	2.20	.028	0.01	0.26	7.53	2	.023	74.2			
BPQ-R-Sub	4	1428	0.05	1.03	.116	-0.04	0.15	6.72	3	.081	60.3			
IAS	5	1633	-0.16	5.2	< .001	-0.21	-0.1	3.17	4	.530	25.8			
IATS	2	581	0.03	0.59	.555	-0.16	0.11	0.49	1	.484	8.8			
ICQ	4	1428	0.24	4.24	< .001	0.13	0.34	10.79	3	< .001	76.1			
MAIA-AR	11	2849	-0.21	-7.58	< .001	-0.26	-0.16	18.56	10	.046	47.2	-3.04	.014	0
MAIA-BL	10	2543	-0.21	-6.03	< .001	-0.28	-0.15	10.26	9	.330	35.5	-3.10	.013	4
MAIA-EA	10	2619	-0.25	-8.16	< .001	-0.31	-0.19	18.65	9	.028	53.6	-3.96	.004	3
MAIA-ND	11	2849	-0.13	-3.44	< .001	-0.20	-0.05	23.31	10	.010	69.8	-3.27	.010	2
MAIA-Noticing	10	2541	-0.14	-3.63	< .001	-0.21	-0.06	30.88	9	< .001	67.8	-1.25	.247	3
MAIA-NW	10	2619	-0.02	-0.80	.423	-0.07	0.03	11.98	9	.215	37.1	0.33	.749	3
MAIA-SR	11	2849	-0.21	-6.26	< .001	-0.27	-0.14	26.53	10	.003	62.4	-3.08	.013	2
MAIA-Trusting	10	2619	-0.20	-6.34	< .001	-0.26	-0.14	6.67	9	.671	53.4	-2.39	.044	0
MAIA-Total	5	1052	-0.24	-7.02	< .001	-0.31	-0.18	3.40	4	.498	21.8			

k: number of effects; *r*: pooled correlation, CI: confidence interval; BAQ: Body Awareness Questionnaire; BPQ-BA: Body Perception Questionnaire-Body Awareness Scale; BPQ-R-Total: Body Perception Questionnaire-Autonomic Reactivity Scale; BPQ-R-Supra: Body Perception Questionnaire-Supradiaphragmatic Symptoms subscale; BPQ-R-Sub: Body Perception Questionnaire-Subdiaphragmatic Symptoms subscale; IAS: Interoceptive Accuracy Scale; IATS: Interoceptive Attention Scale; ICQ: Interoceptive Confusion Questionnaire; MAIA: Multidimensional Assessment of Interoceptive Awareness; MAIA-AR: Attention Regulation subscale; MAIA-BL: Body Listening subscale; MAIA-EA: Emotional Awareness subscale; MAIA-ND: Not-Distracting subscale; MAIA-NW: Not-Worrying subscale; MAIA-SR: Self-Regulation subscale.

https://doi.org/10.1371/journal.pone.0310411.t004

comfortable, and uncomfortable sensations, alongside recognition of the link between sensations and emotions, not experiencing emotional distress with pain or discomfort, and greater attention to non-affective bodily states coincides with lower DDF.

Meta-analyses of interoceptive self-report scales and externally oriented thinking (EOT). As shown in Table 4, we observed significant small overall effects for the association between EOT and 13 interoceptive scales. For data and study details, see the S9 File. Full results and plots are available at https://osf.io/2e5mn.

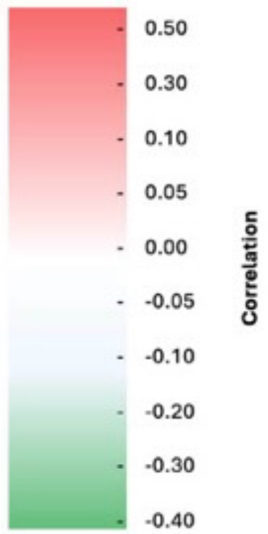
Meta-analysis demonstrated relatively weak positive associations between EOT and the ICQ, $r(4) = 0.24$, $p < .001$, BPQ-R-Total, $r(2) = 0.17$, $p < .001$, and BPQ-R-Supra, $r(3) = 0.14$, $p < .001$. Together, this indicates that greater interoceptive confusion and heightened autonomic stress response activation, particularly experienced as somatic symptoms above the diaphragm, coincides with preferences for focussing on the external environment and hardly on inner experience. We did not find evidence for significant associations between EOT and BPQ-BA, $r(8) = 0.02$, $p = .352$, BPQ-R-Sub, $r(4) = 0.05$, $p = .116$, or the IATS, $r(2) = 0.03$, $p = .555$.

Conversely, weak negative associations between EOT and most MAIA scales and summary scores were identified, including MAIA-total, $r(5) = -0.24$, $p < .001$, MAIA-EA, $r(10) = -0.25$, $p < .001$, MAIA-BL, $r(10) = -0.21$, $p < .001$, MAIA-AR, $r(11) = -0.21$ $p < .001$, MAIA-SR, $r(11) = -0.21$, $p < .001$, MAIA-Trusting, $r(10) = -0.20$, $p < .001$, MAIA-Noticing, $r(10) = -0.14$, $p < .001$, and MAIA-ND, $r(11) = -0.13$, $p < .001$. The BAQ was also positively associated with

Alexithymia Outcome

Interoceptive Scale	Global	DIF	DDF	EOT
BAQ	-0.17	-0.07	-0.14	-0.19
BPQ-BA	-0.05	0.00	0.04	0.02
BPQ-R-Total	0.36	0.48	0.25	0.17
BPQ-R-Supra	0.34	0.40	0.31	0.14
BPQ-R-Sub	0.22	0.30	0.19	0.05
EDI-Aw	0.26			
IAS	-0.30	-0.29	-0.21	-0.16
IATS	0.22	0.27	0.19	0.03
ICQ	0.57	0.51	0.43	0.24
ISQ	0.53			
MAIA-AR	-0.26	-0.25	-0.22	-0.21
MAIA-BL	-0.23	-0.12	-0.19	-0.21
MAIA-EA	-0.18	-0.08	-0.12	-0.25
MAIA-ND	-0.21	-0.17	-0.19	-0.13
MAIA-Noticing	-0.18	-0.11	-0.10	-0.14
MAIA-NW	-0.17	-0.27	-0.14	-0.02
MAIA-SR	-0.28	-0.26	-0.20	-0.21
MAIA-Trusting	-0.34	-0.33	-0.28	-0.20
MAIA-Total	-0.41	-0.34	-0.32	-0.24

Correlation



DIF: Difficulty Identifying Feelings; **DDF**: Difficulty Describing Feelings; **EOT**: Externally Oriented Thinking; **BAQ**: Body Awareness Questionnaire; **BPQ-BA**: Body Perception Questionnaire-Body Awareness Scale; **BPQ-R-Total**: Body Perception Questionnaire-Autonomic Reactivity Scale; **BPQ-R-Supra**: Body Perception Questionnaire-Supradiaphragmatic Symptoms subscale; **BPQ-R-Sub**: Body Perception Questionnaire-Subdiaphragmatic Symptoms subscale; **EDI-IAw**: Interoceptive Awareness subscale of Eating Disorder Inventory; **IAS**: Interoceptive Accuracy Scale; **IATS**: Interoceptive Attention Scale; **ICQ**: Interoceptive Confusion Questionnaire; **ISQ**: Interoception Sensory Questionnaire; **MAIA**: Multidimensional Assessment of Interoceptive Awareness; **MAIA-AR**: Attention Regulation subscale; **MAIA-BL**: Body Listening subscale; **MAIA-EA**: Emotional Awareness subscale; **MAIA-ND**: Not-Distracting subscale; **MAIA-NW**: Not-Worrying subscale; **MAIA-SR**: Self-Regulation subscale.

Fig 5. Heat map of pooled correlations between alexithymia domains and interoceptive measures. The colour gradient illustrates the strength and direction of each pooled correlation, with red indicating positive correlations and green representing negative correlations.

https://doi.org/10.1371/journal.pone.0310411.g005

EOT, $r(2) = -0.19$, $p = .012$. This suggests that more adaptive interoceptive percepts, including awareness of the connection between sensations and emotions, active listening to the body for insight, and sustaining and controlling attention to body sensations are related to less EOT and more focus on inner experiences. However, we found that MAIA-NW and EOT were not significantly associated, $r(10) = -0.02$, $p = .423$.

A heatmap illustrating the pooled correlations between all alexithymic outcomes and interoceptive measures is provided in Fig 5.

Narrative synthesis for other interoceptive self-reports and alexithymia. This section reports a narrative synthesis of findings that were not included in meta-analyses. Ernst et al. [68] examined the relationship between BPQ stress reactivity and stress style scales (BPQ-SR, BPQ-SS, respectively) and alexithymia in 18 healthy Swiss adults. They found strong positive correlations for TAS-Total with BPQ-SR, $r(16) = 0.73$, $p < .05$, and BPQ-SS, $r(16) = 0.65$, $p < .05$.

Mul et al. [70] presented results relevant to the relationship between alternative MAIA factor structures and global alexithymia, measured by TAS-Total. In a pooled ASD and healthy control sample, TAS-Total strongly negatively correlated with Awareness (Noticing, EA, Trusting), $r(50) = -0.57$, $p < .001$, and Active and Reactive Strategies factors (ND, NW, SR, BL), $r(50) = -0.57$, $p < .001$. The study further found that adults with ASD and alexithymia reported significantly lower scores for MAIA factors than adults with ASD and no alexithymia and the control group.

Ventura-Bort et al. [67] employed a two-factor solution for a PCA to ensure that extracted components reflected general constructs underlying their self-report variables. They identified a Sensibility component—interpreted as reflecting beliefs about the accuracy in detecting internal physiological and emotional states—on which DIF, DDF, and EOT from the TAS-20 all loaded (-0.89, -0.67, -0.39, respectively). MAIA-AR (0.63) MAIA-Trusting (0.61), IAS (0.51), and ICQ (-0.63) loaded onto the Sensibility factor with the TAS-20 scales. A Monitoring component—interpreted as a tendency to focus on internal states—was also identified. Noticing (0.54) and EA (0.72) scales loaded onto this component, indicating heterogeneity to these MAIA scales and alexithymic traits. MAIA-BL was found to cross-load (0.47 loading on both components).

Longarzo et al. [37] examined how SAQ-Total, SAQ-F1 (, and SAQ-F2 related to TAS-Total, DIF, DDF, and EOT TAS-20 scales in healthy university students and staff. Regarding TAS-Total, significant negative correlations were found with SAQ-Total, $r(248) = 0.47$, $p < .01$, and SAQ-F2, $r(248) = 0.37$, $p < .01$; the correlation was small with SAQ-F1 $r(248) = 0.25$, $p < .01$. For DIF, medium positive correlations were shown for SAQ-Total, $r(248) = 0.47$, $p < .01$, SAQ-F1, $r(248) = 0.40$, $p < .01$, and SAQ-F2, $r(248) = 0.25$, $p < .01$. For DDF, a medium positive correlation was reported for SAQ-F2, $r(248) = 0.33$, $p < .01$; small correlations were found for SAQ-Total $r(248) = 0.42$, $p < .01$, and SAQ-F1, $r(248) = 0.20$, $p < .01$. For EOT, there was no correlation with any SAQ score. SAQ-Total significantly positively predicted TAS-Total, explaining 13% of variance ($\beta = 0.37$, $p < .001$).

Dunn et al. [78] presented findings relevant to SPI scales (Avoidance, Registration, Seeking, Sensitivity) and alexithymia, as measured by PAQ-Total. In university students, a small positive correlation was shown for SPI-Registration and PAQ-Total, $r(72) = 0.26$, $p < .05$. No correlation was reported for SPI-Avoidance, SPI-Seeking, and SPI-Sensitivity.

Vlemincx et al. [45] presented data relevant to THISQ scales—cardiorespiratory activation (CRA), cardiorespiratory deactivation (CRD), gastro-esophaegeal sensations (GES), THISQ-Total—and alexithymia, as measured by DIF, DDF, and EOT TAS-20 scales. In Dutch- and English-speaking samples, a small positive correlation was found for DIF and THISQ-CRA, $r(729) = 0.10$, $p < .01$, but this was not significant for THISQ-CRD, THISQ-GES, and THISQ-Total. For DDF, small positive correlations were shown for THISQ-CRA, $r(729) = 0.13$, $p < .001$, and THISQ-GES, $r(729) = 0.09$, $p < .05$. No correlation was found for THISQ-CRD and THISQ-Total. For EOT, small negative correlations were found with THISQ-CRA, $r(729) = -0.13$, $p < .01$, THISQ-CRD, $r(729) = -0.09$, $p < .05$, THISQ-GES, $r(729) = -0.12$, $p < .01$, and THISQ-Total, $r(729) = -0.14$, $p < .001$.

Discussion

We conducted a systematic review and meta-analysis of the relationship between subjective interoception, as measured by various self-report scales, and alexithymia. The studies were cross-sectional and, using meta-analyses, we determined that an empirical relationship exists between these constructs, contingent upon both the measurement of self-reported interoception and distinct alexithymic facets. Overall, primary meta-analyses indicated that alexithymia is significantly positively associated with measures assessing interoceptive confusion, interoceptive attention, and autonomic stress responses and negatively associated with measures of interoceptive accuracy and adaptive interoception. These relationships were observed to be stronger with difficulty identifying (DIF) and describing feelings (DDF), relative to externally oriented thinking (EOT). Notably, the BPQ-BA was not significantly associated with any alexithymic outcome. Interoceptive research is fraught with issues pertaining to construct definition and operationalisation. Although behavioural paradigms probing objective performance have received attention, recent scrutiny extends to interoceptive self-report scales [26, 31, 32, 39]. Our findings add weight to current contentions advocating for the application of specific interoceptive constructs gauged via questionnaire and provide a basis for understanding the implications of which measures may be suitable for exploring relationships with alexithymia.

The relationship between interoceptive self-report scales and alexithymia

With respect to global alexithymia, meta-analyses revealed that poorer detection and differentiation of internal bodily sensations coincided with higher alexithymia, involving increased difficulties distinguishing between emotions, realising that physical sensations may represent emotions, and articulating emotional experiences. This follows the observed positive associations between alexithymia and interoceptive self-report scales measuring interoceptive confusion and awareness in both clinical and non-clinical samples—specifically, the ICQ, ISQ, and EDI-IAw—previously classified as interoceptive accuracy measures in the literature [12, 25, 40]. Conversely, stronger beliefs in accurately perceiving various interoceptive signals (IAS) related to lower levels of alexithymia. Previous meta-analyses have found no significant empirical association between task-based interoceptive accuracy and alexithymia [18, 25]. Consistent with Trevisan et al. [25], these findings underscore the importance of subjective trait-based interoceptive accuracy in emotional awareness, suggesting that alexithymia possibly stems from beliefs that interoceptive information is unreliable [22]. Alexithymia is associated with perceived difficulties in conceptualising physiological arousal as representative of emotions (e.g., recognition that elevated heartrate may relate to surprise), and in discriminating between indicators of affective arousal, resulting in less precise distinctions among emotional states and diminished capacities for verbal expression of emotions [25, 91]. Accurate detection of body sensations may facilitate more granular detection, articulation, and conceptualisation of specific emotional states, promoting adaptivity and psychological wellbeing [67].

Higher alexithymia was also associated with heightened autonomic stress response activation and reactivity (BPQ-R-Total), expressed as heightened perceptions of supra- (BPQ-R-Supra) and subdiaphragmatic (BPQ-R-Sub) symptoms, and attention to body sensations (IATS). This suggests that increased attention to bodily sensations, suggestive of hypervigilance and homeostatic disturbance, and autonomic nervous system (ANS) activation co-occur with higher global alexithymia. Atypical brain-body communications and the detection of symptoms implicitly involves interoception. However, it is possible that the BPQ-Reactivity scales are not a strict measure of self-reported interoception, but rather an indication of stress reactivity, which can explain the significant associations with alexithymia. Stress involves the interplay of cognitive (e.g., attentional deployment), affective (e.g., worry, anxiety), and physiological changes (e.g., ANS and hypothalamic-pituitary-adrenocortical [HPA] axis activation) that can manifest as somatic symptoms [92]. Such symptoms may be misinterpreted as indicators of illness requiring medical attention if dissociated from emotional representations [4]. Hypervigilant attention to symptoms, emotion processing deficits, somatisation, and excessive HPA axis activation may perpetuate dysfunctional regulation of bodily systems and interoceptive signal processing, contributing to the onset and maintenance of somatic symptoms and body-related mental disorders (e.g., somatic symptom disorder) [6, 24, 92, 93]. Nonetheless, our results did not support a positive association between BPQ-BA and alexithymia, contrary to previous findings [25]. Consistent with Gaggero et al. [79], there is a stronger association with increased symptomatology reflecting ANS dysfunction rather than the proposed attentional processes captured by the BPQ-BA. ANS dysfunction is not captured by the BPQ-BA, which has been criticised for confusing item wording, focus on unpleasant sensations, and lack of consideration of how respondents who do not experience such sensations might answer such items [16, 79].

Conversely, lower alexithymia was associated with higher adaptive interoceptive beliefs (MAIA-Total), including interoceptive trusting (MAIA-Trusting), self-regulation (MAIA-SR), attention regulation (MAIA-AR), body listening (MAIA-BL), not-distracting (MAIA-ND), emotional awareness (MAIA-EA), noticing (MAIA-Noticing), not-worrying (MAIA-NW), and self-reported attentiveness to normal non-emotive body processes, including anticipation of bodily reactions (BAQ). These findings complement and extend on the previous meta-analytic results of Trevisan et al. [25]. Whilst we also identified that higher MAIA-Noticing and MAIA-EA related to lower alexithymia, results indicated that global alexithymia was more strongly associated with other adaptive constructs measured by the MAIA. These constructs included mindfully sustaining attention to bodily sensations (MAIA-AR), regulating emotions through attention to sensations (MAIA-SR), active listening to bodily sensations for insight (MAIA-BL), tendencies to not ignore (MAIA-ND) or worry about painful or uncomfortable sensations (MAIA-NW), and deeming bodily sensations as trustworthy (MAIA-Trusting). These are characteristics indicating that sensations are important to the individual [16]. Such adaptive beliefs may cumulatively act as top-down modulators of interoceptive attention [94] and promote greater incorporation of physiology into ongoing emotional experiences [95], thus reducing emotional deficits, such as those typifying alexithymia. On the other hand, these findings indicate that lower adaptive beliefs, indexed by lower MAIA scale scores, can be understood as associated with higher alexithymia.

Data amenable to meta-analysis revealed that higher DIF coincided with greater interoceptive confusion (ICQ), attention (IATS), and autonomic stress response activation (BPQ-R-Total, BPQ-R-Supra, BPQ-R-Sub). Conversely, lower DIF was associated with stronger perceptions of interoceptive accuracy (IAS) and adaptive aspects of subjective interoception (MAIA-Total, MAIA-Trusting, MAIA-NW, MAIA-AR, MAIA-SR, MAIA-ND, MAIA-BL, MAIA-Noticing, and MAIA-EA). These results largely reflected the patterns observed for global alexithymia. However, BPQ-BA and BAQ did not show significant relationships with DIF. Among the facets of alexithymia, DIF notably exhibited the strongest associations with interoceptive self-report scales, which could be due to specific aspects of scale construction or to more general features of emotion generation processes. For instance, during development of the TAS, four items were taken from the EDI-IAw to reflect a domain entailing difficulty identifying and distinguishing between feelings and bodily sensations [96]. Subsequent to revisions, this domain is no longer included in the scale [90]. However, two items are retained in the DIF scale, indicating some conceptual overlap. Additionally, theories of emotion propose that the interpretation of physiological sensations and changes is an essential constituent of affect (valence and arousal), which contributes to the experience of emotions [97–99]. In this view, identification of feelings necessitates adequate allocation of attention to and accuracy in detecting interoceptive signals as a basis for an emotional experience.

With respect to DDF, greater interoceptive confusion (ICQ), stronger autonomic nervous system activation (BPQ-R-Supra, BPQ-R-Total, BPQ-R-Sub), and higher interoceptive attention (IATS) was associated with higher DDF. Conversely, lower DDF coincided with stronger perceptions of interoceptive accuracy (IAS) and adaptive aspects of subjective interoception (MAIA-Total, MAIA-Trusting, MAIA-AR, MAIA-SR, IAS, MAIA-BL, MAIA-ND, MAIA-Noticing, MAIA-EA, MAIA-NW, and BAQ). However, DDF was not significantly associated with BPQ-BA. These results were consistent with the patterns observed for global alexithymia and DIF. Although effect sizes were similar, they were somewhat weaker than those observed for DIF. Various theories of emotion highlight the involvement of language in shaping and refining emotion concepts and schemas, which enables individuals to recognise emotions as they arise and to effectively communicate them to others [100, 101]. This implies that language is crucial for identifying and ascribing a label to a feeling, promoting effective communication of emotions. Interoceptive beliefs and values may further contribute to the interpretation and incorporation of physiology into ongoing emotional experiences [95]. Emotion categories combining interoceptive sensations and emotional ascriptions may subsequently facilitate the development of more granular categories and concepts that are readily communicable. Considering DIF and DDF together, interoceptive deficits may manifest as general confusion between bodily and affective states [41], which most profoundly affects capacities for identifying and describing feelings.

In relation to EOT, meta-analyses revealed similar overall patterns, albeit with weaker associations compared to DIF and DDF. Such findings support the contention that interoceptive deficits are most strongly linked with deficits in identifying and describing emotions [79]. The observed associations between interoceptive self-report scales and EOT were either small in magnitude or not significant (BPQ-BA, BPQ-R-Sub, IATS, MAIA-NW). Unlike DIF and DDF, which explicitly pertain to emotions, EOT specifically represents a cognitive mode of thinking and appears a distinct factor in alexithymia, which might better reflect cognitive deficits in attending to emotionally relevant stimuli [3] rather than interoceptive sensations.

Key differences in interoceptive self-report scales

Distinctions between adaptive and maladaptive interoceptive attentional dispositions have been identified using existing measures (i.e., BPQ, MAIA), reflecting maladaptive and adaptive attentional styles [11]. Trevisan et al. [25] quantified these distinctions through meta-analysis and subsequently linked adaptive and maladaptive interoceptive attention to clinical outcomes, including somatisation and alexithymia [12]. Alexithymia, characterised as a marker of atypical interoception [41], therefore serves as a relevant construct for distinguishing between interoceptive self-report scales. In particular, the framework introduced by Desmedt et al. [31] provides a useful structure for classifying interoceptive self-report scales in accordance with four interoceptive factors: sensing, attention, interpretation, and memory.

As adaptive and maladaptive interoceptive processes may promote or hinder effective physiological regulation, maladaptive and adaptive perceptions of interoceptive sensing can be operationalised using existing self-reports. As with attention [11], differentiation is equally important for discerning whether individuals can accurately detect, localise, and discriminate between sensations in ways that support or hinder the maintenance of bodily functioning. With respect to maladaptive interoceptive accuracy, which may impede bodily regulation due to confusion with and poor discrimination of bodily signals, the ICQ, ISQ, and EDI-IAw may serve as suitable measures of maladaptive interoceptive sensing, given their positive relationships with global alexithymia, DIF and DDF, alongside weak associations with adaptive interoceptive scales [43, 65].

Within the suite of self-report scales, adaptive interoceptive sensing is proposed to be encompassed by several measures. Although the IAS has been described as capturing neither adaptive nor maladaptive accuracy [12], our evidence indicates that heightened perceived accuracy in detecting various interoceptive sensations, as indicated by high IAS scores, may mitigate physiological dysregulation that is observed in alexithymia [7]. Accordingly, the IAS could serve as a measure of adaptive interoceptive sensing. Moreover, MAIA-Noticing could also be classified as a measure of adaptive sensing, following the observed associations with alexithymic outcomes. We acknowledge that this reclassification deviates from the scale's traditional classification as a measure of interoceptive attention [e.g., 11, 12, 102]. However, items reflect the basic, non-emotive detection of interoceptive sensations without necessarily attributing meaning or significance to them, nor explicitly engaging attentional mechanisms.

Additionally, the BAQ potentially captures adaptive interoceptive sensing, as items are heavily weighted toward the accurate detection and discrimination of bodily sensations and states. Accurate sensing is imperative for adaptivity, efficient physiological regulation, and wellbeing [12, 13]. BAQ items arguably represent the inverse of poorer capacities measured by ICQ, ISQ, and EDI-IAw—measures involving confusion and interoceptive inaccuracy beliefs, which may propagate chronic physiological dysregulation. Moreover, the prediction of body reactions to internal and external factors (e.g., energy levels, illness) is also assessed [26, 36]. This possibly involves interoceptive memory, as memory of information about factors that have previously affected physiological regulation forms a constituent in predictive models of interoception [13], involving consolidation and encoding of past experiences to inform anticipation of future physiological responses. We recognise that these classifications stand in contrast to the authors' characterisation of the measure as involving self-reported attentiveness to normal non-emotional body processes [36]. Such subjective beliefs may implicitly involve attentional processes, but arguably represent distinct processes. Moreover, although speculated to tap into somatisation [12], previous findings indicate moderate associations between the BAQ and adaptive interoceptive processes captured by the MAIA [26, 32, 38, 39]. Meta-analysis showed negative overall correlations between total BAQ scores and alexithymia in non-clinical student samples. Despite the omission of the Ricciardi et al. [72] finding in a pooled sample of controls and FMD patients, hypotheses regarding the maintenance of functional neurological symptoms suggest a role for somatisation [103]. They reported that FMD patients had significantly lower BAQ scores compared to controls. If the BAQ was assessing maladaptive interoception, high BAQ scores and positive associations with alexithymia would be plausible in this clinical sample. Considering previous evidence and limited data, we speculate that the BAQ scales measure both adaptive interoceptive sensing and memory.

The THISQ, a relatively new interoceptive scale, demonstrated overall weak associations with alexithymic facets; yet, shows mostly moderate correlations with other measures of adaptive non-emotive sensing, including the BAQ and MAIA-Noticing [45]. It is therefore proposed that the THISQ is potentially a measure of adaptive interoceptive sensing of sensations at rest (e.g., typical breathing) and following exertion (e.g., dyspnea).

The present evidence further supports previous assertions regarding the role of MAIA factors in facilitating adaptive attentional processes centred in interoceptive processing [11, 12]. Salient aspects assessable via self-report include not-distracting (MAIA-ND), attention regulation (MAIA-AR), and self-regulation (MAIA-SR). Together, these facets involve a lack of ignoring and acceptance of noxious, uncomfortable sensations, attentional control toward bodily sensations, and regulation of distress through attentional control. These mechanisms are inversely related to alexithymia, underscoring the importance of adaptive interoceptive attentional and regulatory beliefs and mechanisms for emotion identification and articulation.

In concordance with the observed lack of association with alexithymia, we cannot conclusively suggest employment of the BPQ-BA scale, despite previous recommendations [28, 40] and its description as a key measure of maladaptive interoceptive attention [12]. Although limited findings were presented for the IATS [66], the measure was specifically developed to capture subjective interoceptive attention, and may tap into aspects of bodily hypervigilance and homeostatic disturbance based on observed relationships with alexithymia. This is supported by recent experience-sampling findings indicating that higher IATS scores in daily life are associated with more negative valence and fatigue [104]. Whilst IATS and BPQ-BA scores are positively related [42, 66], IATS items are phrased to gauge whether attention is focused on various interoceptive sensations most of the time. In contrast to BPQ-BA, the IATS does not demonstrate ambiguity nor bias toward negative appraisals for uncomfortable sensations [79]. Therefore, high IATS scores may provide more appropriate indications of hypervigilance and maladaptive attention toward interoceptive sensations.

Although a maladaptive interoceptive attention style has been described as encompassing hypervigilance and somatisation [11, 12], there is value in distinguishing maladaptive, negatively biased interpretation from attention, which may be separate, albeit related constructs [17, 31]. Relative to BPQ-BA, BPQ-Reactivity is less frequently employed in studies examining self-reported interoception and alexithymia and within broader interoceptive research [26]. However, it merits consideration where researchers seek to operationalise maladaptive interpretation of interoceptive sensations. This proposal is supported by stronger positive correlations for BPQ-R scales with global alexithymia, DIF, and DDF, such that heightened autonomic nervous system reactivity, expressed through perceptions of symptomatology, covary with alexithymia—particularly in impaired identification and expression of feelings. These propensities may perpetuate somatosensory amplification, heightened sympathetic 'fight-or-flight' responses, and stress reactivity [33, 68], potentially rendering some individuals unable to differentiate bodily sensations as distinctly representative of emotion states from symptoms necessitating medical attention.

Whilst limited findings were presented for the SAQ [37], positive relationships were observed with alexithymia. The SAQ assesses negative feelings propensity [26], based on heightened perceptions of experiencing uncomfortable, noxious, and symptomatic bodily sensations, which relates to stronger illness anxiety beliefs. It is tenable that this scale taps into negatively biased evaluations of sensations, given that greater endorsement is reflective of heightened sympathetic 'fight-or-flight' responses [105] which constitutes a key component of anxiety and somatic symptom disorder [17]. Together, BPQ-Reactivity and SAQ may reflect tendencies toward maladaptive, negative categorisation and interpretation of internal signals [31], predisposing individuals to indiscriminately generalise sensations within vague, negatively valenced terms, thereby contributing to greater difficulties with granular identification and articulation of emotions. Such tendencies could propagate interpretations of benign or ambiguous sensations as threatening [17] or indicative of illness, particularly when accompanied by maladaptive interoceptive attention propensities.

Following recent proposals [31] and the multidimensional framework of the original measure [34], we suggest that adaptive interoceptive interpretation in the context of alexithymia involves subdomains assessable by MAIA scales. This domain encompasses positive, non-judgemental appraisals of internal bodily sensations, including emotional interpretations. Considering the present findings and theoretical proposals, adaptive interpretation of interoceptive sensations seems underpinned by interoceptive trusting (MAIA-Trusting) not-worrying (MAIA-NW), emotional awareness (MAIA-EA), and body listening (MAIA-BL). Such aspects constitute interpretational factors, tacitly involving beliefs which may modify perceptions of bodily sensations [31, 34]. Recognising that emotions have a physical component (MAIA-EA) is arguably reflective of an interoceptive belief, whereas actively listening to the body for insight (MAIA-BL) involves attributing meaning to internal bodily signals to inform emotional experiences and decision-making. Moreover, the tendency to not categorise noxious and uncomfortable sensations as worrying or distressing (MAIA-NW) reflects an interpretational style. Additionally, perceptions that enable regarding the body as safe (MAIA-Trusting) reflect positive attitudes regarding internal signals [34]. Collectively, such interpretations may promote the enactment of adaptive behaviours aimed at addressing the perceived state of the body.

Interoceptive constructs and measurement

The systematic review findings indicate there is consistent use of the term 'interoceptive sensibility', as defined by Garfinkel et al. [28], in studies concurrently examining alexithymia. Use of this term coincided with inconsistent employment of measures to operationalise the construct. This supports observations regarding tendencies for researchers to assign any interoceptive self-report scale to this term [26, 31]. However, frequent use of 'interoceptive awareness' was also noted. Review of how this construct was defined in investigations indicated the persistence of conflicting and competing definitions in the literature. Some studies administered the MAIA, drawing on Mehling et al.'s [34, 35] conceptualisation of the construct. Mehling et al. [35] noted that 'interoceptive awareness', defined by Garfinkel et al. [28], is reductionistic and proposed it should entail "the conscious level of interoception with its multiple dimensions potentially accessible to self-report" (p. 2). Whilst this definition acknowledges the breadth of consciously accessible dimensions, it is descriptive and similarly constitutes an umbrella term. Alternative frameworks have been proposed since this time, which are more precise in dimension delineation and definitions [17, 27, 31]. A parallel emerging trend toward utilising more specific terms (i.e., 'self-reported interoceptive attention and accuracy [27]) was also identified, whereby greater consistency in operationalisation was observed. This hopefully reflects increasing recognition of the importance of construct-measurement convergence in interoceptive research.

Implications

Recent theoretical proposals have suggested conceptualising interoception hierarchically [17] and to differentiate constructs at different levels of specificity [31]. Considering the present evidence, we advocate for greater precision in specifying the measured interoceptive construct, according to self-report, echoing the need for clearer terminology to enhance convergence between measures and improve generalisability, validity, and replicability of findings. For investigating self-reported maladaptive interoceptive sensing, we recommend the use of the ICQ, ISQ, and EDI-IAw, while the IAS BAQ, MAIA-Noticing, and THISQ are suitable for assessing adaptive interoceptive sensing beliefs. The IATS is proposed for assessing maladaptive attentional tendencies, whereas adaptive attentional processes can be measured through MAIA scales such ND, AR, and SR. For maladaptive interoceptive interpretation, BPQ-Reactivity and SAQ are appropriate, reflecting negatively biased processing of unpleasant sensations. Conversely, adaptive interoceptive interpretation can be assessed using NW, EA, BL, and Trusting MAIA scales. Moreover, it is proposed that certain BAQ items (i.e., from 'Predict Body Reactions', 'Onset of Illness' subscales) may assess adaptive interoceptive memory. However, further validation is needed to confirm whether the recommended self-reports effectively capture these domains, particularly in clinical samples. Future research should test the construct validity of the proposed framework to establish whether adaptive and maladaptive interoception represent second-order constructs influencing sensing, attention, interpretation, and memory, assessed by these interoceptive measures. The meta-analytic findings suggest that the questionnaires capture distinct beliefs of sensing, attention, and interpretation, and should not be uniformly applied to multiple questionnaires. Echoing the advice of Desmedt et al. [31], we recommend adopting a conservative approach, assuming that these measures assess different constructs until convergent evidence is established.

The included studies predominantly focused on global alexithymia; however, the multifaceted nature of alexithymia was evident in the present findings. Interoceptive self-reports showed stronger associations with DIF and DDF compared to EOT. Researchers are therefore encouraged to consider alexithymic facets as separate outcomes when investigating these constructs.

This approach could provide further insights into which interoceptive schemas are associated with difficulties appraising emotions and whether self-reported interoceptive sensing, attention, interpretation, and memory impact on externally directed attention styles.

Issues concerning construct measurement were also identified during the review, particularly concerning computation of MAIA-Total scores [56, 60, 61, 64, 73, 75, 76, 79]—variably conceptualised as representing global interoceptive sensibility [32] or adaptive interoception [26]. Mehling and colleagues [34] observed poor fit for a single-factor model and discouraged calculation of summary scores. However, recent evidence indicates the existence of a general MAIA factor, supporting computation of a summary score to index global adaptive interoception. This score should consist of Noticing, AR, EA, SR, BL, and Trusting scales [26, 32, 38]. Despite this, no recent studies computing MAIA-Total reported omission of ND and NW scales from calculation. This is problematic, as these scales have demonstrated heterogeneity relative to the other six [26, 32, 38]. It is recommended to exclude ND and NW from computation when analysing MAIA-Total scores to ensure clearer interpretation of overall effects.

Although the current findings primarily concerned non-clinical samples, they are of clinical relevance, considering that interoceptive and emotional dysfunctions underlie various disorders [106]. There is emerging consideration of interoception in targeted mind-body therapeutic interventions that enable reframing interoceptive interpretations and regulation of autonomic reactivity [107]. However, alexithymic traits, such as DIF and DDF, can significantly influence treatment outcomes following intervention for psychiatric disorders [46]. Overall, our meta-analyses indicated that these alexithymic traits coincide with perceived dysfunctional, maladaptive interoceptive schemas—findings supported by evidence for convergence of these constructs [67]. Accordingly, assessing interoception and alexithymia through self-report scales seems beneficial. This approach would inform holistic case conceptualisations, providing insights into an individual's interoceptive and emotional awareness. Measuring interoception and alexithymia may facilitate the delivery of therapies aimed at strengthening adaptive interoceptive beliefs, which could enhance capacities for identifying and articulating emotions. In turn, improvement of interoceptive beliefs and emotional skills could bolster adaptation to dynamic environmental stressors and challenges.

Limitations

Firstly, we recognise the susceptibility of self-report scales to biased responses. However, self-reports remain invaluable for assessing subjective experiences, as people vastly vary in their perception and communication of physiological and emotional feelings [95, 108]. Therefore, we deemed it meaningful to review relationships between various self-reports and alexithymia. This is supported by recent calls for clarification of key differences in interoceptive self-report scales [12] which provides useful indication of clinical status when compared to behavioural indicators [18]. The proposed framework serves as a singular suggestion for enhancing construct-measurement convergence. This may provide a foundation for future investigations regarding alternative classification methods concerning the constructs measured by interoceptive self-reports, such as the valence of included sensations. The aim of such endeavours, however, remains consistent: reducing discrepancies in interoceptive domain definitions and their corresponding measurements. We also acknowledge that aspects of inter-rater reliability (see S2 File) were suboptimal—particularly for the title and abstract screening phase. As such, replicability of this phase could be problematic. Moreover, for the extraction phase, whilst percentage agreement suggested a high level of reliability, our reliance on percentage alone could overestimate true reliability. Various measures were noted as administered more frequently (e.g., TAS-20 cf. PAQ; MAIA cf. BAQ). Disparities in the studies included in meta-analyses may have influenced our results. Therefore, some caution should be exercised when interpreting these findings. Moreover, high heterogeneity was observed in several analyses, particularly with the ICQ, which lacks robust psychometric properties and formal validation [41]. This complicated interpretation of the meta-analytic findings, subsequently affecting confidence in the pooled estimated correlations. Despite efforts to conduct pre-registered subgroup analyses according to alexithymic scale, clinical status, and regional location of samples, many analyses were underpowered. Although interesting and significant differences according to geographic variability were identified in our secondary meta-analyses, overall, the smaller sample sizes in certain subgroups (PAQ, BVAQ, clinical, Australasia, North America, and Asia) potentially limited our ability to detect significant subgroup differences. Consequently, conclusively determining whether these factors impact the relationship between self-reported interoception and alexithymia was hindered. Clarifying these influences therefore remains an important pursuit. Lastly, we acknowledge factors affecting inclusion of potentially eligible studies and effects. We did not contact authors of eligible articles for unreported effects, due to previous poor response rates [49, 50]. Moreover, although 'interoceptive awareness' was commonly investigated across articles, this was identified during data extraction. Ideally, this construct would have been included in search terms across databases. As such, eligible articles were likely not identified, and relevant effects excluded.

Conclusion

This study systematically reviewed and meta-analysed the relationship between specific interoceptive self-report scales and distinct aspects of alexithymia. Findings revealed inconsistencies in the conceptualisation and operationalisation of subjective interoceptive constructs across studies using self-report measures of interoception and alexithymia, suggesting a need for more precise terminology. These observations are corroborated by meta-analyses demonstrating that the relationship between self-reported interoception and alexithymia differs as a function of the interoceptive construct measured by self-report. We found that questionnaires proposed to assess maladaptive forms of interoceptive sensing (ICQ, ISQ, EDI-IAw), attention (IATS), and interpretation (BPQ-Reactivity, SAQ) were positively associated with alexithymia, while scales purportedly measuring adaptive aspects of sensing (IAS, BAQ, MAIA-Noticing, THISQ), attention (MAIA-ND, MAIA-AR, MAIA-SR), interpretation (MAIA-NW, MAIA-EA, MAIA-BL, MAIA-Trusting), and memory (BAQ) had overall negative associations. As such, these interoceptive constructs either reinforce or reduce alexithymia—namely DIF and DDF facets. This study highlights that specificity and precision in labelling and measuring interoceptive constructs is an essential first step towards addressing discrepancies in interoceptive construct definitions and accompanying measurements. Researchers and clinicians are therefore encouraged to employ suitable questionnaires to measure specific interoceptive constructs. Self-reported interoceptive deficits are a highly relevant feature of alexithymia and deserve consideration as a contributing factor to mental and physical disorders. Accordingly, assessment of self-reported interoception and alexithymia at global and facet levels is suggested. Therapeutically targeting interoceptive mechanisms may improve emotional awareness and articulation capacities, enhance mind-body connections, and improve treatment outcomes for patients.

Supporting information

S1 File. PRISMA 2020 checklist.
(DOCX)

S2 File. Inter-rater reliability.
(DOCX)

S3 File. Risk of bias assessment.
(DOCX)

S4 File. Characteristics of included studies.
(DOCX)

S5 File. Interoceptive self-report scales employed in included studies.
(DOCX)

S6 File. Sample characteristics and extracted correlations of each independent sample within included studies employing interoceptive self-report scales to examine their relationship with global alexithymia.
(DOCX)

S7 File. Sample characteristics and extracted correlations of each independent sample within included studies employing interoceptive self-report scales to examine their relationship with DIF.
(DOCX)

S8 File. Sample characteristics and extracted correlations of each independent sample within included studies employing interoceptive self-report scales to examine their relationship with DDF.
(DOCX)

S9 File. Sample characteristics and extracted correlations of each independent sample within included studies employing interoceptive self-report scales to examine their relationship with EOT.
(DOCX)

S10 File. Covidence export of screened articles.
(PDF)

Author Contributions

Conceptualization: Kristen Van Bael, Jessica Scarfo, Emra Suleyman, Michelle Ball.

Data curation: Kristen Van Bael, Jessica Katherveloo, Natasha Grimble.

Formal analysis: Kristen Van Bael.

Investigation: Kristen Van Bael, Jessica Katherveloo, Natasha Grimble.

Methodology: Kristen Van Bael.

Project administration: Kristen Van Bael.

Supervision: Jessica Scarfo, Emra Suleyman, Michelle Ball.

Validation: Kristen Van Bael.

Visualization: Kristen Van Bael.

Writing – original draft: Kristen Van Bael.

Writing – review & editing: Kristen Van Bael, Jessica Scarfo, Emra Suleyman, Michelle Ball.

References

1. Sifneos PE. The prevalence of "alexithymic" characteristics in psychosomatic patients. Psychotherapy and Psychosomatics. 1973; 22(2–6):255–62. https://doi.org/10.1159/000286529 PMID: 4770536
2. Taylor GJ, Bagby RM, Parker JDA. The alexithymia construct: a potential paradigm for psychosomatic medicine. Psychosomatics. 1991; 32(2):153–64.
3. Preece D, Becerra R, Allan A, Robinson K, Dandy J. Establishing the theoretical components of alexithymia via factor analysis: Introduction and validation of the attention-appraisal model of alexithymia. Personality and individual differences. 2017; 119:341–52.
4. Porcelli P, Taylor GJ. Alexithymia and physical illness: A psychosomatic approach. Alexithymia: Advances in research, theory, and clinical practice. New York, NY: Cambridge University Press; 2018. p. 105–26.
5. Preece DA, Mehta A, Petrova K, Sikka P, Bjureberg J, Becerra R, et al. Alexithymia and emotion regulation. Journal of affective disorders. 2023; 324:232–8. https://doi.org/10.1016/j.jad.2022.12.065 PMID: 36566943
6. Panayiotou G, Panteli M, Vlemincx E. Adaptive and maladaptive emotion processing and regulation, and the case of alexithymia. Cognition & Emotion. 2021; 35(3):488–99. https://doi.org/10.1080/02699931.2019.1671322 PMID: 31556808
7. Panayiotou G, Panteli M, Vlemincx E. Processing emotions in alexithymia: A systematic review of physiological markers. Alexithymia: Advances in research, theory, and clinical practice. New York, NY: Cambridge University Press; 2018. p. 291–320.
8. Brewer R, Happé F, Cook R, Bird G. Commentary on "Autism, oxytocin and interoception": Alexithymia, not Autism Spectrum Disorders, is the consequence of interoceptive failure. Neuroscience & Biobehavioral Reviews. 2015; 56:348–53.
9. Khalsa SS, Adolphs R, Cameron OG, Critchley HD, Davenport PW, Feinstein JS, et al. Interoception and mental health: a roadmap. Biological psychiatry: cognitive neuroscience and neuroimaging. 2018; 3(6):501–13. https://doi.org/10.1016/j.bpsc.2017.12.004 PMID: 29884281
10. Craig AD. How do you feel? Interoception: the sense of the physiological condition of the body. Nature reviews neuroscience. 2002; 3(8):655–66. https://doi.org/10.1038/nrn894 PMID: 12154366
11. Mehling W. Differentiating attention styles and regulatory aspects of self-reported interoceptive sensibility. Philosophical Transactions of the Royal Society B: Biological Sciences. 2016; 371(1708):20160013. https://doi.org/10.1098/rstb.2016.0013 PMID: 28080970
12. Trevisan DA, Mehling WE, McPartland JC. Adaptive and Maladaptive Bodily Awareness: Distinguishing Interoceptive Sensibility and Interoceptive Attention from Anxiety-Induced Somatization in Autism and Alexithymia. Autism Res. 2021; 14(2):240–7. Epub 20201218. https://doi.org/10.1002/aur.2458 PMID: 33336935.
13. Barrett LF, Quigley KS, Hamilton P. An active inference theory of allostasis and interoception in depression. Philosophical Transactions of the Royal Society B: Biological Sciences. 2016; 371(1708):20160011. https://doi.org/10.1098/rstb.2016.0011 PMID: 28080969
14. Van Bael K, Ball M, Scarfo J, Suleyman E. Assessment of the mind-body connection: preliminary psychometric evidence for a new self-report questionnaire. BMC Psychology. 2023; 11(1):309. https://doi.org/10.1186/s40359-023-01302-3 PMID: 37803484
15. Craig AD. A new view of pain as a homeostatic emotion. Trends in Neurosciences. 2003; 26(6):303–7. https://doi.org/10.1016/s0166-2236(03)00123-1 PMID: 12798599
16. Mehling WE, Gopisetty V, Daubenmier J, Price CJ, Hecht FM, Stewart A. Body Awareness: Construct and Self-Report Measures. PLoS ONE. 2009; 4(5):1–18. https://doi.org/10.1371/journal.pone.0005614 PMID: 19440300
17. Suksasilp C, Garfinkel SN. Towards a comprehensive assessment of interoception in a multi-dimensional framework. Biological Psychology. 2022; 168:108262. https://doi.org/10.1016/j.biopsycho.2022.108262 PMID: 35026353
18. Desmedt O, Van Den Houte M, Walentynowicz M, Dekeyser S, Luminet O, Corneille O. How does heartbeat counting task performance relate to theoretically-relevant mental health outcomes? A meta-analysis. Collabra: Psychology. 2022; 8(1):33271.
19. Paulus MP, Stein MB. Interoception in anxiety and depression. Brain structure and Function. 2010; 214:451–63. https://doi.org/10.1007/s00429-010-0258-9 PMID: 20490545
20. Garfinkel SN, Tiley C, O'Keeffe S, Harrison NA, Seth AK, Critchley HD. Discrepancies between dimensions of interoception in autism: Implications for emotion and anxiety. Biological psychology. 2016; 114:117–26. https://doi.org/10.1016/j.biopsycho.2015.12.003 PMID: 26724504

21. Perry TR, Wierenga CE, Kaye WH, Brown TA. Interoceptive awareness and suicidal ideation in a clinical eating disorder sample: the role of body trust. Behavior therapy. 2021; 52(5):1105–13. https://doi.org/10.1016/j.beth.2020.12.001 PMID: 34452665
22. Pollatos O, Herbert BM. Alexithymia and body awareness. Alexithymia: Advances in research, theory, and clinical practice. New York, NY, US: Cambridge University Press; 2018. p. 321–33.
23. Okur Güney ZE, Sattel H, Witthöft M, Henningsen P. Emotion regulation in patients with somatic symptom and related disorders: A systematic review. PloS one. 2019; 14(6):e0217277. https://doi.org/10.1371/journal.pone.0217277 PMID: 31173599
24. Wolters C, Gerlach AL, Pohl A. Interoceptive accuracy and bias in somatic symptom disorder, illness anxiety disorder, and functional syndromes: A systematic review and meta-analysis. Plos one. 2022; 17(8):e0271717. https://doi.org/10.1371/journal.pone.0271717 PMID: 35980959
25. Trevisan DA, Altschuler MR, Bagdasarov A, Carlos C, Duan S, Hamo E, et al. A meta-analysis on the relationship between interoceptive awareness and alexithymia: Distinguishing interoceptive accuracy and sensibility. J Abnorm Psychol. 2019; 128(8):765–76. Epub 20190805. https://doi.org/10.1037/abn0000454 PMID: 31380655.
26. Desmedt O, Heeren A, Corneille O, Luminet O. What do measures of self-report interoception measure? Insights from a systematic review, latent factor analysis, and network approach. Biological Psychology. 2022; 169:108289. https://doi.org/10.1016/j.biopsycho.2022.108289 PMID: 35150768
27. Murphy J, Catmur C, Bird G. Classifying individual differences in interoception: Implications for the measurement of interoceptive awareness. Psychonomic bulletin & review. 2019; 26:1467–71. https://doi.org/10.3758/s13423-019-01632-7 PMID: 31270764
28. Garfinkel SN, Seth AK, Barrett AB, Suzuki K, Critchley HD. Knowing your own heart: distinguishing interoceptive accuracy from interoceptive awareness. Biological psychology. 2015; 104:65–74. https://doi.org/10.1016/j.biopsycho.2014.11.004 PMID: 25451381
29. Porges S W. Body Perception Questionnaire. Laboratory of Developmental Assessment, University of Maryland.1993.
30. Pollatos O, Herbert BM. Interoception: Definitions, dimensions, neural substrates. Embodiment in psychotherapy: A practitioner's guide. 2018:15–27.
31. Desmedt O, Luminet O, Maurage P, Corneille O. Discrepancies in the Definition and Measurement of Human Interoception: A Comprehensive Discussion and Suggested Ways Forward. Perspectives on Psychological Science. 2023:17456916231191537. https://doi.org/10.1177/17456916231191537 PMID: 37642084
32. Todd J, Swami V, Aspell JE, Furnham A, Horne G, Stieger S. Are some interoceptive sensibility components more central than others? Using item pool visualisation to understand the psychometric representation of interoception. Plos one. 2022; 17(12):e0277894. https://doi.org/10.1371/journal.pone.0277894 PMID: 36455037
33. Cabrera A, Kolacz J, Pailhez G, Bulbena-Cabre A, Bulbena A, Porges SW. Assessing body awareness and autonomic reactivity: Factor structure and psychometric properties of the Body Perception Questionnaire-Short Form (BPQ-SF). International journal of methods in psychiatric research. 2018; 27(2):e1596. https://doi.org/10.1002/mpr.1596 PMID: 29193423
34. Mehling WE, Price C, Daubenmier JJ, Acree M, Bartmess E, Stewart A. The multidimensional assessment of interoceptive awareness (MAIA). PloS one. 2012; 7(11):e48230. https://doi.org/10.1371/journal.pone.0048230 PMID: 23133619
35. Mehling WE, Acree M, Stewart A, Silas J, Jones A. The multidimensional assessment of interoceptive awareness, version 2 (MAIA-2). PloS one. 2018; 13(12):e0208034. https://doi.org/10.1371/journal.pone.0208034 PMID: 30513087
36. Shields SA, Mallory ME, Simon A. The body awareness questionnaire: reliability and validity. Journal of personality Assessment. 1989; 53(4):802–15.
37. Longarzo MD'Olimpio F, Chiavazzo A, Santangelo G, Trojano L, Grossi D. The relationships between interoception and alexithymic trait. The Self-Awareness Questionnaire in healthy subjects. Frontiers in psychology. 2015; 6:1149. https://doi.org/10.3389/fpsyg.2015.01149 PMID: 26300829
38. Ferentzi E, Olaru G, Geiger M, Vig L, Köteles F, Wilhelm O. Examining the factor structure and validity of the multidimensional assessment of interoceptive awareness. Journal of Personality Assessment. 2021; 103(5):675–84. https://doi.org/10.1080/00223891.2020.1813147 PMID: 32955947
39. Vig L, Köteles F, Ferentzi E. Questionnaires of interoception do not assess the same construct. Plos one. 2022; 17(8):e0273299. https://doi.org/10.1371/journal.pone.0273299 PMID: 35998182
40. Murphy J, Brewer R, Plans D, Khalsa SS, Catmur C, Bird G. Testing the independence of self-reported interoceptive accuracy and attention. Quarterly Journal of Experimental Psychology. 2020; 73(1):115–33. https://doi.org/10.1177/1747021819879826 PMID: 31519137

41. Brewer R, Cook R, Bird G. Alexithymia: a general deficit of interoception. Royal Society open science. 2016; 3(10):150664. https://doi.org/10.1098/rsos.150664 PMID: 27853532

42. Gabriele E, Spooner R, Brewer R, Murphy J. Dissociations between self-reported interoceptive accuracy and attention: Evidence from the Interoceptive Attention Scale. Biological psychology. 2022; 168:108243. https://doi.org/10.1016/j.biopsycho.2021.108243 PMID: 34929353

43. Fiene L, Ireland MJ, Brownlow C. The Interoception Sensory Questionnaire (ISQ): A scale to measure interoceptive challenges in adults. Journal of Autism and Developmental Disorders. 2018; 48 (10):3354–66. https://doi.org/10.1007/s10803-018-3600-3 PMID: 29748924

44. Bogaerts K, Walentynowicz M, Van Den Houte M, Constantinou E, Van den Bergh O. The Interoceptive Sensitivity and Attention Questionnaire: Evaluating aspects of self-reported interoception in patients with persistent somatic symptoms, stress-related syndromes, and healthy controls. Psychosomatic medicine. 2022; 84(2):251–60. https://doi.org/10.1097/PSY.0000000000001038 PMID: 34840287

45. Vlemincx E, Walentynowicz M, Zamariola G, Van Oudenhove L, Luminet O. A novel self-report scale of interoception: the three-domain interoceptive sensations questionnaire (THISQ). Psychology & Health. 2021:1–20. https://doi.org/10.1080/08870446.2021.2009479 PMID: 34875958

46. Pinna F, Manchia M, Paribello P, Carpiniello B. The impact of alexithymia on treatment response in psychiatric disorders: a systematic review. Frontiers in Psychiatry. 2020; 11:311. https://doi.org/10.3389/fpsyt.2020.00311 PMID: 32372987

47. Fournier A, Luminet O, Dambrun M, Dutheil F, Pellissier S, Mondillon L. Importance of considering interoceptive abilities in alexithymia assessment. PeerJ. 2019; 7:e7615. https://doi.org/10.7717/peerj.7615 PMID: 31768300

48. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. International journal of surgery. 2021; 88:105906. https://doi.org/10.1016/j.ijsu.2021.105906 PMID: 33789826

49. Prentice F, Murphy J. Sex differences in interoceptive accuracy: A meta-analysis. Neuroscience and Biobehavioral Reviews. 2022; 132:497–518. https://doi.org/10.1016/j.neubiorev.2021.11.030 PMID: 34838927

50. Robinson E, Foote G, Smith J, Higgs S, Jones A. Interoception and obesity: a systematic review and meta-analysis of the relationship between interoception and BMI. International Journal of Obesity. 2021; 45(12):2515. https://doi.org/10.1038/s41366-021-00950-y PMID: 34480102

51. Dettori JR, Norvell DC, Chapman JR. Fixed-Effect vs Random-Effects Models for Meta-Analysis: 3 Points to Consider. Global spine journal. England: SAGE Publications; 2022. p. 1624–6. https://doi.org/10.1177/21925682221110527 PMID: 35723546

52. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd Edition ed. New York: Routledge; 1988.

53. Ryder AG, Sunohara M, Dere J, Chentsova-Dutton YE. The cultural shaping of alexithymia. Alexithymia: Advances in research, theory, and clinical practice. New York, NY, US: Cambridge University Press; 2018. p. 33–48.

54. Ma-Kellams C. Cross-cultural differences in somatic awareness and interoceptive accuracy: A review of the literature and directions for future research. Frontiers in Psychology. 2014; 5(DEC). https://doi.org/10.3389/fpsyg.2014.01379 PMID: 25520688

55. Cuschieri S. The STROBE guidelines. Saudi journal of anaesthesia. 2019; 13(Suppl 1):S31. https://doi.org/10.4103/sja.SJA_543_18 PMID: 30930717

56. Gaggero G, Dellantonio S, Pastore L, Sng KHL, Esposito G. Shared and unique interoceptive deficits in high alexithymia and neuroticism. Plos one. 2022; 17(8):e0273922. https://doi.org/10.1371/journal.pone.0273922 PMID: 36044535

57. Taylor GJ, Parker JDA, Bagby RM, Bourke MP. Relationships between alexithymia and psychological characteristics associated with eating disorders. Journal of Psychosomatic research. 1996; 41 (6):561–8. https://doi.org/10.1016/s0022-3999(96)00224-3 PMID: 9032719

58. Bonete S, Molinero C, Ruisanchez D. Emotional Dysfunction and Interoceptive Challenges in Adults with Autism Spectrum Disorders. Behavioral Sciences. 2023; 13(4):312. https://doi.org/10.3390/bs13040312 PMID: 37102826

59. Hassen NB, Molins F, Garrote-Petisco D, Serrano MÁ. Emotional regulation deficits in autism spectrum disorder: The role of alexithymia and interoception. Research in Developmental Disabilities. 2023; 132:104378. https://doi.org/10.1016/j.ridd.2022.104378 PMID: 36410287

60. Lyvers M, Thorberg FA. Alexithymia and Alcohol Use: Evaluating the Role of Interoceptive Sensibility with the Revised Multidimensional Assessment of Interoceptive Awareness. Journal of

Psychopathology and Behavioral Assessment. 2023:1–13. https://doi.org/10.1007/s10862-023-10034-y PMID: 37361346

61. Sweetnam TJ, Flack M. Ready, set,. . . and difficultly slowing down: What role does alexithymia, emotional regulation and interoceptive awareness play in exercise dependence? Acta Psychologica. 2023; 237:103958.

62. Vinni E, Karaivazoglou K, Tourkochristou E, Tsounis E, Kalogeropoulou M, Konstantopoulou G, et al. Alexithymic characteristics and interoceptive abilities are associated with disease severity and levels of C-reactive protein and cytokines in patients with inflammatory bowel disease. Annals of Gastroenterology. 2023; 36(4):412. https://doi.org/10.20524/aog.2023.0813 PMID: 37396003

63. Zahid A, Taylor GJ, Lau SCL, Stone S, Bagby RM. Examining the Incremental Validity of the Perth Alexithymia Questionnaire (PAQ) Relative to the 20-Item Toronto Alexithymia Scale (TAS-20). Journal of Personality Assessment. 2023:1–12.

64. Morales C, Dolan SC, Anderson DA, Anderson LM, Reilly EE. Exploring the contributions of affective constructs and interoceptive awareness to feeling fat. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity. 2022; 27(8):3533–41. https://doi.org/10.1007/s40519-022-01490-8 PMID: 36261777

65. Brand S, Meis AC, Tünte MR, Murphy J, Woller JP, Jungmann S, et al. Bridging the Gap between Interoception and Mental Health: The German Validation of the Interoceptive Accuracy Scale (IAS) and its Relation to Psychopathological Symptom Burden in a Multicenter Study. 2022.

66. Tünte MR, Petzke T, Brand S, Murphy J, Witthöft M, Hoehl S, et al. He Who Seeks Finds (Bodily Signals): Differential Effects of Self-Reported Interoceptive Attention and Accuracy on Subclinical Psychopathology in a German-Speaking Sample. 2022.

67. Ventura-Bort C, Wendt J, Weymar M. The role of interoceptive sensibility and emotional conceptualization for the experience of emotions. Frontiers in psychology. 2021; 12:712418. https://doi.org/10.3389/fpsyg.2021.712418 PMID: 34867591

68. Ernst J, Böker H, Hättenschwiler J, Schüpbach D, Northoff G, Seifritz E, et al. The association of interoceptive awareness and alexithymia with neurotransmitter concentrations in insula and anterior cingulate. Social cognitive and affective neuroscience. 2014; 9(6):857–63. https://doi.org/10.1093/scan/nst058 PMID: 23596189

69. Pink AE, Williams C, Lee M, Young HA, Harrison S, Davies AE, et al. Manipulating the sensation of feeling fat: The role of alexithymia, interoceptive sensibility and perfectionism. Physiology & Behavior. 2021; 239:113501. https://doi.org/10.1016/j.physbeh.2021.113501 PMID: 34147510

70. Mul C-l Stagg SD, Herbelin B Aspell JE. The feeling of me feeling for you: Interoception, alexithymia and empathy in autism. Journal of Autism and Developmental Disorders. 2018; 48:2953–67. https://doi.org/10.1007/s10803-018-3564-3 PMID: 29644587

71. Schmitz N, Napieralski J, Schroeder D, Loeser J, Gerlach AL, Pohl A. Interoceptive sensibility, alexithymia, and emotion regulation in individuals suffering from fibromyalgia. Psychopathology. 2021; 54 (3):144–9. https://doi.org/10.1159/000513774 PMID: 33951648

72. Ricciardi L, Nisticò V, Andrenelli E, Cunha JM, Demartini B, Kirsch LP, et al. Exploring three levels of interoception in people with functional motor disorders. Parkinsonism & Related Disorders. 2021; 86:15–8. https://doi.org/10.1016/j.parkreldis.2021.03.029 PMID: 33819899

73. Da Costa Silva L, Belrose C, Trousselard M, Rea B, Seery E, Verdonk C, et al. Self-reported body awareness: validation of the Postural Awareness Scale and the Multidimensional Assessment of Interoceptive Awareness (version 2) in a non-clinical adult French-speaking sample. Frontiers in Psychology. 2022; 13:946271. https://doi.org/10.3389/fpsyg.2022.946271 PMID: 35959024

74. Edwards DJ, Lowe R. Associations between mental health, interoception, psychological flexibility, and self-as-context, as predictors for alexithymia: A deep artificial neural network approach. Frontiers in Psychology. 2021; 12:637802. https://doi.org/10.3389/fpsyg.2021.637802 PMID: 33868110

75. Ferraro IK, Taylor AM. Adult attachment styles and emotional regulation: The role of interoceptive awareness and alexithymia. Personality and Individual Differences. 2021; 173:110641.

76. Berenguer C, Rebôlo C, Costa RM. Interoceptive awareness, alexithymia, and sexual function. Journal of sex & marital therapy. 2019; 45(8):729–38. https://doi.org/10.1080/0092623X.2019.1610128 PMID: 31018783

77. Campos C, Rocha N, Barbosa F. Untangling self-reported interoceptive attention and accuracy: Evidence from the european portuguese validation of the body perception questionnaire and the interoceptive accuracy scale. 2021.

78. Dunn W, Brown C, Breitmeyer A, Salwei A. Construct validity of the sensory profile interoception scale: Measuring sensory processing in everyday life. Frontiers in Psychology. 2022; 13:872619. https://doi.org/10.3389/fpsyg.2022.872619 PMID: 35645873

79. Gaggero G, Bizzego A, Dellantonio S, Pastore L, Lim M, Esposito G. Clarifying the relationship between alexithymia and subjective interoception. PLoS One. 2021; 16(12):e0261126. https://doi.org/10.1371/journal.pone.0261126 PMID: 34898643

80. Zamariola G, Vlemincx E, Corneille O, Luminet O. Relationship between interoceptive accuracy, interoceptive sensibility, and alexithymia. Personality and Individual Differences. 2018; 125:14–20.

81. Betka S, Pfeifer G, Garfinkel S, Prins H, Bond R, Sequeira H, et al. How do self-assessment of alexithymia and sensitivity to bodily sensations relate to alcohol consumption? Alcoholism: Clinical and Experimental Research. 2018; 42(1):81–8. https://doi.org/10.1111/acer.13542 PMID: 29094768

82. Palser ER, Palmer CE, Galvez-Pol A, Hannah R, Fotopoulou A, Kilner JM. Alexithymia mediates the relationship between interoceptive sensibility and anxiety. PloS one. 2018; 13(9):e0203212. https://doi.org/10.1371/journal.pone.0203212 PMID: 30212484

83. Scarpazza C, Zangrossi A, Huang Y-C, Sartori G, Massaro S. Disentangling interoceptive abilities in alexithymia. Psychological research. 2022; 86(3):844–57. https://doi.org/10.1007/s00426-021-01538-x PMID: 34097132

84. Garner DM, Olmstead MP, Polivy J. Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. International journal of eating disorders. 1983; 2(2):15–34.

85. Jakobson LS, Rigby SN. Alexithymia and sensory processing sensitivity: Areas of overlap and links to sensory processing styles. Frontiers in Psychology. 2021; 12:583786. https://doi.org/10.3389/fpsyg.2021.583786 PMID: 34108902

86. Desdentado L, Miragall M, Llorens R, Baños RM. Disentangling the role of interoceptive sensibility in alexithymia, emotion dysregulation, and depression in healthy individuals. Current Psychology. 2022:1–13.

87. Huang Y-H, Yang C-M, Huang Y-C, Huang Y-T, Yen N-S. Do alexithymia and negative affect predict poor sleep quality? The moderating role of interoceptive sensibility. Plos one. 2022; 17(10):e0275359. https://doi.org/10.1371/journal.pone.0275359 PMID: 36191028

88. Vorst HCM, Bermond B. Validity and reliability of the Bermond–Vorst alexithymia questionnaire. Personality and individual differences. 2001; 30(3):413–34.

89. Preece D, Becerra R, Robinson K, Dandy J, Allan A. The psychometric assessment of alexithymia: Development and validation of the Perth Alexithymia Questionnaire. Personality and Individual Differences. 2018; 132:32–44.

90. Bagby RM, Taylor GJ, Parker JDA. The twenty-item Toronto Alexithymia Scale—II. Convergent, discriminant, and concurrent validity. Journal of psychosomatic research. 1994; 38(1):33–40. https://doi.org/10.1016/0022-3999(94)90006-x PMID: 8126688

91. Naho S, Tetsuya Y. The influence of interoceptive accuracy on the verbalization of emotions. Scientific Reports: Nature Portfolio; 2023. p. 1–13. https://doi.org/10.1038/s41598-023-49313-9 PMID: 38092823

92. Schulz A, Vögele C. Interoception and stress. Frontiers in psychology. 2015; 6:133987. https://doi.org/10.3389/fpsyg.2015.00993 PMID: 26257668

93. Lee D, Kim SJ, Cheon J, Hwang EH, Jung Y-c, Kang JI. Characteristics of autonomic activity and reactivity during rest and emotional processing and their clinical correlations in somatic symptom disorder. Psychosomatic Medicine. 2018; 80(8):690–7. https://doi.org/10.1097/PSY.0000000000000622 PMID: 29995000

94. Stern ER, Grimaldi SJ, Muratore A, Murrough J, Leibu E, Fleysher L, et al. Neural correlates of interoception: Effects of interoceptive focus and relationship to dimensional measures of body awareness. Human Brain Mapping. 2017; 38(12):6068–82. https://doi.org/10.1002/hbm.23811 PMID: 28901713

95. MacCormack JK, Bonar AS, Lindquist KA. Interoceptive beliefs moderate the link between physiological and emotional arousal during an acute stressor. Emotion. 2024; 24(1):269–90. https://doi.org/10.1037/emo0001270 PMID: 37498725

96. Taylor GJ, Ryan D, Bagby M. Toward the development of a new self-report alexithymia scale. Psychotherapy and psychosomatics. 1985; 44(4):191–9. https://doi.org/10.1159/000287912 PMID: 3837277

97. Barrett LF. The theory of constructed emotion: an active inference account of interoception and categorization. Social cognitive and affective neuroscience. 2017; 12(1):1–23. https://doi.org/10.1093/scan/nsw154 PMID: 27798257

98. Schachter S, Singer J. Cognitive, social, and physiological determinants of emotional state. Psychological Review1962. p. 379–99. https://doi.org/10.1037/h0046234 PMID: 14497895

99. Lindquist KA. Emotions emerge from more basic psychological ingredients: A modern psychological constructionist model. Emotion Review. 2013; 5(4):356–68. https://doi.org/10.1177/1754073913489750

100. Hoemann K, Feldman Barrett L. Concepts dissolve artificial boundaries in the study of emotion and cognition, uniting body, brain, and mind. Cognition and emotion. 2019; 33(1):67–76. https://doi.org/10.1080/02699931.2018.1535428 PMID: 30336722

101. Luminet O, Nielson KA, Ridout N. Cognitive-emotional processing in alexithymia: an integrative review. Cognition & Emotion. 2021; 35(3):449–87. https://doi.org/10.1080/02699931.2021.1908231 PMID: 33787442

102. Trevisan DA, Tsheringla S, McPartland JC. On the relation between interoceptive attention and health anxiety: Distinguishing adaptive and maladaptive bodily awareness. Cogent Psychology. 2023; 10 (1):2262855. https://doi.org/10.1080/23311908.2023.2262855

103. Demartini B, Petrochilos P, Ricciardi L, Price G, Edwards MJ, Joyce E. The role of alexithymia in the development of functional motor symptoms (conversion disorder). Journal of Neurology, Neurosurgery & Psychiatry. 2014; 85(10):1132–7. https://doi.org/10.1136/jnnp-2013-307203 PMID: 24610939

104. Poerio GL, Klabunde M, Bird G, Murphy J. Interoceptive attention and mood in daily life: an experience-sampling study. Philosophical Transactions of the Royal Society B: Biological Sciences. 2024; 379(1908):20230256. https://doi.org/10.1098/rstb.2023.0256 PMID: 39005033

105. Kolacz J, Holmes L, Porges SW. Body Perception Questionnaire (BPQ) Manual. Bloomington, in. 2018.

106. Bonaz B, Lane RD, Oshinsky ML, Kenny PJ, Sinha R, Mayer EA, et al. Diseases, disorders, and comorbidities of interoception. Trends in neurosciences. 2021; 44(1):39–51. https://doi.org/10.1016/j.tins.2020.09.009 PMID: 33378656

107. Weng HY, Feldman JL, Leggio L, Napadow V, Park J, Price CJ. Interventions and manipulations of interoception. Trends in neurosciences. 2021; 44(1):52–62. https://doi.org/10.1016/j.tins.2020.09.010 PMID: 33378657

108. Barrett LF. Feelings or Words? Understanding the Content in Self-Report Ratings of Experienced Emotion. Journal of Personality and Social Psychology. 2004; 87(2):266–81. https://doi.org/10.1037/0022-3514.87.2.266 PMID: 15301632

Chapter 5. Assessment of the Mind-Body Connection: Preliminary Psychometric Evidence for a New Self-Report Questionnaire

Paper 2 addresses the limitations identified within existing interoceptive self-report questionnaires capturing the nexus between the mind and the body through development of a new self-report which assesses distinct but related psychological constituents of the mind-body connection. This study describes a preliminary evaluation of a parsimonious questionnaire, providing researchers and clinicians with the 13-item BMCQ, measuring interoceptive attentional control (Interoceptive Attention), capacities for identifying and describing emotions linked to sensations, in conjunction with a preference for an internal focus (Sensation-Emotion Articulation), and mind-body beliefs and initiated behaviours (Body-Mind Values). Correlational evidence demonstrates that the mind-body connection is a multidimensional construct, consisting of three salient psychological constituents: interoceptive attention, emotional identification and expression with internal focus, and mind-body beliefs. Moreover, the BMCQ extends upon questionnaires assessing aspects of subjective interoceptive attention and interpretation. This study provides a foundation for measuring the mind-body connection more holistically when compared to interoceptive self-report scales, as it unifies these constructs in the one self-report. Online supplemental materials accompanying the paper are provided at https://bmcpsychology.biomedcentral.com/articles/10.1186/s40359-023-01302-3 and in Appendix F.

Citations as at 25/01/2025: 2

Van Bael *et al. BMC Psychology* (2023) 11:309
https://doi.org/10.1186/s40359-023-01302-3

BMC Psychology

RESEARCH ARTICLE

Open Access

Assessment of the mind-body connection: preliminary psychometric evidence for a new self-report questionnaire

Kristen Van Bael[1*], Michelle Ball[1], Jessica Scarfo[1] and Emra Suleyman[1]

Abstract

Objectives While interoceptive self-report scales provide a foundation for measuring the mind-body connection, they variably consider other important factors that could influence interpretations of internal bodily sensations and perceptions related to mind-body integration. The proposed Body-Mind Connection Questionnaire (BMCQ) aimed to operationalise the notion that this construct involves three major components: (a) Interoceptive Attention, (b) Sensation-Emotion Articulation, and (c) Body-Mind Values.

Methods Following panel review and piloting with the target population, the developed BMCQ was evaluated in 316 participants (189 identifying as female) aged 18-50 (M_{Age}=30.78), alongside established self-report measures of interoceptive sensibility, body awareness, sensory processing sensitivity, and alexithymia. We examined the BMCQ factor structure through exploratory factor analysis and analysed convergent and discriminant validity.

Results Exploratory factor analysis supported three scales of the BMCQ, which explained 54.03% of variance. Factor loadings (>0.44) and reliability indices (0.74 to 0.85) were acceptable. Inter-scale correlations suggested that the scales are distinct but related (rs=0.38 to 0.59). BMCQ scales were supported by convergent (r=0.33 to 0.67) and discriminant evidence (rs=0.01 to 0.39, p range n.s. to <.05).

Conclusions Preliminary psychometric properties indicate that the BMCQ is multidimensional and consists of three constructs that differentially relate to theoretically associated measures. Interoceptive Attention, Sensation-Emotion Articulation, and Body-Mind Values may serve as a basis for efficiently assessing the mind-body connection more holistically, which could be useful for developing interventions aimed at enhancing mind-body integration.

Keywords Interoception, Emotion, Mind-body connection, Scale development, Reliability, Validity

Introduction

A popular view of the mind and body is that they exist as distinct and separable entities. While some may experience their mind as qualitatively different to their body, mind-body dualism is not biologically plausible. Major advancements in neuroscience indicate that cognition is embodied [45], where continual interactions between the environment and the individual's body and brain influence thoughts and feelings to facilitate situationally appropriate behaviour [6]. This recognition that the body and mind operate as a connected and integrated force has immense implications for physical and psychological health (e.g., [38, 43]).

Several processes emerge as exemplifying the mind-body connection, namely interoception and emotion. Interoception refers to the processes by which the

*Correspondence:
Kristen Van Bael
kristen.vanbael@live.vu.edu.au
[1] Institute for Health and Sport, Victoria University, Melbourne, Victoria, Australia

nervous system anticipates, senses, interprets, integrates, and regulates signals originating from the body across unconscious and conscious levels [55, 77]. By extension, emotions represent psychological states that involve subjective experiences, physiological responses, cognitions, and expressive behaviours [48] that are associated with motivational reorientation [30]. Influential theories posit that emotions arise from the capacity to sense changes from within the body (e.g., [28]). As such, interoception forms a core component of emotion [5] and facilitates adaptive behaviour driven by emotional experience [27, 30].

Despite a growing appreciation of these functions underlying the mind-body connection, existing self-report measures in this area vary in the degree to which emotional processes are captured. What appears omitted amongst them is the consideration of broader values regarding the mind-body connection, which may provide additional insights into the role of holistic health and wellbeing perspectives in physical and psychological outcomes. Considering these factors, a new self-report measure of the mind-body connection incorporating these notions was developed.

Interoception: a foundation of emotion and the mind-body connection

Maintaining desirable physiological states is critical for assuring survival and serves as the foundation of physical wellbeing [23, 30], which is enabled through interoception. Interoception is an iterative function, requiring the intricate interplay between the perception of bodily states (e.g., fatigue, hunger, thirst) and cognitive interpretation of such states to inform appropriate action [24]. Interoception is intimately tied to physiological regulation via homeostasis—the dynamic processes which maintain physiological integrity of the body at setpoints or within narrow ranges conducive to survival and optimum function [18, 24, 71]. Physiological signals arising from the body are projected directly to autonomic and homeostatic regions located in the spinal cord, brainstem, and thalamus for processing [9, 23]. Signals are then projected to a multitude of cortical and subcortical regions that regulate internal physiological systems (e.g., autonomic, immune, neuroendocrine), and represent sensations originating from the body [57].

Interoceptive signals continuously interact with cognitive models comprising past experiences and internal and external environmental regularities (e.g., [9, 83]), which informs experience and interpretation, and motivates regulatory behaviour [24, 25]. This whole-brain network coordination enables the redistribution of physiological and psychological resources to meet individual needs, particularly in the face of environmental challenges [27], and accordingly exemplifies a mind-body connection function.

A longstanding theoretical tradition describes emotions as inexorably linked to changes arising from within the body through interoception (e.g., [5, 29, 53, 80]), where both functions are tied to the cognitive interpretation of changes occurring from within the body [27]. A burgeoning body of neuroanatomical evidence substantiates such views, indicating that neural regions activated during interoceptive processing overlap with those implicated in motor coordination (e.g., [6]), emotional experiences [5, 24, 26, 61, 82, 101] and emotion regulation [97, 104]. In line with such evidence, it is tenable that interoception plays a vital role in motivating behaviours that seek to restore or maintain bodily balance and wellbeing, based upon how—or whether—one affectively interprets the sensation in context [24, 26, 89]. Despite these links, the degree to which emotional functions are captured in existing assessments of the mind-body connection is insufficient.

Interoceptive dimensions and assessment methods

It is now accepted that conscious interoception, which forms the foundation of emotional processes, is multidimensional [55]. Various frameworks exist (e.g., [55, 67, 72, 90]), although the three-dimensional model proposed by Garfinkel and colleagues [47] remains widely endorsed [35]. These domains include interoceptive accuracy (IAcc), interoceptive awareness, (IAw), and interoceptive sensibility (IS). IAcc pertains to the capacity to accurately detect internal bodily sensations, which is typically assessed through objective performance. IAw refers to the metacognitive awareness of accuracy—conceptualised as confidence in the accurate monitoring of internal bodily sensations. Quantification involves the combination of objective interoceptive performance and a subjective appraisal of this. Importantly, tasks proposed to capture accurate monitoring and appraisals implicitly involve bias, due to the role of purposeful top-down directed attention toward an interoceptive channel [2].

On the other hand, IS is a purely subjective dimension, encompassed by the dispositional inclination to possess an internal focus and be interoceptively cognisant [47]. Typically, IS is operationalised through self-report scales that capture trait-based functions [35]. The IS domain has notably been conceptualised as an expression of a high-level model or overarching 'belief' which influences how one tends to interpret interoceptive signals and infers the causes of them [27].

While acuity in accuracy and awareness is crucial for maintaining optimal functioning and facilitates adaptive behaviour [94], the subjective component of interoception is complex and nuanced [55]. Although any subjective assessment inherently involves bias, strongly held beliefs regarding interoceptive abilities may influence overall interpretation of bodily sensations [27, 90] and subsequently guide the enactment of behaviours aimed at addressing equilibrium and wellbeing.

In interoceptive research, the dimensions of interest are primarily those utilising behavioural performance measures (i.e., IAcc and IAw; [55]). Assessments for these dimensions chiefly involve heartbeat tracking (heartbeat discrimination task; [98]) or counting [81], although other physiological tests are utilised (e.g., water load task for gastrointestinal sensitivity, respiratory resistance load detection, [27]). Whilst these are traditionally measures of IAcc and IAw, they assess a singular bodily channel and are not generalisable [39]. Furthermore, the psychometric properties of predominant cardiac measures have been subject to much scrutiny. A major criticism pertains to the influence of subjective prior beliefs on performance (e.g., [34, 79, 102]), which limits reliability, validity, and interpretation. Furthermore, when data have been aggregated for meta-analysis, performance on the heartbeat counting task does not appear to be significantly associated with major indicators of wellbeing, including trait anxiety, depression, or emotion deficits [36].

By contrast, subjective beliefs regarding the degree to which individuals are interoceptively cognisant appears to influence clinical indicators, including depression severity [37] suicidal ideation amongst persons diagnosed with eating disorders [70], and contributes to distorted bodily beliefs amongst high and low physical symptom reporters and persons with somatoform disorders [42]. As such, self-report measures pertaining to beliefs and interpretations of bodily sensations may be more suitable indicators of clinical status than behavioural measures [90]. Psychological interventions are being developed to target facets of subjective interoception to improve global bodily awareness and enhance utilisation of internal cues for self-regulation in disorders characterised by interoceptive and emotional dysfunction [14]. However, self-report measures and conceptualisations of this construct vary in the degree to which emotion is considered.

Limitations of interoceptive self-report scales

Relative to IAcc and IAw, interoceptive self-report scales capture appraisals across multiple channels by nature of definition and design. There are many existing tools, which assess a range of beliefs available to conscious access. Trevisan and colleagues [94] (see also [67]) surmised that scales generally assess: i) self-reported tendency of attention toward bodily signals relevant to homeostatic needs (e.g., thirst, hunger) and to some degree, emotional arousal, and ii) self-perceptions of accuracy in the discrimination and interpretation of such signals.

Through systematic review, Desmedt et al. [35] identified that the Body Awareness scale of the Body Perception Questionnaire (BPQ, [73]), the Body Awareness Questionnaire (BAQ, [85]), and the Multidimensional Assessment of Interoceptive Awareness (MAIA, [65, 66]) are most frequently used in research. The Body Awareness scale of the BPQ is a unifactorial measure of hypersensitivity and maladaptive attention toward autonomic nervous system structures and accompanying sensations [58, 63], but does not explicitly capture elements of emotional arousal nor appraisal. Conversely, the BAQ is a unifactorial measure of self-reported attentiveness to normal non-emotive body processes, including adaptive sensitivity to body cycles and rhythms, and does not empirically relate to affective experience [103]. By contrast, the MAIA comprises eight scales, assessing subjective interoceptive awareness in various domains. Table 1 presents an overview of these.

Amongst MAIA scales and within the overarching framework, emotion is set out to be explicitly captured [65, 66]. For instance, the EA scale measures the awareness of the connection between body sensations and emotional states. Further, regulatory behaviours driven

Table 1 MAIA-2 Scales, abbreviations and descriptions

Scale	Abbreviation	Description
Noticing	Not.	Awareness of uncomfortable, comfortable, and neutral body sensations
Not-Distracting	ND	Tendency not to ignore or distract oneself from sensations of pain or discomfort
Not-Worrying	NW	Tendency not to worry or experience emotional distress with sensations of pain or discomfort
Attention Regulation	AR	Ability to sustain and control attention to body sensations
Emotional Awareness	EA	Awareness of the connection between body sensations and emotional states
Self-Regulation	SR	Ability to regulate distress by attention to body sensations
Body Listening	BL	Active listening to the body for insight
Trusting	Trust.	Experience of one's body as safe and trustworthy

by bodily interpretation are measured, per AR, SR, and BL items [14]. Together, these scales are proposed to facilitate measurement of adaptive attentional styles and regulatory functions underpinning IS than existing measures, such as the BPQ [63].

Prima facie, the MAIA is a comprehensive, multidimensional measure of self-reported interoception. Emerging evidence suggests that the MAIA might instead measure three constructs—not eight. Ferentzi et al. [39] identified that the MAIA is comprised of a general interoception factor, consisting of Not., AR, EA, SR, BL, and Trust. subscales, with ND and NW subscales emerging as distinct and unrelated factors. These findings have been corroborated by Desmedt et al. [35] and extended by Todd et al. [92], suggesting that a summary score comprising these six MAIA scales is a pragmatic measure of IS. Whilst interoceptive self-report scales such as the MAIA conceptually consider mind-body integration, these aspects could be enhanced through further scrutiny of related constructs that may improve how the mind-body connection is currently assessed via self-report—primarily through interoceptive self-report scales.

Interoceptive attention serves as a crucial function underpinning the interpretation of interoceptive signals [90]. Indeed, existing self-reports emphasise this process; elements of interoceptive attention toward bodily signals relevant to homeostatic needs are certainly measured within the BPQ, BAQ, and MAIA. The BPQ appears to assess hypersensitivity, whereas the MAIA and BAQ capture adaptive attentional functions related to interoceptive processing. However, interoceptive attention has been described as involving the capacity to direct attentional resources toward internal bodily sensations that can be captured in bottom-up, stimulus-dependent or top-down, purposeful manners [56]. If attention is understood to be stimulus-driven or goal-directed [21], then measurement of subjective interoceptive attention could alternatively entail the habitual allocation of resources to a sensation if suddenly experienced due to homeostatic perturbation or purposefully contemplated. In line with such views, items amongst these interoceptive self-report scales seem to lack the explicit measurement of such notions pertaining the differing ways that attentional resources can be directed or allocated toward internal sensations.

Furthermore, alexithymia is of worthy consideration in reviewing how emotion could be captured in a mind-body connection self-report, given its characterisation as "the quintessence of impairment of mind-body connection" [31], p. 2). Alexithymia is underpinned by deficits in identifying feelings and differentiating between feelings and bodily sensations associated with emotional arousal, describing feelings, and an externally oriented thinking style, by which there is a preoccupation with details and features of the external environment [86]. Alexithymia is of clinical significance and is associated with subjective health and wellbeing perceptions, including somatisation (i.e., the tendency to experience and report physical symptoms due to emotional distress, [60]), physical symptom severity [78], and health-related quality of life [54, 62]. Various studies report a link between interoception and alexithymia (e.g., [15, 46, 93]), with findings suggesting that alexithymia is the culmination of poor interoceptive perception across multiple channels [67] and even convergence [44, 96]. Both hypersensitivity and hyposensitivity toward bodily sensations may exacerbate poorer emotional articulation, thus impinging on effective mind-body communication [1, 10, 68]. Whilst MAIA items seem to capture the ability to identify the connection between body sensations and emotional states, the additional ability to describe that link is not assessed. Furthermore, items are only suggestive of directing attention internally, rather than explicitly measuring preferences for an internally- or externally oriented focus. Greater incorporation of the capacity to articulate the emotional meaning of internal bodily sensations may enhance measurement of emotion, alongside explicit measurement of preferences for possessing an internal focus. Conceptualised together, these may enrich mind-body self-reports and enable the development of more targeted interventions aimed at improving adaptive cognitions, emotions, and behaviours in clinical populations.

Furthermore, an embodied sense of self reflects a high-order function that can encompass facets of regulatory behaviours guided by bodily cues and trust in body sensations [65], which may contribute to overall health and wellbeing [38]. Conversely, conceptualising the mind as distinct from the body may lead to poorer wellbeing, particularly in line with evidence suggesting that dualistic views are linked reduced health-related behaviours (e.g., [16, 43]). A recent hierarchical interoceptive framework specifies that an 'attribution of sensations' dimension represents the zenith of sensation interpretation [90]. Considering that sensations may be interpreted as benign, ambiguous, or threatening, whereby clinical groups may be negatively biased in their interpretations, such attributions may be a consequence of overarching mind-body beliefs. As such, whether one values physical and mental wellbeing may yield additional insights into the sense of connectedness with both mind and body. Many existing interoceptive self-reports capture attitudinal tendencies pertaining to bodily cues, such as BAQ and the MAIA. However, broader attitudes pertaining to whether physical and mental wellbeing are important and prioritised are not measured.

In sum, prevalent interoceptive self-report scales vary in the concurrent measurement of emotional abilities that could relate to how individuals believe they detect and attend to specific sensations. In addition, there appears variable consideration of broader values pertaining to the mind-body connection and the importance of wellbeing. It is proposed that omission of these factors impinge upon the measurement of an individual's perceived connection to their body and mind. For these reasons, the Body-Mind Connection Questionnaire (BMCQ) was developed to attempt to address limitations identified with existing self-report measures so as to enable clearer identification of whether individuals exhibit a connection with mind and body.

Scale construction

In accordance with suggested guidelines for scale development (e.g., [11]), key domains involved in the mind-body connection were conceptualised by the research team. This guided item generation for the BMCQ, and involved: (a) review of theory, literature and pre-existing scales related to interoception and emotion to ascertain key constructs for mind-body connection measurement,(b) item generation of positively- and negatively-worded items based on reviews; (c) screening for item redundancy relative to existing scales; (d) determining measure structure (e.g., item complexity, response format), (e) panel and target population review of drafted items; and (f) synthesis and integration of feedback and assembly of measure for field test.

Following review, three key domains were identified, and proposed to be qualities informing one's holistic connection to their body and mind. These were conceptualised as 'Interoceptive Attention', 'Sensation-Emotion Articulation', and 'Body-Mind Values'. A total of 59 items were generated for these domains. Specifically, Interoceptive Attention items followed a theoretical grounding in foundational capacities, whereby these reflected non-biased, selective attentional capacities, as other functions (e.g., sustained, divided) are captured in the MAIA. Eighteen items were generated for this domain. While 'Emotional Awareness' is captured in the MAIA, BMCQ items generated for the Sensation-Emotion Articulation domain drew upon alexithymic characteristics and constituents, following recent evidence showing the presence of a latent interoceptive factor in alexithymic assessment tools [44] coupled with indication that MAIA items only seem to measure identification of the link between sensation and emotion. Items were formulated to represent the inverse of alexithymic characteristics. Twenty-three items were generated for this domain. Lastly, Body-Mind Values item generation was guided by identification that existing assessment tools capturing attitudinal facets of mind-body integration but primarily pertain to bodily cues (e.g., MAIA, [65]), with psychological cues not explicitly captured amongst items. Furthermore, that broader endorsement of mind and body are connected entities is not captured by existing tools. For this domain, 19 items were generated.

All items were screened for redundancy. If an item replicated items from existing questionnaires, it was removed. Next, remaining items were assessed for several factors, including grammatical complexity and technical jargon, and were rephrased to increase understanding or readability where necessary. Following these processes, the BMCQ was reduced to a 22-item pool. With respect to response scale ratings, it was agreed that clearly defined 7-point scales would enable respondents a greater degree of distinction in endorsement of BMCQ items. This was determined, as reliability and validity are better retained, and biases influencing responses (e.g., extreme response, acquiescence) are mitigated [59].

Four researchers with expertise in biological psychology and familiarity with interoception independently provided feedback on face validity, theoretical coherence, wording, and item clarity. Where there were differences in opinion, open discussions were held to explain perspectives which facilitated consensus being reached. Following discussions, several items were refined for clarity; the item pool was collectively deemed to be relevant to the hypothesised constructs. This process resulted in a retained 22 item pool to assess three constructs: Interoceptive Attention (five items regarding the ability to direct attentional resources toward interoceptive stimuli in purposeful and spontaneous manners), Sensation-Emotion Articulation (seven items related to the capacity to identify and describe internal bodily changes in emotional contexts and a preference for the internal environment), and Body-Mind Values (10 items reflecting beliefs in mind-body integration and perceived importance of wellbeing).

The BMCQ was then administered to 25 individuals known to the researchers to assess face validity from the perspective of respondents. This is recommended to determine whether target respondents interpret the items as intended [11]. Due to implemented COVID-19 restrictions, participants' mental processes and experiences responding to the BMCQ were provided in written form. This was hosted on Qualtrics (Qualtrics, Provo, UT [76]). The study link was circulated through social media platforms (e.g., Facebook) and amongst members of the research team. Target respondents provided their insights as they completed the questionnaire, inclusive of clarity of items or aspects of experience not considered. Throughout the online study, textboxes were provided after each section for participants to record their experiences and observations.

The research team synthesised and reviewed these results. This included assessment of feedback for each item, and whether they yield skewed responses through review of means and standard deviations. No problematic items were identified. The 22-item BMCQ was retained and administered for field testing. Figure 1 contains an overview of stages involved in scale development.

Method

Participants

An *a priori* sample size of 220 participants for the field test was determined to be the absolute minimum for this study, as this would provide a ratio of 10:1 respondents per item [11]. Scale development and item reduction are contingent upon larger samples in order to produce more stable factor solutions [91]. Accordingly, a total of 417 participants aged 18 to 50 were recruited using the Prolific recruitment service. To be included in the study, participants were required to be:

1. Aged 18-50, to limit the effects of aging on physical health, including beliefs and practices [32]
2. Fluent in the English language
3. Reside in Australia, Canada, New Zealand, the United Kingdom, or the United States
4. Free of a current chronic pain condition (e.g., fibromyalgia, severe arthritis), to limit the effects of chronic pain on subjective processing of homeostatic factors [88].

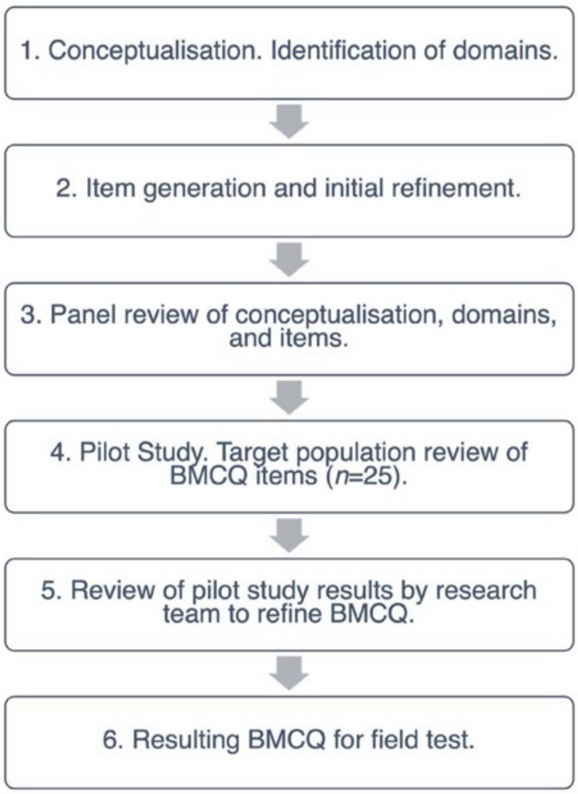


Fig. 1 Iterative Sequence of Development of the BMCQ

Except for a current diagnosis of a chronic pain condition, there were no specific criteria to exclude individuals with a current diagnosis of other physical or mental health conditions. Participants were requested to disclose whether they were currently diagnosed with a physical and/or psychiatric condition, as previous literature indicates an association with altered interoceptive and emotional functioning (e.g., [55]). A total of 119 participants advised of current physical and/or mental diagnoses. Multiple conditions were self-reported. Eighteen participants reported physical conditions, whereas 101 participants disclosed of at least one current psychiatric diagnosis, including anxiety-related, depressive, feeding and eating, and neurodevelopmental disorders. Table S1 of the supplemental material provides an overview of all self-reported diagnoses. As psychiatric conditions can differentially influence interoceptive and emotional processing [56], these participants were excluded. Subsequently, 316 participants (M_{Age}=30.78, SD_{Age}=8.34) were included in the study. Table 2 contains additional demographic characteristics of the included sample.

Other indicators of health and wellbeing were also requested, including body mass index (BMI), smoking status, alcohol consumption, engagement in sport and exercise, yoga, and mindfulness and meditation practice. Table 3 contains this information.The sample were primarily non-smokers that infrequently consumed alcohol and regularly engaged in sport and/or exercise, and meditation and mindfulness practice. On average, the sample reported a BMI that would be classified as overweight (i.e., ≥25; [99]), although this was calculated based on self-reported height and weight (Table 3). Overall, the sample appeared to endorse relatively healthy characteristics and practices.

Materials

To test for convergent and discriminant validity, a questionnaire battery of several published measures sharing theoretical relatedness to the mind-body connection construct was assembled. This included the BPQ, BAQ, MAIA, Perth Alexithymia Questionnaire (PAQ), and the Highly Sensitive Person Scale (HSPS). Table 4 summarises these measures, score interpretation, ranges, means

Table 2 Demographic characteristics of the sample with no self-reported psychiatric diagnosis (*N*=316)

Characteristic	*N* (%)
Age	
18-19	28 (8.9%)
20-29	119 (37.7%)
30-39	117 (37.0%)
40-50	51 (16.1%)
Gender Identity	
Man or male	124 (39.2%)
Woman or female	189 (59.8%)
Another term (e.g., non-binary)	2 (0.6%)
Prefer not to answer	1 (0.3%)
Country of Residence	
Australia	9 (2.8%)
Canada	26 (8.2%)
New Zealand	8 (2.5%)
United Kingdom	225 (71.2%)
United States	48 (15.2%)
Level of Education	
Year 10 or lower	6 (1.9%)
Year 12	121 (38.3%)
Bachelor's Degree	111 (35.1%)
Honours	15 (4.7%)
TAFE or vocational training	11 (3.5%)
Masters	41 (13.0%)
PhD or Doctorate	6 (1.6%)
Graduate Certificate	5 (1.6%)

Table 3 Overview of health and wellbeing characteristics of the sample (*N*=316)

Characteristic	*N (%)*	*M (SD)*
Body Mass Index (BMI)[a]	296 (93.7%)	27.27 *(8.53)*
Underweight (<18.5)	10 (3.2%)	
Normal (18.5-24.9)	136 (43.0%)	
Overweight (25.29.9)	76 (24.1%)	
Obese (30+)	74 (23.4%)	
Smoking Status		
Smoker	33 (10.4%)	
Non-Smoker	283 (89.6%)	
Alcohol Consumption		
0-1 times per week	224 (70.9%)	
1-2 times per week	56 (17.7%)	
2-3 times per week	19 (6.0%)	
3-4 times per week	7 (2.2%)	
4 or more times per week	10 (3.2%)	
Sport or Exercise Engagement		
Yes (Hours per week)	208 (65.8%)	3.05 *(2.11)*
No	108 (34.2%)	
Yoga Practice		
Yes (Hours per week)	52 (16.5%)	0.97 *(1.64)*
No	264 (83.5%)	
Meditation and Mindfulness Practice		
Yes (Hours per week)	75 (23.7%)	1.23 *(1.30)*
No	241 (76.3%)	

[a] Calculated based on self-reported weight and height

Table 4 Score interpretation, possible and observed ranges of scores, means, standard deviations, and internal consistency reliability for validity measures ($N=316$)

Validity Measures	Interpretation	*N*	Possible Range	Observed Range	*M*	*SD*	Skewness	Kurtosis	Alpha
MAIA		313	0.00-5.00						
Not.	Higher scores reflect greater awareness of uncomfortable, comfortable, and neutral body sensations			0.00 - 5.00	3.28	0.93	-0.45	0.24	0.79
ND	Higher scores reflect a tendency to not ignore or distract oneself from sensations of discomfort and pain			0.00 - 5.00	1.97	0.96	0.42	0.38	0.88
NW	Higher scores reflect a tendency not to worry or experience emotional distress with sensations of pain or discomfort			0.00 - 4.80	2.56	0.89	-0.10	-0.06	0.78
AR	Higher scores reflect greater ability to sustain and control attention to body sensations			0.43 - 4.86	2.72	0.88	-0.05	-0.48	0.88
EA	Higher scores reflect greater awareness of the connection between body sensations and emotional states			0.20 - 5.00	3.33	0.97	-0.46	-0.16	0.85
SR	Higher scores reflect greater tendency to regulate distress by attention to body sensations			0.00 - 5.00	2.71	1.03	-0.31	-0.34	0.85
BL	Higher scores reflect actively listening to the body for insight.			0.00 - 5.00	2.45	1.15	-0.05	-0.56	0.85
Trust.	Higher scores reflect greater appraisals of the body being safe and trustworthy			0.00 - 5.00	3.12	1.15	-0.32	-0.49	0.89
BAQ	Higher scores reflect greater bodily awareness in non-emotive contexts	309	18-126	29 - 119	79.48	16.18	-0.23	0.02	0.87
BPQ	Higher scores reflect hypersensitivity toward sensations	313	26-130	26 - 130	71.69	21.6	0.41	-0.37	0.95
PAQ		313							
DIF	Higher values indicate greater difficulty identifying, understanding, and differentiating between one's own positive and negative feelings.		8-56	8-56	24.83	10.03	0.23	-0.52	0.9
DDF	Higher values indicate greater difficulty describing and communicating one's own positive and negative feelings.		8-56	8-56	29.06	10.24	-0.03	-0.32	0.9
EOT	Higher values indicate greater tendency to not focus attention on one's own emotions (negative and positive).		8-56	8-50	26.45	9.91	0.12	-0.60	0.89
PAQ- Total	Higher values reflect greater levels of overall alexithymia; difficulty focusing attention on and appraising one's own feelings (negative and positive).		24-168	26-162	80.35	26.9	0.04	-0.28	0.95
HSPS		313							
EOE	Higher values indicate greater ease of excitation		12-84	12-83	55.58	11.58	-0.18	0.05	0.84
AES	Higher values indicate greater sensitivity to aesthetic stimuli		7-49	7-49	31.1	6.57	-0.18	0.13	0.72
LST	Higher values indicate lower sensory threshold		6-42	6-41	20.81	7.26	0.30	-0.30	0.76
HSPS-Total	Higher scores indicate greater global sensory processing sensitivity		27-189	27-181	115.49	22.86	0.11	0.39	0.9

and standard deviations, and Cronbach's alpha coefficients for the present sample.

Body-Mind Connection Questionnaire (BMCQ)

The BMCQ administered for field testing consisted of 22 items pertaining to Interoceptive Attention, Sensation-Emotion Articulation, and Body-Mind Values. Participants rated how applicable each statement is to them generally on a scale ranging from *not at all true of me* (1) to *very true of me* (7). Items were scored such that higher scores represented greater capacities in connecting mind with body. The 22-item version is provided in the Supplemental Material. Additional details regarding scale refinement, reliability, and construct validity are outlined in later sections.

Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2 [66])

The MAIA-2 is a 37-item self-report measure of interoceptive body awareness on 8 dimensions: 1) Noticing (MAIA-Not.); 2) Not-Distracting (MAIA-ND), 3) Not-Worrying (MAIA-NW), 4) Attention Regulation (MAIA-AR), 5) Emotional Awareness (MAIA-EA), 6) Self-Regulation (MAIA-SR), 7) Body Listening (MAIA-BL), 8) Trusting (MAIA-Trust). See Table 1 for MAIA-2 scale descriptions. Participants rate items on a 6-point scale ranging from *never* (0) to *always* (5), based on how often each statement applies to them generally in daily life. Scores are totalled and averaged for each subscale. Higher average scores reflect greater bodily awareness. MAIA scales demonstrate questionable to good internal consistency, where $\alpha > 0.65$ for all subscales [66]. Incremental validity is shown through five subscales accounting for 41% of variance in trait anxiety [65].

Body Awareness Questionnaire (BAQ [85])

The BAQ is an 18-item scale assessing self-reported attentiveness to normal non-emotive body processes, including sensitivity to body cycles and rhythms, changes in normal bodily functioning, and the ability to anticipate bodily reactions. Participants answer items on a seven-point Likert-scale, ranging from *not at all true about me* (1) to *very true about me* (7). Scores are summed, where higher values indicate higher body awareness. The BAQ shows good test-retest reliability (r = 0.72) and internal consistency reliability (α = 0.79-0.83, [39, 40]). BAQ scores correlate with functional interoception, as measured by the MAIA (r =0.56, [35]).

Body Perception Questionnaire (BPQ [15, 73])

The BPQ is a self-report measure of bodily awareness and autonomic reactivity. The BPQ consists of two subscales: Body Awareness and Autonomic Reactivity [17]. Studies examining IS utilise the Body Awareness subscale of the BPQ [36], which this study administered. This scale is unifactorial and consists of 26 items pertaining to subjective experiences of bodily sensations. Respondents rate how aware they are of these during most situations on a 5-point Likert-scale ranging from *Never* (1) to *Always* (5). A summary score is calculated, where higher values reflect hypersensitivity [58]. The *Body Awareness* subscale of the BPQ demonstrates excellent internal consistency (ω=0.92) and test-retest reliability (r =0.99, [17]). Convergent evidence indicates that Body Awareness relates to somatosensory amplification (r_s=0.51) and stress reactivity (r_s=0.57, [17]), but appears distinct from adaptive interoception, as measured by the MAIA (r=0.21) and attentiveness to bodily sensations, as measured by BAQ items (r=0.26, [35]).

Perth Alexithymia Questionnaire (PAQ [74])

The PAQ is a 24-item measure assessing alexithymia. This includes difficulty identifying feelings (PAQ-DIF), difficulty describing feelings (PAQ-DDF), and externally oriented thinking (PAQ-EOT). Participants rate items according to how much they agree or disagree that the statement is true of them from *Strongly Disagree* (1) to *Strongly Agree* (7). The PAQ assesses both positive and negative emotion identification and description, as well as EOT. Separate subscales exist for positive and negative DIF and DDF. A total score is also calculated to indicate global alexithymia. As BMCQ Emotion-Sensation Articulation items reflect identification and description of positive and negative emotions, composite scores were computed to provide general DIF and DDF [74]. Higher PAQ scores are indicative of higher alexithymic characteristics. PAQ scales demonstrate good internal consistency (Cronbach's α=0.85 to 0.87) and convergent validity, where PAQ-Total strongly correlates with the Toronto Alexithymia Scale (r = 0.76 [74]). PAQ scores are not strongly related to MAIA subscales [100].

Highly Sensitive Person Scale (HSPS [4])

The HSPS is a 27-item self-report measure of sensory processing sensitivity (SPS), a personality trait involving dispositional heightened processing of external (e.g., light, scent) and internal (e.g., hunger, pain) stimuli. Participants rate items on a 7-point Likert-scale, ranging from *not at all* (1) to *extremely* (7). Whilst SPS was initially conceptualised as unidimensional [4], subsequent research indicates that SPS is composed of three factors: 1) Ease of Excitation (HSPS-EOE), regarding the propensity to feel overwhelmed by external and internal demands, 2) Aesthetic Sensitivity (HSPS-AES), regarding aesthetic awareness, and 3) Low Sensory Threshold (HSPS-LST), involving the tendency to become unpleasantly aroused by external and internal stimuli [87]. As the three-factor solution omits items from the full HSPS, a total score was also calculated, where higher scores indicate heightened SPS. Strong internal consistency has been observed (α=0.89, [87]. The HSPS demonstrates construct validity where EOE and total HSPS scores moderately correlate with Neuroticism (r = 0.48 and 0.45, respectively, [87]), SPS appears distinct from interoception, as measured by the BPQ [95].

Procedure

Ethics approval was granted by the Victoria University Human Research Ethics Committee (VUHREC). Participants were recruited using the Prolific service, including screening for inclusion/exclusion criteria. Study details were published via Prolific, including the link for the study that was hosted on Qualtrics (Qualtrics, Provo, UT [76]). Participants read through the participant information form detailing the goals and procedures of the study. Then, they reviewed the consent form. Consent was implied by checking the relevant option. Participants provided demographic information and information regarding their general health. Then, they proceeded to the questionnaire battery, consisting of the BMCQ, MAIA, BPQ, BAQ, HSPS, and PAQ. Questionnaires were presented in a randomised order to control for possible ordering effects of responses. In total, the full battery took participants approximately 45 minutes to complete and they were remunerated.

Statistical analyses for BMCQ

All analyses were conducted with IBM® SPSS® Statistics (Version 28) [52]. As this study aimed to develop a self-report measure that assesses the degree to which individuals are connected to both body and mind, an exploratory factor analysis (EFA) was employed to substantiate an underlying factor structure, reduce data, and estimate communalities amongst items. To ensure the data were suitable for analysis, all relevant assumptions were assessed. The removal of participants that self-reported a psychiatric diagnosis impacted the envisioned adequate sample size of 400, the included sample of 316 participants with no self-reported psychiatric condition provided a ratio of approximately 14 respondents per item which was deemed sufficient for EFA [11]. Normality amongst items was assessed by observing non-significant skewness values [91]. Univariate linearity was assessed by inspecting scatterplots for each item pairing. As outliers can influence factor solutions, univariate outliers were screened by inspection of histograms for individual items, and multivariate outliers through Mahalanobis' distance (χ^2_{22}= 48.27, α = .001). To assess the absence of multicollinearity and singularity, squared multiple correlations were assessed. If any of these were 1.00 or close to, the corresponding item would be deleted [91]. Factorability was assessed using several methods. First, intercorrelations amongst items were reviewed, where r=>0.32 was required. Bartlett's Test of Sphericity was also reviewed, with p <.05 as the desired parameter. In addition, Kaiser-Meyer-Olin Measure of Sampling Adequacy (KMO) was assessed, with a cut-off of KMO=>0.60 [49]. Diagonals of the anti-image correlation matrix were screened to inform potential item reduction, with a minimum criterion of 0.50 required [91].

To examine the structure of the BMCQ, a combination of techniques was employed, per suggestions from Tabachnick and Fidell [91]. First, a principal components analysis (PCA) with oblique (direct oblimin.) rotation was conducted prior to principal factors extraction analysis to initially estimate the likely number of factors from eigenvalues >1.0 and Scree-plot inspection [19]. Review of the pattern matrix informed item reduction, where loadings <0.32 and/or the presence of complex variables with low primary loadings were indicators for possible item deletion. Next, principal axis factors extraction with oblique rotation (direct oblimin.) was applied to determine the underlying factors as contributing to the body-mind connection construct. This approach was informed by features of principal factors analysis, whereby estimated communalities eliminate unique and error variance from variables, thus providing a salient solution. Oblique rotation (direct oblimin.) was deemed suitable, as items were likely to co-vary [91]. To further determine appropriateness, the factor correlation matrix was examined for correlations around 0.32. Analysis of communalities also informed extraction, where values ≤0.32 were scrutinised and removed. Where variables were complex with cross-loading and low primary loadings (<0.32), these items were also removed [49], 100. Following EFA, retained items were submitted to a reliability analysis. Internal consistency was assessed using Cronbach's alpha coefficients, where α≥0.70 indicated acceptability.

Results

Results of data screening for BMCQ

All relevant assumptions for EFA were assessed. Normality amongst single variables was acceptable. Scatterplot inspection indicated that univariate linearity was acceptable. Whilst no major univariate outliers were detected, 12 multivariate outliers were identified. These cases were omitted from analysis. The remaining sample of 304 participants was deemed sufficient for EFA, as this provided an adequate ratio of approximately 14 respondents per item. No squared multiple correlations were close to 1.00.

Results of exploratory factor analysis of BMCQ

All 22 BMCQ items were submitted to a preliminary PCA. The initial factorability of the 22 BMCQ items was examined. It was observed that 18 of the 22 items correlated at least r=0.32 with at least one other item, indicating adequate factorability. Bartlett's test of sphericity was significant, χ^2_{231}= 2430.63, p <.001, and KMO measure of sampling adequacy was 0.85. Diagonals of the anti-image correlation matrix were above 0.50. Communalities following extraction indicated that all items were suitable for inclusion, as they exceeded the minimum criterion of 0.32. Scree-plot inspection and Eigenvalues indicated that five to six factors would likely be extracted in the principal factors extraction analysis with all 22 items. Considering these overall indicators, principal factors extraction with oblique rotation was deemed to be suitable with all 22 items.

Principal axis factors extraction with direct oblimin. rotation was then employed. Communality values for five of the 22 items were low, indicating heterogeneity relative to other BMCQ items, alongside indication that these variables were complex with low primary loadings. These items were removed and analyses re-run with 17 items; two items subsequently produced a low communality value and were removed. A four-factor structure was produced with the remaining 15 items. Two items strongly loaded onto a unique factor (Eigenvalue >1.0) with poor internal consistency (α=0.66) and low item-full scale correlations (<0.30). These were subsequently removed and analysis re-run. It was identified that one item cross-loaded (*'I consider myself in touch with my body and mind'*). Due to this item explicitly concerning mind-body valuation, it was retained for future investigations. Reliability analysis substantiated inclusion, based on consideration of acceptable squared multiple correlation (0.41) and reduced scale reliability, should the item be deleted (0.77 from 0.80; [41]). Accordingly, the BMCQ was reduced from 22 to 13 items. Specifically, the three BMCQ factors explained 39.09%, 8.94%, and 5.99% of variance in the mind-body connection construct, respectively. Table 5 presents factor loadings, communalities, means, and standard deviations for individual items. Variables are ordered, bolded, and grouped by size of loading to facilitate interpretation. Interpretative labels for each factor are included in the table footnote.

In sum, the three factors of the BMCQ were Body-Mind Values, Sensation-Emotion Articulation, and Interoceptive Attention, reflecting that the body-mind construct involves cognitive and emotional processing of interoceptive signals, and holistic mind-body beliefs. As the scales ranged from three to six items, mean scores for each BMCQ factor were computed for the full sample of 316. As the data were normally distributed, internal consistency reliability and descriptive statistics were evaluated for the full sample with no psychiatric diagnosis (N=316). These are presented in Table 6.

Cronbach's alpha coefficients ranged from 0.74 to 0.85, indicating acceptable to good internal consistency;

Table 5 Factor loadings, extracted communalities following principal axis factors extraction with direct oblimin. Rotation for 13 Items from the Body-Mind Connection Questionnaire (BMCQ) with item means and standard deviations (N=304)

Item	Factor					
	1[a]	2	3	*M*	*SD*	Extracted Communality
Feeling physically well is something that I prioritise in life.	**0.81**	-0.09	0.02	4.98	1.37	0.60
I value being well-balanced in my body and my mind.	**0.76**	-0.04	-0.04	5.41	1.15	0.50
Feeling mentally well is something that I prioritise in life.	**0.71**	-0.01	0.00	5.33	1.29	0.59
I am usually proactive in addressing the needs of my body.	**0.70**	0.11	0.01	4.65	1.36	0.56
Where possible, I always attend to what my body is telling me.	**0.62**	0.17	-0.03	4.78	1.31	0.52
I feel disconnected from my body. (R)	**0.43**	0.05	-0.29	5.25	1.32	0.43
If I were asked to, I'd find it hard to describe changes in my body associated with positive and negative emotions. (R)	-0.04	**0.83**	0.03	4.41	1.54	0.64
I find it hard to identify changes in my body associated with positive and negative emotions. (R)	-0.09	**0.74**	-0.15	4.65	1.39	0.62
I tend to focus on things happening in my physical environment rather than what is happening inside of me. (R)	0.20	**0.55**	0.05	3.67	1.40	0.40
I can direct my focus toward how specific parts of my body feel.	0.03	0.09	**-0.74**	5.06	1.19	0.64
It is easy for me to focus on specific sensations if they are suddenly experienced.	-0.04	0.04	**-0.71**	5.38	1.02	0.50
It is easy for me to focus on specific sensations if I purposefully think about them.	0.03	-0.07	**-0.70**	5.35	1.08	0.48
I consider myself in touch with my body and mind.	0.36	0.08	**-0.44**	4.99	1.16	0.55

[a] F1: Body-Mind Values, F2: Sensation-Emotion Articulation, F3: Interoceptive Attention

Table 6 Score interpretation, ranges, descriptive statistics, and cronbach's alpha coefficients of BMCQ subscales in sample with no psychiatric diagnosis (N=316)

Scale	No. of Items	Score Interpretation	Observed Range[a]	M (SD)	Skewness	Kurtosis	Alpha	Range of Item-Scale Correlations
Body-Mind Values	6*	Higher values reflect stronger beliefs in mind-body integration and importance of wellbeing.	2.17-7.00	5.06 *(1.01)*	-0.64	0.63	0.85	0.55-0.69
Sensation-Emotion Articulation	3*	Higher values reflect greater internal focus and capacity for articulating bodily changes associated with emotions.	1.00-7.00	4.24 *(1.18)*	-0.26	-0.39	0.74	0.47-0.62
Interoceptive Attention	4	Higher values reflect greater direction of attentional resources toward interoceptive stimuli.	2.00-7.00	5.17 *(0.91)*	-0.42	-0.28	0.8	0.56-0.72

* Contains reverse scored items

[a] Possible range from 1-7

Table 7 Pearson's correlations between BMCQ scales (N=316)

Scale	1	2	3
1. Body-Mind Values	-		
2. Sensation-Emotion Articulation	0.38**	-	
3. Interoceptive Attention	0.59**	0.42**	-

** p<.001 (two-tailed)

all item-scale correlations were ≥0.30. Mean scores tended to be high; on a 1-7 scale, means ranged from a low of 4.24 (Sensation-Emotion Articulation) to a high of 5.17 (Interoceptive Attention), indicating that the sample endorsed characteristics underlying a strong connection with mind and body. To further understand the degree to which the BMCQ factors were related, correlations between the scales were conducted and are presented in Table 7.

Plausible directions were observed amongst the subscales, where stronger correlations were observed between theoretically related constructs (e.g., strong positive correlation between Interoceptive Attention and Body-Mind Values), although the magnitude of some relationships indicated distinctness (e.g., Sensation-Emotion Articulation and Body-Mind Values).

Analyses were also undertaken to compare BMCQ scores in demographic variables (age, gender, education level, self-reported BMI, smoking status, sport and exercise engagement, yoga practice, and mindfulness and meditation practice). All means, standard deviations, and statistics are provided in the Supplemental Material. Results indicated that several demographic factors elicited significant differences for several BMCQ scales. These included gender, BMI, sport and exercise engagement, yoga practice, and mindfulness and meditation practice. See Tables S2 and S3 in Supplemental Material.

Convergent and discriminant validity

For newly developed measures such as the BMCQ, evaluating correlations with other measures sharing theoretical relatedness enables a preliminary understanding of the meaning of the developed scale.

Statistical analyses for convergent and discriminant validity

To test for convergent and discriminant validity, a similar approach to Mehling et al. [65] was adopted, by which two integrated analyses of correlational patterns were performed: (1) determining whether the BMCQ scales relate to other measures in ways that are consistent with *a priori* hypotheses, and (2) examining correlations of each BMCQ scale across all validity measures and interpreting the meaning of these relationships (i.e., correlation coefficients >0.30). In presenting the results for convergent and discriminant validity, characteristics across all BMCQ scales in conjunction with validity measures and subscales were interpreted to engender greater clarity regarding the body-mind connection.

Hypotheses for correlations between BMCQ and validity measures

A priori hypotheses were formulated in terms of strength and directionality. Based on the approach of Mehling et al. [65], the conceptual factor structure of BMCQ and generated items for these domains were reviewed alongside the related constructs. Due to the number of administered validity scales, hypotheses were developed for each individual BMCQ scale using theoretically relevant subsets of validity measures with respect to which scales would be most highly correlated, inclusive of directionality. All correlations were rank ordered according to Cohen's [22] conventions. This enabled determining whether the measures hypothesised to be most strongly correlated were in the top rank (r=≥0.50), mid-rank (r=0.30 to 0.49), and low rank (r=0.00 to 0.29). Significant correlations were interpreted where p<.05 (two-tailed).

The Interoceptive Attention scale assesses spontaneous and purposeful direction of attention toward internal bodily sensations. This was expected to correlate with other measures of mindful, non-biased attentional capacities and tendencies in the context of interoception and bodily awareness (i.e., MAIA, BAQ), but not with scales assessing heightened sensory processing sensitivity (HSPS). Sensation-Emotion Articulation scale items were generated to represent the inverse of alexithymic characteristics, and therefore expected to negatively relate to alexithymia scales, but positively relate to emotional awareness. This was not expected to relate to scores from questionnaires that do not assess the interface of emotion and interoception (i.e., BAQ, BPQ). The Body-Mind Values scale was expected to relate to other scales assessing regulatory and behavioural tendencies involving higher order interoceptive processing and body awareness more strongly (i.e., adaptive MAIA scales, BAQ). It was expected that this would be distinct from scales involving negative emotional interpretations and behaviours related to pain and discomfort. Table 8 presents hypotheses formulated for convergent and discriminant validity.

Results of correlations between BMCQ scales and validity measures

To assess convergent and discriminant validity, correlational analyses were conducted between BMCQ subscales, the MAIA, BPQ, BAQ, HSPS, and PAQ. Results are discussed with respect to each BMCQ scale and hypothesised correlations. Correlations demonstrating a moderate relationship, irrespective of *a priori* hypotheses, are also reported. Table 9 displays correlation coefficients between BMCQ scales and validity measures.

Body-mind values Stronger beliefs in mind-body integration and the importance of wellbeing was strongly positively correlated with MAIA-Trust., MAIA-BL, and MAIA-SR scales. Body-Mind Values was moderately positively related to MAIA-AR, and the BAQ. By contrast, Body-Mind Values was marginally positively related to MAIA-ND and did not correlate with MAIA-NW. Additionally, correlational patterns indicated that Body-Mind Values moderately positively correlated with MAIA-Not., MAIA-EA, and HSPS-AES. Additionally, this scale moderately negatively correlated with PAQ-Total and PAQ-EOT.

Sensation-emotion articulation A stronger capacity to identify and describe internal body changes in emotional contexts and be internally focused, as measured by the BMCQ Sensation-Emotion Articulation scale, was moderately negatively correlated with PAQ-Total. Further review of the relationship between Sensation-Emotion Articulation, as measured by the BMCQ, and PAQ alexithymia subscales revealed a strong negative correlation with PAQ-EOT and moderate negative correlations with

Table 8 Hypothesised correlations between BMCQ Scales and validation measures for convergent and discriminant validity

BMCQ Scale	Convergent Validity	Discriminant Validity
Body-Mind Values	1. Strong positive with MAIA-Trust. 2. Strong positive with MAIA-BL. 3. Moderate positive with MAIA-SR 4. Moderate positive with MAIA-AR 5. Moderate positive with BAQ	1. Weak positive with MAIA-ND 2. Weak positive with MAIA-NW
Sensation-Emotion Articulation	1. Strong negative with PAQ-Total 2. Moderate negative with PAQ-DIF 3. Moderate negative with PAQ-DDF 4. Moderate negative with PAQ-EOT 5. Moderate positive with MAIA-EA	1. Weak positive with BAQ 2. Weak positive with BPQ
Interoceptive Attention	1. Strong positive with MAIA-AR 2. Moderate positive with MAIA-Not. 3. Moderate positive with BAQ	1. Weak positive with HSPS 2. Weak positive with HSPS-EOE 3. Weak positive with HSPS-AES 4. Weak positive with HSPS-LST

Validity Measures: Interoceptive Sensibility and Bodily Awareness: *MAIA-2* Multidimensional Assessment of Interoceptive Awareness, Version 2, *Not* Noticing, *ND* Not-Distracting, *NW* Not Worrying, *AR* Attention Regulation, *EA* Emotional Awareness, *SR* Self-Regulation, *BL* Body Listening, *Trust* Trusting, *BAQ* Body Awareness Questionnaire, *BPQ* Body Perception Questionnaire; Sensory Processing Sensitivity, *HSPS* Highly Sensitive Person Scale, *EOE* Ease of Excitability, *AES* Aesthetic Sensitivity, *LST* Low Sensory Threshold, Alexithymia, *PAQ* Perth Alexithymia Questionnaire, *DIF* Difficulty Identifying Feelings, *DDF* Difficulty Describing Feelings, *EOT* Externally-Oriented Thinking, *PAQ-Total* Global Alexithymia)

Table 9 Pearson's correlations between BMCQ subscales and validity measures

Validity Measures	Interoceptive Sensibility and Bodily Awareness										Alexithymia				Sensory Processing Sensitivity			
	MAIA-2[a]								BAQ[b]	BPQ[b]	PAQ[a]				HSPS[a]			
BMCQ Subscales	Not.	ND	NW	AR	EA	SR	BL	Trust.			DIF	DDF	EOT	PAQ-Total	EOE	AES	LST	HSPS-Total
Body-Mind Values	_0.46**_	0.13*	0.06	_0.49**_	_0.42**_	_0.51**_	_0.58**_	**_0.67**_**	_0.48**_	_0.13*_	-0.26**	-0.27**	-0.44**	-0.36**	-0.03	0.30**	0.06	0.09
Sensation-Emotion Articulation	0.35**	_0.26**_	0.02	0.28**	0.33**	0.26**	0.35**	0.27**	0.28**	0.11*	-0.34**	_-0.41**_	**_-0.50**_**	_-0.47**_	_0.05_	0.22**	_0.13*_	_0.14**_
Interoceptive Attention	0.43**	0.14**	_0.14*_	0.44**	0.34**	0.36**	0.42**	**0.52****	0.41**	0.08	_-0.37**_	-0.37**	-0.46**	-0.45**	-0.01	_0.39**_	0.04	0.12*

Bolded are the highest correlations for the BMCQ subscale rows, *italicised* are the highest correlations for the validity measure columns

[a] N=313

[b] N=309 **p<.001, *p<.05 (two-tailed)

Validity Measures: Interoceptive Sensibility and Bodily Awareness: *MAIA-2* Multidimensional Assessment of Interoceptive Awareness, Version 2, *Not* Noticing, *ND* Not-Distracting, *NW* Not Worrying, *AR* Attention Regulation, *EA* Emotional Awareness, *SR* Self-Regulation, *BL* Body Listening, *Trust* Trusting, *BAQ* Body Awareness Questionnaire, *BPQ* Body Perception Questionnaire, Sensory Processing Sensitivity, *HSPS* Highly Sensitive Person Scale, *EOE* Ease of Excitability, *AES* Aesthetic Sensitivity, *LST* Low Sensory Threshold, Alexithymia, *PAQ* Perth Alexithymia Questionnaire, *DIF* Difficulty Identifying Feelings, *DDF* Difficulty Describing Feelings, *EOT* Externally-Oriented Thinking, *PAQ-Total* Global Alexithymia)

PAQ-DIF and PAQ-DDF. A moderate positive correlation with MAIA-EA was also observed. There were small but significant positive correlations between Sensation-Emotion Articulation and the BAQ and BPQ, respectively. Correlational patterns indicated that Sensation-Emotion Articulation was also moderately positively correlated with MAIA-Not. and MAIA-BL.

Interoceptive attention The BMCQ Interoceptive Attention scale, which captures the self-reported ability to direct attentional resources toward internal bodily sensations showed moderate positive correlations with MAIA-AR, MAIA-Not., and the BAQ. A low positive correlation with HSPS-Total was observed; Interoceptive Attention was not significantly correlated with HSPS-EOE or HSPS-LST. However, there was a moderate positive correlation with HSPS-AES. In examining patterns of correlations ($r \geq 0.30$), Interoceptive Attention strongly positively correlated with MAIA-Trust., moderately positively correlated with MAIA-BL and MAIA-SR, and moderately negatively correlated with PAQ-Total, PAQ-DIF, PAQ-DDF, and PAQ-EOT. See Table 9.

Discussion

Increasing interest in perceptions and characteristics underlying the mind-body connection has prompted the need for reliable, valid, and efficient measures. The BPQ, MAIA, and BAQ are well established and widely used in the assessment of IS [35]. Although these measures were not developed for the specific purpose of assessing the mind-body connection, interoceptive self-report scales have served as primary assessment tools in mind-body research [75] and as outcome measures to evaluate the effects psychological interventions aimed at improving mind-body integration (e.g., [14]). The aim of this research was to develop a new self-report measure that explicitly assesses the mind-body connection: the BMCQ. This study describes the development and preliminary psychometric evaluation of the BMCQ. An EFA resulted in a three-factor solution reflecting relatively distinct factors underpinning one's connection with both body and mind: Body-Mind Values, Sensation-Emotion Articulation, and Interoceptive Attention.

Internal consistency

The Body-Mind Values, Sensation-Emotion Articulation, and Interoceptive Attention scales produced acceptable to good internal consistency, as demonstrated by coefficient alpha, which were 0.85, 0.74, and 0.80, respectively. Coefficients are contingent upon the number of constituent items, which can explain why the Sensation-Emotion Articulation scale—comprised of three items—produced the lowest. Despite generating positively- and negatively worded items for this scale, the EFA led to the deletion of positively worded items generated for this construct. As such, the scale consisted of only negatively worded items which could have contributed to the coefficient obtained in this present preliminary psychometric assessment [41]. Despite this, BMCQ scales should be considered relative to other established multidimensional questionnaires assessing similar constructs. These present findings reflect ranges observed for theoretically associated MAIA scales in initial [65] and subsequent validations. This indicates that the BMCQ is a reliable measure of mind-body connection domains, despite the scales containing substantially fewer items.

Convergent and discriminant validity

As this is a newly developed self-report measure of the mind-body connection, preliminarily examining convergent and discriminant validity was of utmost importance. Although metrics for establishing convergent and discriminant validity vary across the literature and in practice [20], the method employed in the present study enabled identification of convergent and discriminant evidence for the BMCQ. Expected correlations were hypothesised and generally supported by the data from the present sample. Collectively, the results highlight that BMCQ scales reflect distinct perceptions, as they conceptually and empirically differ to pre-existing tools that measure theoretically associated constructs, and that the mind-body connection should be regarded as a multidimensional construct.

Body-mind values

The Body-Mind Values scale was designed to be a more explicit measure of embodied views and holistic wellbeing. Mind-body beliefs, as measured by this BMCQ scale, were strongly positively correlated with the experience of one's body as safe and trustworthy (MAIA-Trust.), active listening to the body for insight (MAIA-BL) and regulating distress by attention to body sensations (MAIA-SR). These three scales arguably represent the zenith of healthy mind-body integration [65]. Experiencing the body as safe with sufficient trust instilled in one's interpretation of sensations guides motivated decision-making in both the present and future, as informed by one's high-level model that comprises past experiences (e.g., [5, 83]). Substantiating this, moderate positive correlations were observed between the Body-Mind Values scale and MAIA-AR and the BAQ. In terms of implications for motivation and behaviour, the capacity to purposefully focus on the body, regulate attention and distress, and gain additional insight about emotional states to enhance the precision of sensation interpretation [14] may serve as the behavioural outcomes of stronger views regarding mind-body integration and wellbeing importance. Considered together, these related measures capture interoceptive and emotional processing, regulation, and goal-directed action. Furthermore, reviewed correlational patterns revealed moderate positive relationships between Beliefs and Behaviours and measures encapsulating adaptive attentional and regulatory styles involving interoception [63], specifically in awareness of uncomfortable, comfortable, and neutral body sensations (MAIA-Not.) and the connection between body sensations and emotional states (MAIA-EA), which reflect functional interoception [35]. Furthermore, Body-Mind Values was moderately negatively correlated with global alexithymia (PAQ-Total), but particularly in terms of externally oriented thinking and preferences for focussing on the external environment (PAQ-EOT). Taken together, the Body-Mind Values scale encompasses holistic beliefs underscored by a healthy capacity to connect body with mind and facilitates adaptivity in the face of environmental challenges. Thus, it is tenable that these interoceptive and affective concepts underpin one's broader Body-Mind Values, as conceptualised by the BMCQ.

Discriminant evidence further suggested that the Body-Mind Values scale is distinct from the tendency to not ignore or distract oneself from sensations of pain or discomfort (MAIA-ND) or experience minimal emotional distress or worry (MAIA-NW). This is in line with previous findings which demonstrated these MAIA scales are related to pain catastrophising and maladaptive bodily awareness. However, it is noted that the present study excluded participants with chronic pain conditions that might underlie altered attentional focus and catastrophising [13].

Sensation-emotion articulation

The Sensation-Emotion Articulation scale was created to assess the capacity to articulate the emotional meaning of internal bodily sensations, in conjunction with internally oriented thinking. As anticipated, moderate to strong correlations were observed with difficulties identifying feelings (PAQ-DIF), difficulties describing feelings (PAQ-DDF), externally oriented thinking (PAQ-EOT), and global alexithymia (PAQ-Total), as was a moderate positive correlation with MAIA-EA. Such capacities could underpin capabilities for cultivating emotions with precision and specificity across multiple contexts [7, 96]. These abilities are purported to be founded on an unambiguous identification and articulation of feelings [51], which characterises the ability to connect mind with body. Furthermore, the moderate correlation with MAIA-BL might further suggest that the ability to articulate emotions, based on interpretation of bodily sensations, is important for situationally appropriate, motivated behaviour. Together, this implies that the BMCQ capably measures more complex emotional processing of bodily factors than existing self-reports that are used in mind-body research. This is particularly evident when considering other lines of evidence which are weakly suggestive of an association between aspects of self-reported interoception and the multiple facets of alexithymia (e.g., [46, 96]). Though the MAIA-EA scale arguably assesses the ability to identify feelings through connection of sensations with emotions, the present findings demonstrate stronger relationships with alexithymic traits not captured by other scales conceptualised as measures of the mind-body connection—traits that typify a maladaptive mind-body disconnection [31]. Promisingly, the BMCQ Sensation-Emotion Articulation scale explicitly captures these capacities.

This view is particularly emphasised upon review of discriminant evidence for the Sensation-Emotion Articulation scale. Although they were significant, correlations with the BAQ and BPQ were observed to be small in magnitude. Accordingly, this scale is distinct from attentiveness to normal non-emotive body processes (BAQ) and maladaptive hypersensitivity toward bodily sensations (BPQ), given that each of these measures do not examine the interface of interoception and emotion [64]. Moreover, further review of correlations between Sensation-Emotion Articulation and other MAIA subscale scores generally substantiates the view that the scale captures functions beyond facets of subjective interoceptive awareness.

Interoceptive attention

The Interoceptive Attention scale was designed to operationalise the notion that attention can be purposefully and spontaneously directed toward internal bodily sensations. As expected, Interoceptive Attention scores showed moderate positive correlations with MAIA-AR, MAIA-Not., and the BAQ. Each of these scales assess elements of self-reported attentional processes, ranging in complexity. MAIA-Not. forms a foundational facet of attention, by which baseline awareness of sensations is measured. By contrast, MAIA-AR qualitatively involves more sophisticated body-centric attentional processes (i.e., sustained, divided attention), whereas BAQ items involve a capacity to integrate external information relative to the physiological condition of the body [35]. In line with the present correlational evidence, the Interoceptive Attention scale can be interpreted as a parsimonious self-report measure of interoceptive attentional control. Un-hypothesised patterns of correlations further revealed moderate to strong correlations between Interoceptive

Attention and measures encapsulating adaptive attentional and regulatory styles involving interoception [63], including more active listening to the body for insight (MAIA-BL) and greater experiences of one's body as safe and trustworthy (MAIA-Trust.), as well as lower global alexithymia (PAQ-Total)—particularly a diminished preference for features of the external environment (PAQ-EOT). Collectively, this suggests that stronger interoceptive attentional control, as measured by Interoceptive Attention, may facilitate sensing and addressing 'somatic markers' [28] when affective appraisals of bodily sensations are trusted. This is particularly salient, given increasing acknowledgement that bodily states arising from homeostatic perturbation serve as a critical factor in increasing attention, which, in turn, motivates situationally appropriate behaviour to address perceived bodily needs and thus expedite equilibrium [24, 30, 33].

Discriminant validity was also demonstrated, as the Interoceptive Attention scale was mostly unrelated to sensory processing sensitivity—a trait typified by deep cognitive processing of external and internal stimuli that is augmented by greater negative emotional reactivity [3]. Specifically, there was a small positive correlation between Interoceptive Attention and global sensory processing sensitivity (HSPS-Total), and no significant correlation with the propensity to feel overwhelmed by external and internal demands (HSPS-EOE) or experiencing unpleasant arousal in processing of internal and external stimuli (HSPS-LST). Given that such sensory processing characteristics appear driven by avoidance of negative consequences and unpleasant states, and high distractibility [87], this lack of relationship is feasible as the present sample demonstrated non-judgemental, adaptive processing of internal bodily sensations [63]. This is corroborated by the observed small correlation between Interoceptive Attention and the BPQ—a measure of maladaptive attention toward internal bodily sensations [63], and MAIA-ND and MAIA-NW scales, which relate more strongly to pain catastrophising and anxiety-driven bodily focus. In sum, the present results lend credence to the view that Interoceptive Attention forms the basis of the mind-body connection.

Limitations

While the findings are valuable, several limitations should be considered. The convenience sampling, cross-sectional design, and reliance on self-report data for the measurement of these constructs indicate that there should be some caution exerted in interpreting results. This is pertinent, given the proportion of the sample that provided demographical information that has been related to poorer health and wellbeing outcomes (e.g., self-reported BMI, psychiatric diagnosis). Furthermore, it is acknowledged that one item was retained as part of the Interoceptive Attention scale, despite cross-loading on the scale it was generated for—Body-Mind Values. Accordingly, cross-validation studies are strongly suggested to further confirm the structure and validity of the BMCQ. Furthermore, the present study recruited 101 individuals that self-reported a range of psychiatric diagnosis that can differentially affect mind-body connection perceptions (e.g., anxiety and depression; [56]). Samples within the disorder categories were deemed insufficiently powered to interpret EFA of BMCQ factor structures for different disorders. It is suggested that future studies consider more purposeful sampling of clinical populations, coupled with measurement of disorder symptomatology that enables identification of severity, such as administering validated screening tools. This will enable greater clarification of whether the mind-body connection is conceptualised differently amongst particular clinical samples, based on whether the three-factor structure is replicated and further, whether correlational patterns differ.

Implications and future directions

Despite these factors, the current findings are of clinical relevance, considering arguments for the importance of coaching individuals with alexithymia to utilise awareness-of-sensation practices, so as to enable more granular differentiation between bodily perceptions and psychological interpretation [84], the effects of which could be measured utilising the BMCQ scales. A multitude of psychiatric disorders are now viewed as involving both interoceptive and emotional dysfunctions [8, 12, 55, 69]. There appears to be an emergent consideration of interoception in the development of therapeutic interventions that seek to target facets of IS in order to enhance global bodily awareness (e.g., MAIA domains, [14]. However, existing interoceptive self-report measures and interventions drawing upon such features may engender identification of sensations or establishing a baseline connection between sensations and emotions. Although functions such as listening to one's body for insight and bodily trust are important bases for connecting body with mind, the present findings suggest that articulating the link between sensations and emotions, as well as values regarding mind-body integration and wellbeing, are relevant factors. Such appraisals and values may further influence how individuals adapt to and cope with environmental stressors and challenges.

The BMCQ therefore presents a promising tool for clinicians that could also enable the development of more targeted psychological interventions. For instance, clinical populations such as those typified by comorbid interoceptive and emotional dysfunction (e.g., somatic symptom disorder; [50, 56]) could greatly benefit from treatments drawing upon BMCQ constituents. Interventions could potentially address characteristic externalisation that contributes to maladaptive misattributions of bodily sensations across contexts. In doing so, future work should seek to elucidate how Interoceptive Attention, Sensation-Emotion Articulation, and Body-Mind Values factors interact and link with wellbeing outcomes. Whilst the conceptualisation phase of scale development identified three factors that could be targeted in mind-body therapies, it would be valuable to understand whether these mechanisms are hierarchical and relate to an overall second-order construct. Such findings could support the delivery of interventions that are tailored to the presenting individual.

In conclusion, the results from this study indicate that the BMCQ is a parsimonious measure of the mind-body connection. The self-report may be a valuable tool for assessing perceptions related to one's concept of mind-body constituents. To our knowledge, the BMCQ is the first self-report measure that incorporates interoceptive attentional control, the ability to articulate the link between sensations and emotions, and broader mind-body values. Furthermore, the BMCQ is a brief, convenient 13-item self-report measure that extends upon elements of the mind-body connection disparately captured by other self-report scales. The BMCQ provides researchers and clinicians with an alternative Interoceptive Attention scale that differs from pre-existing tools that capture the proclivity to notice sensations, because it considers the direction and allocation of resources to bodily sensations in spontaneous and purposeful manners. Furthermore, the Sensation-Emotion Articulation scale builds upon how emotion is currently captured in similar scales, where awareness of the connection between sensations and discrete emotions is emphasised. With this new scale, identifying and describing this connection is assessed, alongside preference for an internally oriented focus, which is inversely related to alexithymia. Lastly, the BMCQ provides an alternative scale of mind-body beliefs than is currently captured in existing tools; broader, albeit explicit, measurement of whether mind and body are viewed as integrated entities is now captured by the BMCQ. Though the Body-Mind Values scale strongly related to body listening and trusting, endorsement of such concepts may underlie the value one places on their holistic wellbeing.

The present findings indicate that the BMCQ serves as a basis for considering Sensation-Emotion Articulation and Body-Mind Beliefs as forming part of one's mind-body connection in addition to Interoceptive Attention. Based on the preliminary assessment of construct validity, the BMCQ should be considered a multidimensional self-report measure of the mind-body connection—not subjective interoception. Accordingly, the scales and constructs comprising the BMCQ could better serve research pursuits pertaining to the mind-body connection and importantly enable the development of targeted psychological interventions aimed at fostering and fortifying adaptive mind-body connections.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40359-023-01302-3.

Additional file 1: Table S1. Self-Disclosed Diagnoses of Physical and Psychiatric Conditions. **Table S2.** Means and Standard Deviations for BMCQ Scales According to Age, Education Level, BMI (Self-Reported), Smoking Status, Alcohol Consumption, Psychiatric Diagnosis, Sport and Exercise Engagement, Yoga Practice, and Mindfulness and Meditation Practice (*N*=316). **Table S3.** Results of Group Difference Analyses for BMCQ Scales According to Age, Education Level, BMI (Self-Reported), Smoking Status, Alcohol Consumption, Psychiatric Diagnosis, Sport and Exercise Engagement, Yoga Practice, and Mindfulness and Meditation Practice (*N*=316).

Acknowledgements
Not applicable.

Authors' contributions
KVB conceived and designed the project, acquired and processed the data, performed analyses, and drafted the article. ES, JS, and MB conceived and designed the project and supervised the work. All authors participated in data interpretation and revising the article critically and gave final approval for the version to be submitted.

Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Availability of data and materials
Data will be made available upon request.

Declarations

Ethics approval and consent to participate
This study was approved by the Victoria University Human Research Ethics Committee (VUHREC; Application ID: HRE21001). Participants consented to participate by indicating this in the online Qualtrics survey.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 2 September 2022 Accepted: 23 August 2023
Published online: 06 October 2023

References

1. Aaron RV, Blain SD, Snodgress MA, Park S. Quadratic relationship between alexithymia and interoceptive accuracy, and results from a pilot mindfulness intervention. Front Psychiatry. 2020. https://doi.org/10.3389/fpsyt.2020.00132.
2. Ainley V, Apps MA, Fotopoulou A, Tsakiris M. 'Bodily precision': a predictive coding account of individual differences in interoceptive accuracy.

Philos Trans R Soc Lond B Biol Sci. 2016;371(1708):20160003. https://doi.org/10.1098/rstb.2016.0003.
3. Aron EN, Aron A, Jagiellowicz J. Sensory processing sensitivity: a review in the light of the evolution of biological responsivity. Pers Soc Psychol Rev. 2012;16(3):262–82. https://doi.org/10.1177/1088868311434213.
4. Aron EN, Aron A. Sensory-processing sensitivity and its relation to introversion and emotionality. J Pers Soc Psychol. 1997;73(2):345.
5. Barrett LF. The theory of constructed emotion: an active inference account of interoception and categorization. Soc Cogn Affect Neurosci. 2017;12(1):1–23.
6. Barrett LF, Finlay BL. Concepts, goals and the control of survival-related behaviors. Curr Opin Behav Sci. 2018;24:172–9.
7. Barrett LF, Quigley KS, Bliss-Moreau E, Aronson KR. Interoceptive sensitivity and self-reports of emotional experience. J Pers Soc Psychol. 2004;87(5):684–97. https://doi.org/10.1037/0022-3514.87.5.684.
8. Barrett LF, Quigley KS, Hamilton P. An active inference theory of allostasis and interoception in depression. Philos Trans R Soc Lond B Biol Sci. 2016;371(1708):20160011. https://doi.org/10.1098/rstb.2016.0011.
9. Barrett LF, Simmons WK. Interoceptive predictions in the brain. Nat Rev Neurosci. 2015;16(7):419–29.
10. Betka S, Pfeifer G, Garfinkel S, Prins H, Bond R, Sequeira H, Duka T, Critchley H. How do self-assessment of alexithymia and sensitivity to bodily sensations relate to alcohol consumption? Alcohol Clin Exp Res. 2018;42(1):81–8. https://doi.org/10.1111/acer.13542.
11. Boateng GO, Neilands TB, Frongillo EA, Melgar-Quiñonez HR, Young SL. Best practices for developing and validating scales for health, social, and behavioral research: a primer. Front Public Health. 2018;6:149.
12. Bonaz B, Lane RD, Oshinsky ML, Kenny PJ, Sinha R, Mayer EA, Critchley HD. Diseases, Disorders, and Comorbidities of Interoception. Trends Neurosci. 2021;44(1):39–51. https://doi.org/10.1016/j.tins.2020.09.009.
13. Borg C, Emond FC, Colson D, Laurent B, Michael GA. Attentional focus on subjective interoceptive experience in patients with fibromyalgia. Brain Cogn. 2015;101:35–43. https://doi.org/10.1016/j.bandc.2015.10.002.
14. Bornemann B, Herbert BM, Mehling WE, Singer T. Differential changes in self-reported aspects of interoceptive awareness through 3 months of contemplative training. Front Psychology. 2015;5:1504. https://doi.org/10.3389/fpsyg.2014.01504.
15. Brewer R, Cook R, Bird G. Alexithymia: a general deficit of interoception. R Soc Open Sci. 2016;3(10):150664. https://doi.org/10.1098/rsos.150664.
16. Burgmer P, Forstmann M. Mind-body dualism and health revisited: How belief in dualism shapes health behavior. Soc Psychol. 2018;49(4):219–30. https://doi.org/10.1027/1864-9335/a000344.
17. Cabrera A, Kolacz J, Pailhez G, Bulbena-Cabre A, Bulbena A, Porges SW. Assessing body awareness and autonomic reactivity: Factor structure and psychometric properties of the Body Perception Questionnaire-Short Form (BPQ-SF). Int J Methods Psychiatr Res. 2018;27(2):e1596–10.1002/mpr.v27.2. https://doi.org/10.1002/mpr.1596.
18. Carvalho GB, Damasio A. Interoception and the origin of feelings: A new synthesis. BioEssays. 2021;43(6):e2000261. https://doi.org/10.1002/bies.202000261.
19. Cattell RB. The Scree test for the number of factors. Multivariate Behav Res. 1966;1(2):245–76. https://doi.org/10.1207/s15327906mbr0102_10.
20. Clark LA, Watson D. Constructing validity: New developments in creating objective measuring instruments. Psychol Assess. 2019;31(12):1412–27. https://doi.org/10.1037/pas0000626.
21. Corbetta M, Shulman GL. Control of goal-directed and stimulus-driven attention in the brain. Nat Rev Neurosci. 2002;3(3):201–15.
22. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers; 1988.
23. Craig AD. How do you feel? Interoception: the sense of the physiological condition of the body. Nat Rev Neurosci. 2002;3(8):655–66. https://doi.org/10.1038/nrn894.
24. Craig AD. A new view of pain as a homeostatic emotion. Trends Neurosci. 2003;26(6):303–7. https://doi.org/10.1016/s0166-2236(03)00123-1.
25. Craig AD. How do you feel—now? The anterior insula and human awareness. Nat Rev Neurosci. 2009;10(1):59–70.
26. Craig AD. How do you feel? An interoceptive moment with your neurobiological self: Princeton University Press; 2015.
27. Critchley HD, Garfinkel SN. Interoception and emotion. Curr Opin Psychol. 2017;17:7–14.
28. Damasio AR. Descartes' error: Emotion, reason, and the human brain. Putnam; 1994.
29. Damasio, A. (2018). The strange order of things. The life, feelings and the making of culture. Pantheon Books.
30. Damasio AR, Carvalho G. The nature of feelings: Evolutionary and neurobiological origins. Nat Rev Neurosci. 2013;14(2):143–52.
31. De Beradis D, Fornaro M, Orsolini L. "No words for feelings, yet!" Exploring alexithymia, disorder of affect regulation, and the "mind-body" connection. Front Psychiatry. 2020;11:311. https://doi.org/10.3389/fpsyt.2020.593462.
32. Deeks, A., Lombard, C., Michelmore, J. Teede, H. (2009). The effects of gender and age on health related behaviors. BMC Public Health, 9(213). https://doi.org/10.1186/1471-2458-9-213.
33. Denton DA, McKinley MJ, Farrell M, Egan GF. The role of primordial emotions in the evolutionary origin of consciousness. Conscious Cogn. 2009;18(2):500–14. https://doi.org/10.1016/j.concog.2008.06.009.
34. Desmedt O, Luminet O, Corneille O. The heartbeat counting task largely involves non-interoceptive processes: Evidence from both the original and an adapted counting task. Biol Psychol. 2018;138:185–8. https://doi.org/10.1016/j.biopsycho.2018.09.004.
35. Desmedt O, Heeren A, Corneille O, Luminet O. What do measures of self-report interoception measure? Insights from a systematic review, latent factor analysis, and network approach. Biol Psychol. 2022;169:108289. https://doi.org/10.1016/j.biopsycho.2022.108289.
36. Desmedt O, Van Den Houte M, Walentynowicz M, Dekeyser S, Luminet O, Corneille O. How does heartbeat counting task performance relate to theoretically-relevant mental health outcomes? A meta-analysis. Collabra. 2022;8(1):33271. https://doi.org/10.1525/collabra.33271.
37. Dunne J, Flores M, Gawande R, Schuman-Olivier Z. Losing trust in body sensations: Interoceptive awareness and depression symptom severity among primary care patients. J Affect Disord. 2021;282:1210–9. https://doi.org/10.1016/j.jad.2020.12.092.
38. Farb N, Daubenmier J, Price CJ, Gard T, Kerr C, Dunn BD, Klein AC, Paulus MP, Mehling WE. Interoception, contemplative practice, and health. Front Psychol. 2015;6:763.
39. Ferentzi, E., Bogdány, T., Szabolcs, Z., Csala, B., Horváth, Á., Köteles, F. (2018a). Multichannel investigation of interoception: Sensitivity is not a generalizable feature. Frontiers in Human Neuroscience, 12, Article 223. https://doi.org/10.3389/fnhum.2018.00223.
40. Ferentzi E, Drew R, Tihanyi BT, Köteles F. Interoceptive accuracy and body awareness – Temporal and longitudinal associations in a non-clinical sample. Physiol Behav. 2018;184:100–7. https://doi.org/10.1016/j.physbeh.2017.11.015.
41. Field, A. (2013). Discovering statistics using IBM SPSS statistics (4th ed.). SAGE Publications.
42. Flasinski T, Dierolf AM, Rost S, Lutz APC, Voderholzer U, Koch S, Bach M, Asenstorfer C, Münch EE, Mertens VC, Vögele C, Schulz A. Altered Interoceptive Awareness in High Habitual Symptom Reporters and Patients With Somatoform Disorders. Front Psychol. 2020;11:1859. https://doi.org/10.3389/fpsyg.2020.01859.
43. Forstmann M, Burgmer P, Mussweiler T. "The mind is willing, but the flesh is weak" The effects of mind-body dualism on health behavior. Psychol Sci. 2012;23(10):1239–45.
44. Fournier A, Luminet O, Dambrun M, Dutheil F, Pellissier S, Mondillon L. Importance of considering interoceptive abilities in alexithymia assessment. PeerJ. 2019;7:e7615. https://doi.org/10.7717/peerj.7615.
45. Friston K. The free energy principle: a unified brain theory? Nat Rev Neurosci. 2010;11:127–38.
46. Gaggero G, Bizzego A, Dellantonio S, Pastore L, Lim M, Esposito G. Clarifying the relationship between alexithymia and subjective interoception. PLoS One. 2021;16(12):e0261126. https://doi.org/10.1371/journal.pone.0261126.
47. Garfinkel SN, Seth AK, Barrett AB, Suzuki K, Critchley HD. Knowing your own heart: Distinguishing interoceptive accuracy from interoceptive awareness. Biol Psychol. 2015;104:65–74. https://doi.org/10.1016/j.biopsycho.2014.11.004.
48. Gross JJ, Barrett LF. Emotion generation and emotion regulation: One or two depends on your point of view. Emot Rev. 2011;3:8–16.
49. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2013). Multivariate data analysis (7th ed). Pearson Education Limited.

50. Henningsen P, Gündel H, Kop WJ, Löwe B, Martin A, Rief W, Rosmalen J, Schröder A, van der Feltz-Cornelis C, Van den Bergh O, EURONET-SOMA Group. Persistent physical symptoms as perceptual dysregulation: A neuropsychobehavioral model and its clinical implications. Psychosomatic Medicine. 2018;80(5):422–31. https://doi.org/10.1097/PSY.0000000000000588.
51. Hoemann K, Barrett LF, Quigley KA. Emotional granularity increases with intensive ambulatory assessment: Methodological and individual factors influence how much. Front Psychol. 2021;12:704125. https://doi.org/10.3389/fpsyg.2021.704125.
52. IBM Corp. (2021). IBM SPSS Statistics for Mac (Version 28.0) [Computer Software]. Armonk, NY: IBM Corp.
53. James, W. (1948). What is emotion? 1884. In W. Dennis (Ed.), Readings in the history of psychology (pp. 290–303). Appleton-Century-Crofts. https://doi.org/10.1037/11304-033.
54. Kano M, Endo Y, Fukudo S. Association between alexithymia and functional gastrointestinal disorders. Front Psychol. 2018;9:599. https://doi.org/10.3389/fpsyg.2018.00599.
55. Khalsa SS, Adolphs R, Cameron OG, Critchley HD, Davenport PW, Feinstein JS, Feusner JD, Garfinkel SN, Lane RD, Mehling WE, Meuret AE, Nemeroff CB, Oppenheimer S, Petzschner FH, Pollatos O, Rhudy JL, Schramm LP, Simmons WK, Stein MB, Stephan KE, Interoception Summit 2016 participants. Interoception and mental health: A roadmap Biological Psychiatry. Cogn Neurosci Neuroimaging. 2018;3(6):501–13. https://doi.org/10.1016/j.bpsc.2017.12.004.
56. Khalsa SS, Lapidus RC. Can interoception improve the pragmatic search for biomarkers in psychiatry? Front Psychiat. 2016;7:121. https://doi.org/10.3389/fpsyt.2016.00121.
57. Kleckner IR, Zhang J, Touroutoglou A, Chanes L, Xia C, Simmons WK, Quigley KS, Dickerson BC, Barrett LF. Evidence for a large-scale brain system supporting allostasis and interoception in humans. Nat Hum Behav. 2017;1(5):1–14.
58. Kolacz J, Holmes L, Porges SW. Body Perception Questionnaire (BPQ) Manual. 2018.
59. Krosnick, J. A., & Presser, S. (2009). Question and questionnaire design. In J. D. Wright & P. V. Marsden (Eds). Handbook of Survey Research (2nd ed.), 263-314. Elseiver.
60. Lanzara R, Conti C, Camelio M, Cannizzaro P, Lalli V, Bellomo RG, Saggini R, Porcelli P. Alexithymia and somatization in chronic pain patients: A sequential mediation model. Front Psychol. 2020;11:545881. https://doi.org/10.3389/fpsyg.2020.545881.
61. Lindquist KA, Wager TD, Kober H, Bliss-Moreau E, Barrett LF. The brain basis of emotion: A meta-analytic review. Behav Brain Sci. 2012;35:121–43.
62. Mattila AK, Saarni SI, Salminen JK, Huhtala H, Sintonen H, Joukamaa M. Alexithymia and health-related quality of life in a general population. Psychosomatics. 2009;50(1):59–68. https://doi.org/10.1176/appi.psy.50.1.59.
63. Mehling W. Differentiating attention styles and regulatory aspects of self-reported interoceptive sensibility. Philos Trans R Soc Lond B Biol Sci. 2016;371(1708):20160013. https://doi.org/10.1098/rstb.2016.0013.
64. Mehling W. If it all comes down to bodily awareness, how do we know? Assessing bodily awareness. Kinesiol Rev. 2020;9(3):1–7. https://doi.org/10.1123/kr.2020-0021.
65. Mehling WE, Price C, Daubenmier JJ, Acree M, Bartmess E, Stewart A. The Multidimensional Assessment of Interoceptive Awareness (MAIA). PloS One. 2012;7(11):e48230. https://doi.org/10.1371/journal.pone.0048230.
66. Mehling WE, Acree M, Stewart A, Silas J, Jones A. The Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA- 2). PloS One. 2018;13(12):e0208034. https://doi.org/10.1371/journal.pone.0208034.
67. Murphy J, Catmur C, Bird G. Classifying individual differences in interoception: Implications for the measurement of interoceptive awareness. Psychon Bull Rev. 2019;26:1467–71. https://doi.org/10.3758/s13423-019-01632-7.
68. Palser ER, Palmer CE, Galvez-Pol A, Hannah R, Fotopoulou A, Kilner JM. Alexithymia mediates the relationship between interoceptive sensibility and anxiety. PloS One. 2018;13(9):e0203212. https://doi.org/10.1371/journal.pone.0203212.
69. Paulus MP, Stein MB. Interoception in anxiety and depression. Brain Struct Funct. 2010;214(5–6):451–63. https://doi.org/10.1007/s00429-010-0258-9.
70. Perry TR, Wierenga CE, Kaye WH, Brown TA. Interoceptive awareness and suicidal ideation in a clinical eating disorder sample: the role of body trust. Behav Ther. 2021;52(5):1105–13. https://doi.org/10.1016/j.beth.2020.12.001.
71. Petzschner FH, Garfinkel SN, Paulus MP, Koch C, Khalsa SS. Computational models of interoception and body regulation. Trends Neurosci. 2021;44(1):63–76. https://doi.org/10.1016/j.tins.2020.09.012.
72. Pollatos, O., Herbert, B. M. (2018). Interoception: Definitions, dimensions, neural substrates. In G. Hauke, & A. Kritikos (Eds), Embodiment in psychotherapy. Springer, Cham. https://doi.org/10.1007/978-3-319-92889-0_2
73. Porges, S. W. (1993). Body Perception Questionnaire. Laboratory of Developmental Assessment, University of Maryland
74. Preece D, Becerra R, Robinson K, Dandy J, Allan A. The psychometric assessment of alexithymia: Development and validation of the Perth Alexithymia Questionnaire. Pers Individ Differ. 2018;132:32–44.
75. Price CJ, Thompson EA, Cheng SC. Scale of Body Connection: A multi-sample construct validation study. PloS One. 2017;12(10):e0184757. https://doi.org/10.1371/journal.pone.0184757.
76. Qualtrics (2021). Qualtrics XM - Experience Management Software (Version: October 2021) [Computer Software]. Provo, Utah, USA. https://www.qualtrics.com
77. Quigley KS, Kanoski S, Grill WM, Barrett LF, Tsakiris M. Functions of interoception: From energy regulation to experience of the self. Trends Neurosci. 2021;44(1):29–38.
78. Rady A, Alamrawy R, Ramadan I, Abd El Raouf M. Does alexithymia, independent of depressive and anxiety disorders, correlate with the severity of somatic manifestations among patients with medically unexplained physical symptoms? J Exp Psychopathol. 2021;12(4):20438087211043730. https://doi.org/10.1177/20438087211043729.
79. Ring C, Brener J, Knapp K, Mailloux J. Effects of heartbeat feedback on beliefs about heart rate and heartbeat counting: A cautionary tale about interoceptive awareness. Biol Psychol. 2015;104:193–8. https://doi.org/10.1016/j.biopsycho.2014.12.010.
80. Schachter S, Singer J. Cognitive, social, and physiological determinants of emotional state. Psychol Rev. 1962;69(5):379–99. https://doi.org/10.1037/h0046234.
81. Schandry R. Heart beat perception and emotional experience. Psychophysiology. 1981;18(4):483–8.
82. Seth AK. Interoceptive inference, emotion, and the embodied self. Trends Cogn Sci. 2013;17(11):565–73. https://doi.org/10.1016/j.tics.2013.09.007.
83. Seth AK, Friston KJ. Active interoceptive inference and the emotional brain. Philos Trans R Soc Lond B Biol Sci. 2016;371(1708):20160007. https://doi.org/10.1098/rstb.2016.0007.
84. Shalev I. Motivated Cue Integration in Alexithymia: Improving Interoception and Emotion Information Processing by Awareness-of-Sensation Techniques. Front Psychiatry. 2019;10:329. https://doi.org/10.3389/fpsyt.2019.00329. PMID: 31133902.
85. Shields SA, Mallory ME, Simon A. The body awareness questionnaire: reliability and validity. J Pers Assess. 1989;53(4):802–15.
86. Sifneos PE. The prevalence of "alexithymic" characteristics in psychosomatic patients. Psychother Psychosom. 1973;22(2–6):255–62. https://doi.org/10.1159/000286529.
87. Smolewska KA, McCabe SB, Woody EZ. A psychometric evaluation of the Highly Sensitive Person Scale: The components of sensory-processing sensitivity and their relation to the BIS/BAS and "Big Five." Pers Individ Differ. 2006;40(6):1269–79. https://doi.org/10.1016/j.paid.2005.09.022.
88. Staud R, Rodriguez M. Mechanisms of disease: pain in fibromyalgia syndrome. Nat Rev Rheumatol. 2006;2:90–8. https://doi.org/10.1038/ncprheum0091.
89. Strigo IA, Craig AD. Interoception, homeostatic emotions and sympathovagal balance. Philos Trans R Soc Lond B Biol Sci. 2016;371(1708):20160010. https://doi.org/10.1098/rstb.2016.0010.
90. Suksasilp C, Garfinkel SN. Towards a comprehensive assessment of interoception in a multi-dimensional framework. Biol Psychol. 2022;168:108262. https://doi.org/10.1016/j.biopsycho.2022.108262.
91. Tabachnick, B. G., Fidell, L. S. (2013). Using multivariate statistics (6th ed.) Boston: Pearson/Allyn & Bacon.

92. Todd J, Swami V, Aspell JE, Furnham A, Horne G, Stieger S. Are some interoceptive sensibility components more central than others? Using item pool visualisation to understand the psychometric representation of interoception. PloS One. 2022;17(12):e0277894. https://doi.org/10.1371/journal.pone.0277894.
93. Trevisan DA, Altschuler MR, Bagdasarov A, Carlos C, Duan S, Hamo E, Kala S, McNair ML, Parker T, Stahl D, Winkelman T, Zhou M, McPartland JC. A meta-analysis on the relationship between interoceptive awareness and alexithymia: Distinguishing interoceptive accuracy and sensibility. J Abnorm Psychol. 2019;128(8):765–76. https://doi.org/10.1037/abn0000454.
94. Trevisan DA, Mehling WE, McPartland JC. Adaptive and Maladaptive Bodily awareness: Distinguishing interoceptive sensibility and interoceptive attention from anxiety-induced somatization in autism and alexithymia. Autism Res. 2021;14(2):240–7. https://doi.org/10.1002/aur.2458.
95. Ujiie, Y., Takahashi, K. (2022). Subjective sensitivity to exteroceptive and interoceptive processing in Highly Sensitive Person. Psychological Reports, 0(0). https://doi.org/10.1177/00332941221119403
96. Ventura-Bort C, Wendt J, Weymar M. The role of interoceptive sensibility and emotional conceptualization for the experience of emotions. Front Psychol. 2021;12. https://doi.org/10.3389/fpsyg.2021.712418.
97. Wager TD, Davidson ML, Hughes BL, Lindquist MA, Ochsner KN. Prefrontal-subcortical pathways mediating successful emotion regulation. Neuron. 2008;59(6):1037–50. https://doi.org/10.1016/j.neuron.2008.09.006.
98. Whitehead WE, Drescher VM, Heiman P, Blackwell B. Relation of heart rate control to heartbeat perception. Biofeedback Self Regul. 1977;2:371–92.
99. World Health Organization. (2021). Obesity. https://www.who.int/health-topics/obesity#tab=tab_1
100. Zahid, A., Taylor, G. J., Lau, S. C. L., Stone, S., Bagby, R. M. (2023). Examining the Incremental Validity of the Perth Alexithymia Questionnaire (PAQ) Relative to the 20-Item Toronto Alexithymia Scale (TAS-20). Journal of Personality Assessment, 1–12. Advance online publication. https://doi.org/10.1080/00223891.2023.2201831
101. Zaki J, Davis JI, Ochsner KN. Overlapping activity in anterior insula during interoception and emotional experience. NeuroImage. 2012;62(1):493–9. https://doi.org/10.1016/j.neuroimage.2012.05.012.
102. Zamariola G, Maurage P, Luminet O, Corneille O. Interoceptive accuracy scores from the heartbeat counting task are problematic: Evidence from simple bivariate correlations. Biol Psychol. 2018;137:12–7. https://doi.org/10.1016/j.biopsycho.2018.06.006.
103. Zamariola G, Luminet O, Mierop A, Corneille O. Does it help to feel your body? Evidence is inconclusive that interoceptive accuracy and sensibility help cope with negative experiences. Cogn Emot. 2019;33(8):1627–38.
104. Zhang J, Hua Y, Xiu L, Oei TP, Hu P. Resting state frontal alpha asymmetry predicts emotion regulation difficulties in impulse control. Pers Individ Differ. 2020;159:109870. https://doi.org/10.1016/j.paid.2020.109870.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Chapter 6. Elucidating the Role of Mind-Body Connection Profiles in Emotional Reactivity and Regulation Amongst Typically Developed Adults

Paper 3 builds upon the findings of Paper 2 to validate the BMCQ in a new sample of typically developed adults. This paper also addresses several gaps in the literature, being the first to provide classification of latent mind-body connection profiles through inclusion of interoceptive attention, identification and description of emotions with internal focus, and mind-body belief variables in an LPA. This combination of variables has not been applied in existing research, thus expanding conceptualisation of the psychological constituents underlying the mind-body connection. This paper further extends on previous studies examining how emotional reactivity relates to either self-reported interoception or alexithymia. Specifically, the study considers how these factors interact with explicit mind-body beliefs within distinct profiles to influence typically experienced emotional reactivity phases (frequency, intensity, persistence) and ease of regulation for both positive and negative emotions. This study lays the foundation for more inclusive, precise classification of mind-body connections and specific mechanisms to target in mind-body interventions aimed at improving awareness of sensations and adaptive emotional functioning. Supplemental materials accompanying this paper are provided in Appendix G. For evidence of submission, see Appendix H.

Manuscript submitted on 25/07/2024 – Under Review (BMC Psychology)

6.1. Abstract

Background: Adaptive emotional functioning necessitates a strong mind-body connection. The 13-item Body-Mind Connection Questionnaire (BMCQ) was developed to measure attention directed to sensations (Interoceptive Attention), identifying and describing sensations associated with emotions (Sensation-Emotion Articulation), and beliefs regarding mind-body integration and wellbeing (Body-Mind Values). This study aimed to (1) confirm and refine the BMCQ in a new sample of typically developed adults through confirmatory factor analysis (CFA), (2) identify distinct mind-body connection profiles through latent profile analysis (LPA), and (3) explore the impact of these profiles on emotional reactivity and regulation.

Methods: Data were collected from 401 typically developed adults with and without self-reported psychological disorders, aged 18 to 50 (M_{age} = 30.62, SD_{age}= 7.98), who completed the BMCQ and the Multidimensional Emotion Questionnaire, assessing frequency, intensity, persistence, and regulation of positive and negative emotions.

Results: The CFA led to removal of three BMCQ items in the sample with no disorder, confirming a three-factor model with good fit, resulting in the BMCQ-10 (CFI: .98, TLI: .98, GFI: .97, RMSEA: .05, RMR: .08) observed, and reliable internal consistency for the scales (α = 0.70 to 0.82). LPA in the pooled sample revealed three mind-body connection profiles: Strong Mind-Body Connection, Weak Mind-Body Connection, and Mind-Body Disconnection. The Strong Mind Body Connection profile reported more frequent, intense, and persistent positive emotions and found regulating positive and negative emotions the easiest. Conversely, the Weak Mind-Body Connection profile reported less frequent, intense positive emotions, and greater regulation difficulties. The Mind-Body Disconnection profile reported the least intense positive emotions and, with a psychological disorder present, found regulating emotions easier than both the Strong and Weak profiles.

Conclusions: The BMCQ-10 holds promise as an efficient measure of salient mind-body connection constituents. Findings underscore the nuanced, significant within-group variability that exists amongst mind-body connection beliefs, emotional reactivity, and ease of regulating emotions. Targeted interventions for persons with particular mind-body connection profiles (for example, mindfulness) may be effective avenues for enhancing adaptive beliefs which may promote the cultivation of positive emotions and improve emotion regulation in clinical and non-clinical groups.

Key words: interoception, alexithymia, mind-body connection, individual differences, emotional reactivity, emotion regulation

6.2. Introduction

At their core, emotions enable us to make meaningful sense of our internal and external experiences. They are generally conceptualised as psychological states involving subjective experiences, physiological changes, cognitions, and expressive behaviours (1, 2). Davidson (3, 4) proposed that emotional responses comprise related but distinguishable components. Specifically, individuals may differ with respect to (1) the relative ease of emotional response activation—i.e., the threshold required for an emotional response to be elicited and the rate of arousal levels reaching peak amplitude, thus determining the *frequency* of emotional responses, (2) the *intensity* of an emotional response, and (3) the *duration* of an emotional response—i.e., the length of time required for arousal levels to return to baseline. Such components acknowledge the chronometric nature of emotions and are collectively termed 'emotional reactivity' (3, 5). Adaptive emotional functioning entails generating goal-appropriate, timely, and contextually proportionate responses, contrasting with inadequate, maladaptive reactivity, characterised by emotional hyper- and hypo-reactivity. Maladaptive emotional reactivity contributes to chronic physiological dysregulation, stemming from the misinterpretation of valence and arousal, together with deficits in learning, memory, and attentional deployment to emotional stimuli and bodily sensations (6, 7).

Cultivating positive emotions is shown to have significant momentary and long-term benefits. According to Fredrickson (8), positive emotions play a crucial role in the 'broaden-and-build' theory, which suggests that these emotions can facilitate the cultivation of physical, intellectual, and social resources, leading to long-term psychological wellbeing. Moreover, their cultivation can be particularly effective in preventing and treating conditions rooted in negative emotionality, such as depression, anxiety, and stress-related illnesses (9). Indeed, positive and negative emotions have distinct impacts on the body: positive affectivity is negatively associated with biomarkers indicating chronic dysregulation of homeostatic processes following prolonged, intense activation of stress systems (10), whereas negative affectivity has the opposite effect (11). Furthermore, longitudinal increases in positive emotionality have been related to lower pro-inflammatory and antiviral gene expression, whereas the inverse has been observed for increased negative emotionality (Rahal et al., 2023).

Emotions are increasingly understood as inexorably involving interoception—the afferent signalling, processing, and neural and mental representation of internal bodily signals (1, 12-15). Interoceptive sensations are typically experienced consciously as affect—comprising valence and arousal dimensions—and are proposed to form a foundational component of emotional experiences (14, 16). The synchronous coupling of bodily sensations and emotions promotes the enactment of goal-directed behaviours aimed at restoring or maintaining physiological integrity (1, 14, 15, 17). In this view, adaptive emotional responses necessitate coherence in detecting, appraising, and categorising body sensations. Interoceptive and emotional dysfunctions (e.g., emotion dysregulation), underlie various clinical conditions, including depression, anxiety, functional disorders, and medically unexplained symptoms (18-21). As such, they are important mechanisms to consider in the context of a client's presentation. Investigations concerning reactivity for positive and negative emotions, however, have seldom holistically considered beliefs and perceived competencies in mind-body connection processes, including interoceptive attentional deployment and emotional capacities together.

Habitual propensities for being aware of interoceptive sensations and emotional awareness have been found to contribute to emotional reactivity. The quality of adaptive interoceptive attention is conceptualised as reflective of active attention, which adjusts, filters, and augments sensory inputs from the body (22). By contrast, exaggerated and maladaptive interoceptive attention is driven by hypervigilance and negatively biased interpretations of sensations (23), and related to illness anxiety (24) and somatisation (25). Evidence further indicates that adaptive interoceptive attentional components and regulatory behaviours are more strongly associated with enhanced identification and description of emotions (26) and positive emotionality (27, 28). Conversely, reactivity for negative emotions appears related to dysfunctional processing and interpretation of bodily sensations, including maladaptive, hypervigilant interoceptive attention (23, 27), negatively biased reporting (29), and somatosensory amplification (28, 30).

Interoceptive attunement and values may also influence the degree to which emotional arousal is perceived. Individuals with positive and neutral interoceptive beliefs and lower sympathetic nervous system (SNS) activity tend to report lower levels of emotional arousal, while those with positive or neutral interoceptive beliefs and greater SNS activity report increased levels of emotional arousal. Contrarily, individuals with negative interoceptive beliefs have reported increased emotional arousal, regardless of whether they experience high or low SNS activity (31). This suggests that individuals with stronger correspondence between physiological and emotional arousal may be more likely to value and incorporate their physiology into emotional experiences, while those who do not value bodily sensations may ignore or suppress their physiological sensations and rely on external features of the environment to inform their emotional experiences (31). Similar observations have been made amongst individuals with marked difficulties identifying and articulating emotional experiences, such as those with alexithymia (32). Persons with high alexithymia struggle to differentiate emotions from sensations, perceiving them as similar—for example, feeling anger as hunger, and vice versa (33), suggesting possible disregard or indifference toward valuing sensations and emotions.

The Body-Mind Connection Questionnaire (BMCQ) is a new 13-item self-report measure of adaptive mind-body connection beliefs (34). The questionnaire is multidimensional, consisting of three distinct scales assessing the capacity to spontaneously and purposefully direct attention to internal bodily signals (Interoceptive Attention), the ability to identify and describe the link between sensations and emotions, together with internal orientation (Sensation-Emotion Articulation), and beliefs regarding wellbeing and mind-body integration (Body-Mind Values). The BMCQ was developed to facilitate parsimonious measurement of mind-body connection constituents by self-report, where preliminary findings indicated differential relationships between BMCQ scales and theoretically related aspects. Specifically, the Body-Mind Values scale was shown to correlate most strongly with Trusting, Body Listening, and Self-Regulation scales from the Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2; 35). Moreover, Sensation-Emotion Articulation was positively related to Emotional Awareness and Body Listening scales from the MAIA, whereas stronger inverse relationships with alexithymia (difficulties identifying and describing feelings, externally oriented thinking) were shown. Lastly, Interoceptive Attention was most strongly related to Attention Regulation and Noticing MAIA scales. However, several retained questionnaire items demonstrated cross-loading, low primary loadings, and low communalities (34). The present study scrutinises these items in another sample of typically developed adults. As the BMCQ is a new scale, evidence pertaining to its association with adaptive and maladaptive outcomes is limited. Further exploration of the BMCQ scales could shed light on how distinct mind-body connection profiles may influence the experience of emotions and ease of regulation.

To date, studies have scarcely examined the relation between mind-body connection profiles and emotional reactivity. Yun-Hsin et al. (28) recently did so in a Taiwanese sample using cluster analysis to establish three interoceptive sensibility profiles, according to MAIA dimensions, and examined their effect on emotional reactivity using the Perth Emotional Reactivity Scale (PERS; 36). A high interoceptive sensibility cluster demonstrated strong awareness of bodily sensations and emotions, and capacities for self-regulation using sensations. A low interoceptive sensibility cluster lacked perceived capacity to attend to bodily sensations and did not self-regulate by drawing attention to sensations. The worrier cluster showed heightened awareness of bodily sensations but experienced worry during discomfort. Results indicated that the high interoceptive sensibility cluster consistently exhibited higher levels of reactivity for positive emotions compared to worrier and low interoceptive sensibility clusters. Conversely, worrier and low interoceptive sensibility clusters reported the highest reactivity for negative emotions. Although the PERS comprehensively assesses emotional reactivity for positive and negative emotions, other scales measuring reactivity for specific emotions exist.

The Multidimensional Emotion Questionnaire (MEQ; 37), like the PERS (36), was developed according to Davidson's (3) emotional reactivity model. Each assess typical experiences of positive and negative emotions according to the separable phases of (1) activation or frequency; (2) intensity; and (3) duration or persistence. Although semantic differences exist with respect to scale labels (e.g., PERS–activation cf. MEQ–frequency), there are discrepancies in how the scales capture this. The MEQ captures reactivity components based on five discrete positive (e.g., happiness, enthusiasm) and five negative (e.g., sadness, anger) emotions. Although some emotions measured by the MEQ overlap with those specified in PERS items, the latter questionnaire lacks specificity in capturing reactivity for individual emotions. Differences also emerge in scale structure and how respondents rate their emotional experiences. The PERS provides indices of emotional reactivity phases by requesting respondents to rate worded items on a 5-point Likert scale ranging from *very unlike me* (1) to *very like me* (5). Conversely, the MEQ is structured to specify discrete emotions, instructing respondents to rate how often, intense, and long-lasting the emotion is typically experienced—assessing frequency, intensity, and persistence phases, respectively. These are also rated on 5-point Likert scales, albeit with more specific response scale anchors—for instance, frequency items range from *about 1 month or less* (1) to *more than 3 times each day* (5)—thereby enabling more granular ratings. Moreover, the MEQ was developed to address limitations of existing reactivity questionnaires lacking assessment of how easy individuals find regulating discrete emotions, which is absent in the PERS. Inclusion of regulation scales in the MEQ is advantageous, as emotional reactivity and capacities for regulating emotions are closely intertwined, interactive processes which shape emotional experiences and responses (6). Heightened reactivity is often more challenging to regulate (38), and poor regulation abilities can lead to intensified, perseverative emotional responses (39). We deemed the MEQ's scope of discrete emotions, granular chronometry, and regulation items suitable for this study's exploratory purposes.

The purpose of the current study was to confirm the BMCQ in a new sample of typically developed adults through confirmatory factor analysis. The study adopted a person-centred approach by employing LPA which aimed to distinguish mind-body connection profiles based on BMCQ scales, including interoceptive attentional control (Interoceptive Attention), capacities for identifying and describing the link between sensations and emotions (Sensation-Emotion Articulation), and beliefs regarding physical and mental wellbeing (Body-Mind Values). Lastly, the study aimed to examine the emergent latent profiles and their effect on reactivity for positive and negative emotions and emotion regulation outcomes.

6.3. Method

6.3.1. Participants

As part of a larger cross-sectional study concerning interoception and emotion, a convenience sample of 401 participants ($M_{age} = 30.62$, $SD_{age} = 7.98$) from English-speaking countries was recruited for the study through the Prolific recruitment service. To be eligible for inclusion, participants were required to be: aged 18-50, fluent in the English language, reside in Australia, Canada, New Zealand, the United Kingdom, or the United States, and free of a current chronic pain condition (e.g., fibromyalgia). An *a priori* sample size of 260 was deemed an appropriate minimum for validation of the BMCQ, providing a ratio of 20 respondents per item (40). However, structural equation modelling techniques, (e.g., confirmatory factor analysis) require larger samples to provide reliable and stable estimates (i.e., 200-300 minimum; 40, 41). Thus, the present sample was deemed sufficient for enhancing statistical power to examine the BMCQ factor structure.

6.3.2. Materials

Body-Mind Connection Questionnaire (BMCQ).

The BMCQ (34) is a 13-item, 3-scale measure that was developed to capture self-reported mind-body connection valuations. Scales include *Body-Mind Values*, consisting of six items related to beliefs in mind-body integration and perceived importance of wellbeing, *Sensation-Emotion Articulation*, comprised of three negatively keyed items involving capacities for identify and describe internal bodily changes in emotional contexts and preference for the internal environment, and *Interoceptive Attention*, consisting of four items capturing the ability to direct attentional resources toward interoceptive stimuli in purposeful and spontaneous manners. Items are rated on a 7-point Likert-scale, ranging from *not at all true of me* (1) to *very true of me* (7). Scores for each scale are obtained by averaging the sum of responses. The preliminary evaluation demonstrated that the BMCQ scales are distinct, and differentially related to self-reports capturing theoretically related constructs including self-reported interoceptive attention and interpretation, and alexithymia. Acceptable to good internal consistency reliability was previously observed for BMCQ scales (α = 0.74 to 0.85). The 13-item BMCQ administered for cross-validation is available in File S1 of the Supplemental Materials.

Multidimensional Emotion Questionnaire (MEQ).

The MEQ is a self-report measure of emotional experiences, requiring respondents to consider their typical experience of five positive (happy, excited, enthusiastic, proud, inspired) and five negative (sad, afraid, angry, ashamed, anxious) discrete emotions (37). Participants rate experiences of each emotion on 5-point Likert scales for four facets: (1) Frequency, *'How often?'* ranging from *about once per month or less* to *more than 3 times each day*; (2) Intensity, *'How intense?'*, ranging from *very low* to *very high*; (3) Persistence, *'How long-lasting?'*, ranging from *less than 1 minute* to *longer than 4 hours*; and (4) Regulation, *'How easy to regulate?'*, ranging from *very easy* to *very difficult*. Qualitative descriptors were converted to numerical values for scoring; nomination of the first descriptor corresponded to a score of 1 and nomination of the last to a score of 5. Summary scores for Frequency, Intensity, Persistence, and Regulation were computed for positive and negative emotions, respectively. Higher scores indicate greater frequency, intensity, or persistence of positive or negative emotions. Frequency, intensity, and persistence facets form components of an Emotional Reactivity factor (3, 37). For Regulation scales, higher scores indicate greater difficulty regulating positive or negative emotions. Evidence for convergent validity is observed, where MEQ reactivity summary scores strongly correlated with positive and negative affectivity scores from the Positive and Negative Affect Schedule (Positive: r = 0.72, Negative: r = 0.69). Moderate correlations between the MEQ regulation scales and total scores from the Difficulties in Emotion Regulation Scale were shown (Positive: $r = 0.31$, Negative: $r = 0.42$) (37). Internal consistency reliability for MEQ facets was good in the present sample (see Table 5).

6.3.3. Procedure

Following ethics approval from the Victoria University Human Research Ethics Committee for a larger study examining interoception and emotion, the study was advertised through Prolific, which included screening for inclusion and exclusion criteria. Interested individuals accessed a survey link for the study that was hosted online using Qualtrics software. After providing informed consent, participants completed a demographic questionnaire and provided information regarding health and lifestyle factors. Then, they proceeded to the questionnaires. Upon study completion, they were remunerated for their participation.

6.3.4. Statistical Analyses

To determine whether the 13 BMCQ items conformed to a hypothesised structure and fit the previously identified three-factor model (34) in a new sample of typically developed adults, confirmatory factor analysis (CFA) was conducted using SPSS AMOS, Version 29. Maximum likelihood factoring was employed to estimate the models. Model goodness of fit was evaluated via the χ^2 statistic (40). Although non-significant χ^2 (p >.05) is indicative of excellent fit, the test is known to reject models marginally differing from the population structure (41). We therefore considered additional fit indices, including the ratio of chi-square to its degrees of freedom (CMIN/df), comparative fit index (CFI), Tucker-Lewis index (TLI), goodness of fit index (GFI), root mean square residual (RMR), and root mean squared error of approximation (RMSEA). For absolute fit, CMIN/df values <3.0 indicate better fit between the model and the data. CFI, TLI, and GFI values ≥ .90 were deemed to indicate acceptable fit and values $\geq .95$ considered as evidence of excellent fit (42, 43). RMSEA and RMR $< .08$ were judged to indicate acceptable fit and values around .05 indicated excellent fit (40). Internal consistency reliability of the BMCQ scales was evaluated with Cronbach's alpha in SPSS, Version 29. Inter-scale correlations were assessed through Pearson's bivariate correlations.

Following revision of the BMCQ through CFA, participants' BMCQ subscale scores were analysed through Latent Profile Analysis (LPA) using the TidyLPA package in R-Studio (version 4.3.2). This was conducted to further understand mind-body connection profiles within the sample. Analysis spanned models ranging from two to three profiles to ascertain the most fitting representation of the data. Determination of the optimal model was based on evaluation of several statistical indices, following guidelines proposed by Spurk et al. (44). We prioritised the model exhibiting lower Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and the Sample-Size Adjusted BIC (SSA-BIC) values, as these metrics are indicative of fit suitability. Moreover, a significant Bootstrapped Likelihood Ratio Test (BLRT) served as a key indicator, indicating that a given model provides a better fit than a model with a single profile where $p < .05$. Classification accuracy via entropy values were also considered. Higher figures (i.e., ≥ 0.80) denote a model's precision in categorising participants into distinct profiles, although cut-offs of between 0.60 and 0.80 are also appropriate (44).

In addition to these statistical criteria, emergent latent profiles were inspected through one-way between-subjects analysis of variance (ANOVA) in SPSS to investigate meaningful differences between the mind-body connection profiles across the BMCQ subscales using Welch's F-tests with Games-Howell post-hoc pairwise comparisons, which are robust to heterogenous group variances and unequal groups sizes (45).

Two separate one-way multivariate analysis of covariance (MANCOVA) were also conducted to compare mind-body connection profiles identified via LPA on three dependent variables (DVs) of reactivity for positive and negative emotions (frequency, intensity, and persistence), with self-reported psychological disorder entered as a covariate, as conditions such as depression and anxiety influence emotional reactivity and emotion regulation (6, 39). To determine whether the mind-body connection profiles affected regulation of positive and negative emotions, one-way between subjects analysis of covariance (ANCOVAs) with self-reported disorder as covariate were planned.

6.5. Results

Sample demographics are summarised in Table 1. Overall, the sample endorsed relatively healthy practices and was comparable to the sample included in the original evaluation of the BMCQ (34). Ninety-two participants self-reported a current psychological disorder, most commonly comorbid depression and anxiety. For further detail regarding self-reported disorders, see Table S1 of the Supplemental Materials.

Table 1.

Demographic characteristics of the sample (N=401).

Characteristic	*N* (%)
Age	
18-19	19 (4.8%)
20-29	179 (44.8%)
30-39	138 (34.5%)
40-50	64 (16.0%)
Gender Identity	
Male	195 (48.6%)
Female	197 (49.1%)
Another term (e.g., non-binary)	6 (1.5%)
Prefer not to answer	3 (0.7%)
Country of Residence	

Australia	11 (2.9%)
Canada	79 (19.7%)
New Zealand	286 (71.3%)
United Kingdom	6 (1.5%)
United States	19 (4.7%)
Level of Education	
Year 10 or lower	4 (1.0%)
Year 12	152 (37.9%)
Bachelor's Degree	140 (34.9%)
Honours	16 (4%)
TAFE or vocational training	27 (6.7%)
Masters	51 (12.7%)
PhD or Doctorate	5 (1.2%)
Graduate Certificate	6 (1.5%)
Body Mass Index (BMI)*	
Underweight (<18.5)	10 (2.5%)
Normal (18.5-24.9)	180 (44.9%)
Overweight (25.29.9)	94 (23.4%)
Obese (30+)	99 (24.7%)
Smoking Status	
Smoker	33 (10.4%)
Non-Smoker	283 (89.6%)
Alcohol Consumption	
0-1 time per week	224 (70.9%)
1-2 times per week	56 (17.7%)
2-3 times per week	19 (6.0%)
3-4 times per week	7 (2.2%)
4 or more times per week	10 (3.2%)
Sport or Exercise Engagement	
Yes	208 (65.8%)
No	108 (34.2%)
Yoga Practice	
Yes	52 (16.5%)
No	264 (83.5%)
Meditation and Mindfulness Practice	
Yes	75 (23.7%)
No	241 (76.3%)
Psychological Disorder*	
Yes	92 (22.9%)
No	309 (77.1%)

* Self-reported

Confirmatory Factor Analysis

Preliminary analyses were conducted to ensure there were no violations of missing data, normality, linearity, homoscedasticity, presence of outliers, and multicollinearity assumptions underlying CFA (41). Ninety-two participants with self-reported psychological disorders were omitted from analysis, ensuring confirmatory analysis was restricted to a sample comparable to the preliminary evaluation of the BMCQ (34). This provided a sample of 309 participants. There were no missing BMCQ data. Inspection of standardised residual plots indicated that BMCQ items were linear and normally distributed, and homoscedasticity was assumed, as residuals were equally spread. Ten multivariate outliers were identified and removed from CFA analysis, as they exceeded Mahalanobis' distance (p <.001). The analysed sample was reduced to 299 participants, providing an appropriate ratio of 23 respondents per item. Correlations between predictor variables were below 0.80, and VIF scores of coefficients below 10, indicating an absence of multicollinearity (41, 46).

As shown in Table 2, CFA results indicated poor fit for the original 13-item BMCQ structure to the data and the initially determined model through exploratory factor analysis was not adequate. Given the poor fit, model modification was considered. Examination of modification indices indicated model misspecification sources—specifically items 3 and 4 from the Interoceptive Attention scale, and items 5, 6, 12 and 13 from the Body-Mind Values scale. Covariance between these error terms were added, which improved model fit, although review of CMIN/df, RMSEA, RMR values indicated that the fit remained poor. Moreover, standardised residual covariances for items 1, 5, and 10 were primarily above 2.0, indicating specification discrepancies (42). Accordingly, the three items were removed.

Following these modifications, allowing for error terms to covary (item 3-4; item 12-13), the revised model demonstrated good fit compared to the original model, according to CMIN/df, CFI, TLI, GFI, RMSEA, and RMR. One item from the Sensation Emotion

Articulation scale (original Item 9 – *'I tend to focus on things happening in my physical environment rather than what is happening inside of me'*) had a low factor loading and squared multiple correlation. The item was retained for theoretical purposes based on the involvement of externally oriented thinking in alexithymia (47, 48) and the Sensation-Emotion Articulation construct (34). Table 2 provides model fit indices for original and modified BMCQ models. Table 3 contains standardised factor loadings for BMCQ items according to scale and squared multiple correlations for the refined 10-item BMCQ (BMCQ-10). See File S2 of Supplemental Material for the revised 10-item BMCQ following CFA.

Table 2.

Fit indices for confirmatory factor analyses on the original and refined BMCQ (N=299).

CFA	χ^2	*df*	*p*	CMIN/*df*	CFI	TLI	GFI	RMSEA	RMR
Original 13-item BMCQ	329.92	62	<.001	5.32	.84	.8	.85	.12	.14
13-item modified BMCQ	289.99	59	<.001	3.49	.91	.89	.90	.09	.11
10-item refined BMCQ	48.27	30	.019	1.61	.98	.98	.97	.05	.08

Note. CMIN/df: chi-square to its degrees of freedom; CFI: comparative fit index; TLI: Tucker-Lewis index; GFI: goodness of fit index; RMSEA: root mean squared error of approximation, RMR: root mean square residual.

Table 3.

Standardised CFA factor loadings and squared multiple correlations (SMC) for BMCQ-10 (N=299)

Item	Standardised Factor Loadings			
	Body-Mind Values	Sensation-Emotion Articulation	Interoceptive Attention	SMC
I value being well-balanced in my body and my mind.	.754			.568
Feeling mentally well is something that I prioritise in life.	.759			.577
Feeling physically well is something that I prioritise in life.	.716			.513
I am usually proactive in addressing the needs of my body.	.678			.459
I tend to focus on things happening in my physical environment rather than what is happening inside of me. *		.480		.231
If I were asked to, I'd find it hard to describe changes in my body associated with positive or negative emotions. *		.806		.649
I find it hard to identify changes in my body associated with positive or negative emotions. *		.698		.487
It is easy for me to focus on specific sensations if I purposefully think about them.			.754	.568
It is easy for me to focus on specific sensations if they are suddenly experienced.			.752	.565
I can direct my focus toward how specific parts of my body feel.			.815	.664

* Item reverse scored.

Means, internal consistency and inter-scale correlations

Score interpretation for BMCQ scales, means, standard deviations, range of observed values, Cronbach's alpha coefficients, and correlations between BMCQ-10 scales for the sample with no self-reported psychological disorder are presented in Table 4.

Table 4.

Descriptive statistics for BMCQ-10 scales with Cronbach alphas, scale means, average inter-item correlations, and inter-scale correlations in sample with no self-reported psychological disorder (N=309).

Scale	Score Interpretation	Scale *M* *(SD)*	Observed Range	Skewness	Kurtosis	BMCQ-10 Cronbach's Alpha	13-item BMCQ Cronbach's Alpha	Average Inter-Item Correlation (BMCQ-10)	Inter-Scale Correlations 1	2	3
1. Body-Mind Values	Higher values reflect stronger beliefs in importance of physical and mental wellbeing.	5.25 (1.02)	2-7	-0.66	0.23	0.81	0.85	0.52	-		
2. Sensation-Emotion Articulation	Higher values reflect greater internal focus and capacity for identifying and articulating bodily changes associated with emotions.	4.18 (1.12)	1-7	-0.08	-0.15	0.70	0.74	0.43	0.36**	-	
3. Interoceptive Attention	Higher values reflect greater deployment of attentional resources toward interoceptive stimuli.	5.26 (1.08)	1-7	-1.04	1.76	0.82	0.80	0.61	0.45**	0.35**	-

** *p* <.001

Score interpretations were amended from the original to better reflect retained scale items. Scale scores demonstrated appropriate skewness and kurtosis. Cronbach's alpha ranges remained acceptable to good; however, Sensation-Emotion Articulation reduced from 0.74 in the preliminary study (34) to 0.70 for BMCQ-10, due to retention of original BMCQ item 9 (alpha-if-removed = 0.75). Regarding inter-scale correlations, the highest correlation was between Interoceptive Attention and Body-Mind Values. As previously observed, positive directionalities were shown, although lower in magnitude (34), indicating greater distinctness between the refined mind-body constructs.

Correlations between measures

Table 5 presents Pearson's correlations between the study measures for the full sample. MEQ reactivity scales (frequency, intensity, persistence) for positive emotions were all significantly correlated, ranging from $r = 0.29$ to 0.50. Only positive emotion frequency correlated with regulation of positive emotions. Correlations between MEQ reactivity scales for negative emotions were significant and ranged from $r = 0.30$ to 0.56. The negative emotional reactivity scales correlated with regulation of negative emotions. Regarding the BMCQ-10, Body-Mind Values positively correlated with reactivity for positive emotions scales, and negatively correlated with reactivity for negative emotions scales and regulation of positive and negative emotions. Sensation-Emotion Articulation was positively correlated with positive emotion frequency and negatively correlated with regulation of positive and negative emotions. Interoceptive Attention positively correlated with positive emotional reactivity scales and negatively with regulation of positive and negative emotions

Table 5.

Correlations between BMCQ-10 and MEQ Scales.

Scale	*M (SD)*	Cronbach's Alpha	1	2	3	4	5	6	7	8	9	10	11
1. Body-Mind Values	5.14 (1.06)	0.80	–										
2. Sensation-Emotion Articulation	4.14 (1.18)	0.69	0.31**	–									
3. Interoceptive Attention	5.27 (1.04)	0.80	0.39**	0.34**	–								
4. P-Frequency	12.51 (3.81)	0.79	0.24**	0.10*	0.14**	–							
5. P-Intensity	14.65 (3.19)	0.73	0.22**	0.08	0.21**	0.50**	–						
6. P-Persistence	13.11 (3.28)	0.71	0.12*	0.10	0.20**	0.29**	0.48**	–					
7. N-Frequency	10.73 (3.68)	0.77	-0.25**	-0.10	0.03	-0.05	-0.15**	-0.08	--				
8. N-Intensity	14.04 (3.60)	0.71	-0.13*	-0.06	0.09	-0.16**	0.13*	0.03	0.53**	–			
9. N-Persistence	12.73 (3.51)	0.73	-0.11*	-0.03	0.12*	-0.19**	0.00	0.41**	0.30**	0.56**	–		
10. P-Regulation	11.58 (3.32)	0.72	-0.19**	-0.22**	-0.14**	-0.18**	-0.01	0.00	0.23**	0.24**	0.15**	–	
11. N-Regulation	15.58 (3.84)	0.76	-0.22**	-0.15**	-0.01	-0.26**	-0.03	0.04	0.47**	0.68**	0.48**	0.31**	–

Note. P-: Positive Emotions; N-: Negative Emotions. Means, standard deviations, and correlations between BMCQ scales: $n = 401$. Means, standard deviations, correlations between MEQ scales and BMCQ scales: $n = 381$

** $p < .01$; * $p < .05$

Latent Profile Analysis

To identify mind-body connection profiles within the full sample, inclusive of individuals self-reporting a psychological disorder, participants' BMCQ=10 subscale scores were analysed through LPA (*N* = 401). Table 6 displays comparative fit indices derived from the LPA. Models 1 (comprising two profiles) and 2 (comprising three profiles) showed significant BLRT values, indicating superior fit over a single-profile model. Model 2 produced the lowest AIC and BIC values, underscoring more optimal fit when compared to Model 1. A pivotal factor in favouring Model 2 was its classification accuracy, denoted by an entropy value of 0.75, deemed acceptable for signifying precision in participant classification across the models (44). Accordingly, Model 2, encapsulating three distinct mind-body connection profiles, was determined to be the most appropriate model to represent the present sample. Figure 1 contains latent profile plots for Models 1 and 2.

Table 6.

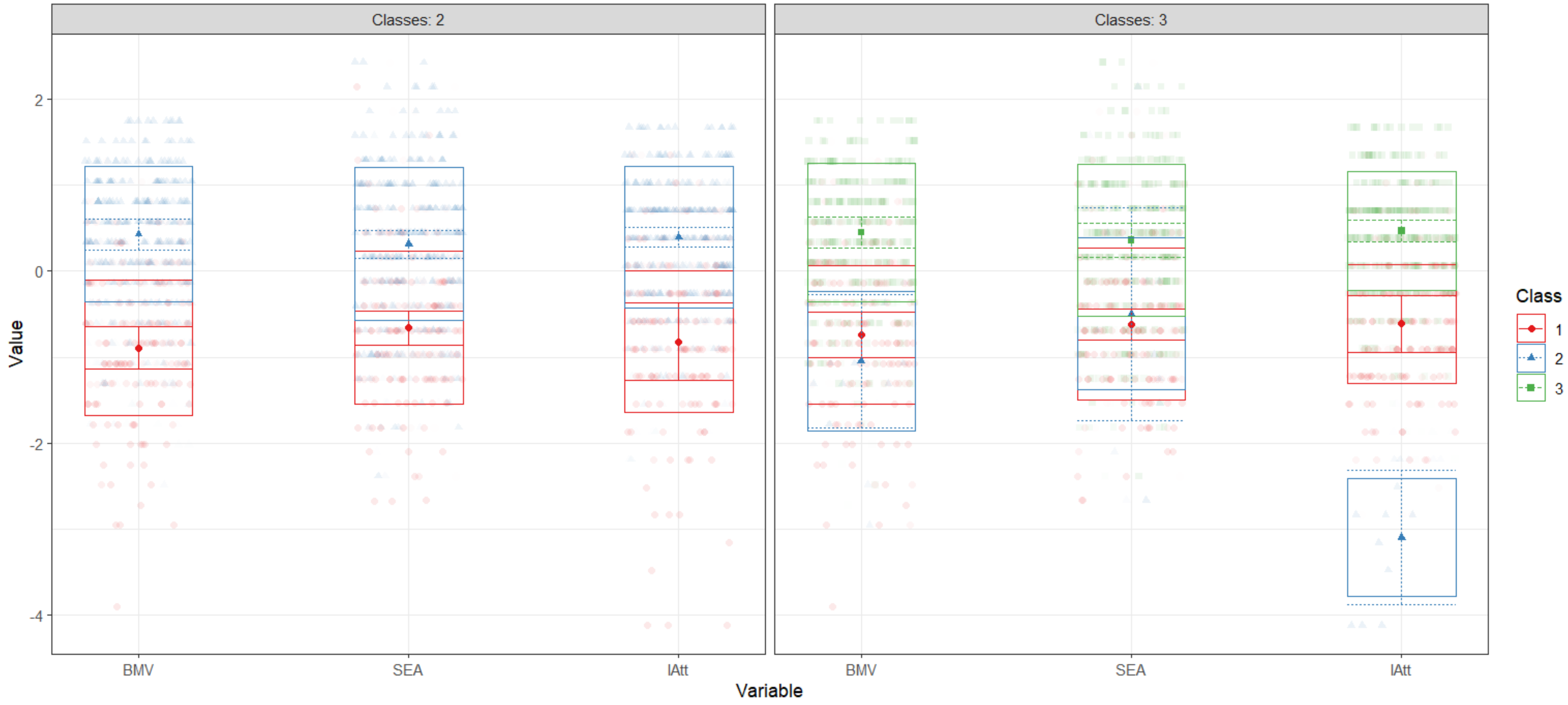
LPA Fit Indices (N=401).

Model	*k*	AIC	BIC	SSA-BIC	BLRT (*p*)	Entropy
1	2	3296.19	3336.13	3304.40	134.77 (.009)	0.64
2	3	3258.44	3314.35	3269.93	45.76 (.009)	0.75

Note. k: number of profiles; AIC: Akaike's Information Criterion; BIC: Bayesian Information Criterion; SSA-BIC: Sample-size Adjusted BIC; BLRT: Bootstrap Likelihood Ratio Test.

Figure 1.

Latent Profile Plots for Model 1 and Model 2.



Note. Values on the y-axis reflect z-scores.

BMV: Body-Mind Values, SEA: Sensation-Emotion Articulation, IAtt: Interoceptive Attention.

Table 7 presents descriptive statistics across the BMCQ subscales, distinguishing three profiles based on their Body-Mind Values, Sensation-Emotion Articulation, and Interoceptive Attention scores, and ANOVA results.

Table 7.

Descriptive Statistics of BMCQ Subscale Scores for Latent Profiles.

BMCQ Scale	Profile 1 (Weak Mind-Body Connection) *n*=127 *M* (*SD*)	Profile 2 (Mind-Body Disconnection) *n*=10 *M* (*SD*)	Profile 3 (Strong Mind-Body Connection) *n*=264 *M* (*SD*)	Welch's F-Statistic	Significant Games-Howell Contrasts
Body-Mind Values	4.22 (0.91)	3.90 (0.96)	5.64 (0.76)	120.59**	P3 > P1, P2
Sensation-Emotion Articulation	3.30 (0.90)	3.67 (1.58)	4.57 (1.05)	73.83**	P3 > P1
Interoceptive Attention	4.52 (0.73)	1.93 (0.73)	5.76 (0.65)	234.81**	P3 > P1, P2 P1 > P2

***p* <.001.
Note. P1: Profile 1; P2: Profile 2; P3: Profile 3.

Profile 3 was the most common profile (*n* = 264, 65.8%), characterised by the highest Body-Mind Values, Sensation-Emotion Articulation, and Interoceptive Attention scores amongst profiles. This profile indicates a high valuation of physical and mental wellbeing, capacity to identify and describe the connection between their sensations and emotions, an internally oriented focus, and proficient control over attention toward bodily sensations in both purposeful and spontaneous manners. This profile was interpreted as constituting a 'Strong Mind-Body Connection', as such features are collectively suggestive of adaptive mind-body integration perceptions and attitudes (22).

The least common profile—Profile 2 (*n* = 10, 2.5%)—was characterised by low Body-Mind Values and Sensation-Emotion Articulation, together with extremely low

Interoceptive Attention. Individuals in this profile do not particularly value their wellbeing, may struggle to link and articulate emotions associated with sensations, prefer an external focus, and find it markedly challenging to direct attention to internal bodily sensations. Accordingly, this profile was labelled ‘Mind-Body Disconnection’. Despite its small size, retaining this profile is justified by conceptual relevance and empirical precedent (44, 49). Profile 2 represents a unique subgroup that may struggle with wellbeing, offering insights for targeted interventions. Spurk et al. (44) found that 15.2% of studies retain profiles ranging from 1 to 3%, indicating that inclusion of small, conceptually meaningful profiles is common.

Profile 1 (n = 127, 31.7%) was characterised by average Interoceptive Attention, relatively low Body-Mind Values, and the lowest Sensation-Emotion Articulation scores amongst profiles. Despite Body-Mind Values appearing moderate when compared to the Strong Mind-Body Connection and Disconnection profiles, they were relatively low compared to sample means (see Tables 4 and 5). Individuals in this profile may perceive themselves as capable of deploying attention toward sensations but struggle to integrate sensory information into their mental representations of emotions. Consequently, they may find it challenging to identify and express the association between sensations and emotions, relying on external factors to inform their emotional experiences and health-promoting beliefs. Despite their capacity for interoceptive attentional control, the condition of their body and mind may not be particularly salient. Given the endorsed interoceptive attentional control, Profile 1 was labelled ‘Weak Mind-Body Connection’. Collectively, these traits suggested proneness to alexithymia (25).

Emotion Outcomes Associated with Latent Profiles

Table 8 displays descriptive statistics across positive and negative emotion outcomes. Twenty respondents had completely or substantially missing MEQ data and were omitted from analysis. No outliers were identified. Multivariate normality was assumed through inspection of Q-Q plots for each emotional reactivity outcome and consideration of Box's M tests, where p >.05 for both positive and negative emotional reactivity DVs. Homogeneity of variance-covariance matrices was also assumed, according to Box's M tests. Regression slopes were homogenous (p >.05). There was no multicollinearity, as correlations between DVs were moderate (see Table 5). However, large discrepancies amongst profile membership were noted. Pillai's Trace test is robust to this (41) and therefore interpreted to explore whether mind-body connection profiles affected reactivity for positive and negative emotional reactivity through two separate one-way MANCOVAs, controlling for self-reported psychological disorder.

Table 8.

Descriptive statistics of frequency, intensity, persistence, and regulation of positive and negative emotions for latent profiles.

Emotion Outcome	Profile 1 (Weak Mind-Body Connection) *n*=120 *M (SD)*	Profile 2 (Mind-Body Disconnection) *n*=10 *M (SD)*	Profile 3 (Strong Mind-Body Connection) *n*=251 *M (SD)*
Reactivity – Positive Emotions			
Frequency	11.87 (3.72)	10.40 (2.83)	12.91 (3.84)
Intensity	13.84 (3.43)	13.50 (1.90)	15.10 (3.03)
Persistence	12.59 (3.45)	10.10 (2.47)	13.47 (3.14)
Reactivity – Negative Emotions			
Frequency	11.41 (3.83)	9.70 (2.98)	10.45 (3.87)
Intensity	14.08 (3.84)	12.90 (2.81)	14.06 (3.51)
Persistence	12.95 (3.89)	10.30 (3.83)	12.70 (3.27)
Emotion Regulation			
Positive Emotions	12.53 (3.46)	12.60 (3.31)	11.09 (3.15)
Negative Emotions	16.36 (3.84)	15.90 (4.43)	15.19 (3.77)

Using Pillai's Trace test, the combined reactivity DVs for positive emotions were significantly affected by latent mind-body connection profiles, controlling for self-reported psychological disorder, $V = 0.06$, $F(6,756) = 3.92$, $p <.001$, $\eta^2 p = 0.03$. To examine the impact of latent profiles on each emotional reactivity facet, one-way between-subjects ANOVAs, controlling for self-reported psychological disorder, were subsequently interpreted, with Fisher's Least Significant Differences (LSD) post-hoc pairwise comparisons applied, as we had no *a priori* hypotheses regarding which profiles would differ. Mind-body connection profiles significantly affected positive emotion frequency, $F(2,378) = 4.55$, $p = .011$, $\eta^2 p = 0.02$. Post-hoc comparisons using Fisher's LSD tests indicated that individuals with a Strong Mind-Body Connection profile experience positive emotions significantly more frequently than those with a Weak Mind-Body Connection profile, ($p = .021$). Positive emotion intensity was also significantly affected by mind-body connection profiles, $F(2,378) = 6.79$, $p = .001$, $\eta^2 p = 0.04$, such that the Strong Mind-Body Connection profile typically experience positive emotions more intensely than the Weak Mind-Body Connection profile ($p <.001$). Mind-body connection profiles further significantly affected positive emotion persistence, $F(2,378) = 7.43$, $p <.001$, $\eta^2 p = 0.04$, wherein the Strong Mind-Body Connection profile experienced positive emotions for longer durations compared to both Mind-Body Disconnection ($p = .001$) and Weak Mind-Body Connection profiles ($p =.015$). The Weak Mind-Body Connection profile was further found to experience positive emotions for longer durations than the Mind-Body Disconnection profile ($p = .020$). The combined reactivity DVs for negative emotions were not significantly affected by latent mind-body connection profiles, controlling for self-reported disorder, $V = 0.03$, $F(6,752) = 1.64$, $p = .134$.

To explore the effect of latent profiles on regulation outcomes for positive and negative emotions, ANCOVAs controlling for self-reported psychological disorder with Fisher's LSD tests for post-hoc comparisons were planned. Normality, absence of outliers, homogeneity of variance, and normality of residuals were assumed. However, homogeneity of regression slopes was not assumed (p <.05), indicating that the relationship between regulation outcomes and self-reported diagnosis was different across mind-body connection profiles. The Johnson-Neyman procedure is recommended when this assumption is violated (50) and was applied. As the IV is multicategorical, the Omnibus Groups Regions of Significance tool was utilised, which applies the Johnson-Neyman technique for such variables (51). Within these analyses, IV categories are set to 0 and form reference groups, enabling comparison with other categories. The dichotomous moderator (*M*) was psychological disorder status (0=no disorder, 1=disorder). Accordingly, this analysis enabled comparison between profiles at each *M* level. Per suggested interpretation for a dichotomous *M* (51), Johnson-Neyman boundaries for the effect of profiles on regulation were interpreted at the coded levels of 0 and 1, representing no disorder and disorder, respectively.

Regarding regulation of positive emotions, the model was significant, $F(5,377) = 4.66$, $p = .0004$, $R^2 = .058$. With Strong Mind-Body Connection as the reference profile, the regression coefficient for the Weak Mind-Body Connection profile was significant ($b = 1.06$, $p = .0116$, 95% CI: 0.24, 1.88), indicating that, with no psychological disorder, the Weak Mind-Body Connection profile perceive comparatively greater difficulty regulating positive emotions. No significant differences were found between the Mind-Body Disconnection and Strong Mind-Body Connection profiles in the absence of disorder ($b = 1.03$, $p = .351$). The presence of a psychological disorder did not significantly affect regulation of positive emotions for those with a Strong Mind-Body Connection ($b = 0.05$, $p = .9172$), indicating disorder does not predict greater difficulties for this profile. Interactions between Weak Mind-Body Connection and *M* ($b = 1.31$, $p = .1137$) and Mind-Body Disconnection and *M* ($b = 4.84$, $p = .1619$) were not significant, suggesting that differences between Strong and Weak and Strong and Disconnection profiles in regulation of positive emotions are not estimated to change in the presence of a disorder. With Weak Mind-Body Connection as the reference profile, the regression coefficient for the Mind-Body Disconnection profile was non-significant in the absence of a disorder (b = -0.03, p = .9800). However, psychological disorder predicted greater difficulty regulating positive emotions in the Weak profile (b = 1.36, p = .0389, 95% CI = 0.07, 2.65). The Mind-Body Disconnection and M interaction was non-significant (b = 3.53, p = .3109), suggesting that the difference between Weak and Disconnection profiles in regulating positive emotions is not expected to change in the presence of a disorder. With Mind-Body Disconnection as the reference profile, the presence of a psychological disorder was not associated with regulation of positive emotions (b = 4.89, p = .1531). Allowing for relationships to covary based on diagnosis explained a further non-significant 1% of variance ($R^2\Delta$ = .010, F(2,377) = 2.06, p = .1290). The Johnson-Neyman procedure identified no significant bounds; the effect of profiles was significant at both levels of M (M=0: $R^2\Delta$ = 0.02, F = 3.43, p = .0335; M=1: $R^2\Delta$ = 0.03, F = 6.68, p =.0014), suggesting the effect of profiles on regulation of positive emotions does not vary significantly by diagnosis status.

Regarding regulation of negative emotions, the model was significant, F(5,376) = 10.24, p <.0001, R^2 = .120. With Strong Mind-Body Connection profile as reference profile, the regression coefficient for Weak Mind-Body Connection was significant (b = 1.03, p = .0287, 95% CI: 0.12, 1.95), indicating that, in the absence of a psychological disorder, the Weak Mind-Body Connection profile reported comparatively greater difficulty regulating negative emotions. No significant differences were found between Mind-Body Disconnection and Strong Mind-Body Connection profiles (b = 1.97, p = .1124). The presence of a psychological disorder predicted greater difficulty regulating negative emotions in the Strong Mind-Body Connection profile (b = 2.91, p <.0001, 95% CI: 1.80, 4.02). The interaction between the Weak Mind-Body Connection profile and M was not significant (b = -0.26, p

=.7778), but significant for the Disconnection profile and M (b = -9.47, p =.0147, 95% CI: -17.06, -1.87), indicating that persons with a psychological disorder and Mind-Body Disconnection profile find regulating negative emotions easier than those with a disorder and Strong Mind-Body Connection profile. With Weak Mind-Body Connection as the reference profile, the regression coefficient for the Mind-Body Disconnection profile was not significant (b = 0.94, p = .4600), suggesting that, in the absence of psychological disorders, these profiles do not significantly differ in ease of regulating negative emotions. The presence of a psychological disorder predicted greater difficulty regulating negative emotions in the Weak Mind-Body Connection profile (b = 2.65, p = .0004, 95% CI: 1.20, 4.09). The Mind-Body Disconnection and M interaction was significant (b = -9.20, p = .0185, 95% CI = -16.85, -1.55), suggesting that persons with a psychological disorder and Mind-Body Disconnection profile find regulating negative emotions easier than those with a disorder and Weak Mind-Body Connection profile. With Mind-Body Disconnection as the reference profile, the presence of a psychological disorder was not significantly predictive of regulating negative emotions (b = 6.56, p = .0870). Allowing for covariance based on diagnosis explained an additional non-significant 1.4% of variance ($R^2\Delta$ = .014, F(2,376) = 3.01, p = .0507). The Johnson-Neyman procedure identified three bounds of significance (0.07, 0.27, 0.63); this was significant for persons with no disorder (M=0: $R^2\Delta$ = 0.02, F = 3.32, p = .0371) but non-significant for persons with a disorder (M=1; $R^2\Delta$ = 0.01, F = 2.75, p = .0654).

6.6. Discussion

With the aim of validating the three-factor structure of the 13-item BMCQ, we employed CFA in a new sample of typically developed adults, which confirmed the hypothesised three-factor structure and led to refinement of the questionnaire, resulting in a condensed 10-item version: the BMCQ-10. Additionally, this investigation sought to examine the association between emergent patterns of mind-body perception using the BMCQ, including the typical experiences of positive and negative emotions and emotion regulation. Employing LPA, three distinct profiles were identified, which best accounted for response pattern probabilities among BMCQ respondents. Furthermore, findings underscored the association between latent mind-body connection profiles and reactivity for positive emotions, and their impact on the ease of emotion regulation.

Confirmation of the BMCQ

Through CFA, the hypothesised three-factor structure of the BMCQ was confirmed in a new sample of typically developed adults, demonstrating good fit, and reduced from 13 to 10 items. Sensation-Emotion Articulation remained an unchanged scale, although internal consistency reliability reduced from 0.74 (34) to 0.70. The original Item 9 from this subscale (*'I tend to focus on things happening in my physical environment rather than what is happening inside of me'*) performed the weakest according to factor loading, contribution to Cronbach's alpha, and low inter-item correlations. Although the item was previously noted to have the lowest extracted communality following exploratory factor analysis (34), it was retained for the BMCQ-10 due to the crucial involvement of externally oriented thinking in alexithymia (47, 48), a theoretical foundation for development of the Sensation-Emotion Articulation scale and informed generation of the item (34). Despite this, present BMCQ psychometric properties demonstrate relative similarity to those observed in the preliminary assessment. For instance, Cronbach's alpha remained acceptable for Body-Mind Values and Interoceptive Attention scales following removal of two items from the original Body-Mind Values scale (*'I feel disconnected from my body'* and *'Where possible, I always attend to what my body is telling me'*), and one item from the Interoceptive Attention scale *('I consider myself in touch with my body and mind')*.

Mind-body connection profiles

Prima facie, descriptive statistics shown for BMCQ-10 scales in both the non-diagnosed and pooled samples may suggest homogeneity and minimal score dispersion. Nonetheless, through LPA, three distinct mind-body connection profiles emerged, based on BMCQ scale response patterns within our full sample. This person-centred approach captured the nuances of beliefs in conscious mind-body connection aspects.

One profile pleasingly emerged with the highest levels of Body-Mind Values, Sensation-Emotion Articulation, and Interoceptive Attention, labelled as Strong Mind-Body Connection. This profile, predominant in our sample, exhibited adaptive mind-body connection characteristics, including self-efficacy in attentional control and active responses to sensations, positive values regarding physical and mental wellbeing, and awareness of mind-body integration, exemplified through recognition and verbal expression of physical sensations as components of emotions (22). Higher interoceptive attention levels in this profile may suggest hypervigilance and maladaptive patterns (25), potentially leading to distorted interpretations of bodily sensations (52). However, given the predominance of this profile, the mean Interoceptive Attention score was close to mean sample values and not vastly different to the mean score when participants with no reported disorder were excluded, suggesting this is unlikely. Furthermore, stronger capacities for identifying and articulating emotions based on such attentional abilities may mitigate tendencies to perceive sensations as disturbing and noxious (30), and engender healthier perspectives on holistic wellbeing (53).

By contrast, the least prevalent profile amongst the sample, labelled Mind-Body Disconnection, displayed the lowest Body-Mind Values and Interoceptive Attention scores, together with low Sensation-Emotion Articulation. Individuals in this profile do not prioritise their physical and mental wellbeing. It is plausible that such perspectives arise from belief in the separateness of mental and physical wellbeing—a characteristic of dualistic beliefs, wherein body and mind are perceived as distinct, separate entities (54). Within this profile, holding such views may manifest in disconnection from and indifference toward interoceptive sensations, resulting from decreased accuracy and trust in detection of sensory signals, and reduced recognition of the salience of bodily information (32, 55, 56). Such individuals may rely more heavily on external environmental cues to shape their ongoing emotional experiences, rather than integrating physiological sensations with their emotional responses (31, 32). This reliance could exacerbate the attenuation of bodily information, potentially resulting in greater challenges with identifying and articulating emotional experiences for some individuals (34, 57, 58). It is possible that such characteristics are learned, culminating in coping strategies against unwanted emotions and even bodily sensations (59, 60) to protect the self.

The profile characterised as Weak Mind-Body Connection, frequently observed within our sample, tended to endorse capacities for Interoceptive Attention, relatively low Body-Mind Values, and diminished Sensation-Emotion Articulation confidence. Whilst spontaneous and purposeful attention to sensations was present, the co-occurrence of poor emotional capacities and low valuation of wellbeing suggests that this profile is potentially characterised by alexithymic propensities (6, 25, 53, 61, 62). Reduced emotional identification and expression is argued to arise from difficulty constructing mental representations of emotions (63). Those with limited emotional capacities due to such challenges are prone to misinterpreting bodily sensations (64) and may perceive of emotions as predominantly physiological phenomena because of a diminished emotion vocabulary and imprecise emotion categories (65-67). In times of emotional distress, they could misconstrue physical sensations accompanying emotional arousal as indicative of physical illness (63, 68). Considering this profile's low prioritisation of wellbeing, the potential for heightened interoceptive attention and misinterpretation of physiological sensations also possibly stem from stronger dualistic beliefs.

Mind-body connection profiles, emotional reactivity, and emotion regulation

Latent mind-body connection profiles significantly affected reactivity for positive emotions, indexed by frequency, intensity, and persistence. Previous research demonstrates that components of self-reported interoceptive attention and values positively predict trait positive affectivity (27). Independently predictive components include awareness of comfortable, uncomfortable, and neutral bodily sensations (MAIA Noticing scale), attention toward normal, non-emotive bodily sensations, prediction of bodily reactions (Body Awareness Questionnaire), and perceptions of the body as safe and trustworthy (MAIA Trusting scale). Notably, these facets have demonstrated moderate to strong relatedness with BMCQ Interoceptive Attention and Body-Mind Values scales (34). Such capacities are cumulatively suggestive of interoceptive self-efficacy (22, 27). Positive emotional states may modulate attentional control capacities, enabling individuals to allocate attentional resources to a broader array of stimuli, including those originating from the body (69). Conversely, stronger, more adaptive attunement with the body and mind may contribute to positive states and overall wellbeing, particularly when individuals perceive their body to be in an optimal condition (22, 27).

Individuals within the Strong Mind-Body Connection profile perceived experiencing positive emotions with greater frequency and intensity compared to those within the Weak Mind-Body Connection profile, as well as experiencing positive emotions more persistently than individuals within Weak Connection and Mind-Body Disconnection profiles. This observation aligns with previous findings suggesting that individuals with high interoceptive sensibility skills exhibit heightened activation, intensity, and prolonged positive emotional experiences (28). Collectively, such findings indicate that a subjective inclination toward monitoring bodily sensations plays a pivotal role in shaping emotional states, as heightened attention to interoceptive cues during emotional episodes can amplify emotional activation or frequency and intensity (31), particularly in the context of certain positive emotions.

Individuals characterised by Strong Mind-Body Connection are posited to possess propensities for engaging with positive stimuli and experiences, thereby facilitating appetitive behaviour and fostering positive affect in the pursuit of desired goals (3). Moreover, a strong belief in interoceptive attentional control capacities may augment the coupling between physiological and emotional arousal, with bodily sensations serving as valuable sources of information contributing to emotional episodes (31). In contrast, higher alexithymia is characterised by inflexible responsivity and indifference to emotional stimuli (6), coupled with deficits in and fear of positive emotions (66, 70). Collectively, this implies a preference for withdrawal from positive or rewarding stimuli (Davidson, 1998). As such, individuals with alexithymic inclinations—characteristic of the Weak Mind-Body Connection profile—may subsequently exhibit diminished intensity and heightened thresholds for the activation of positive emotions (3, 71).

Relative to Strong and Weak Mind-Body Connection profiles, the observation that the Mind-Body Disconnection profile experienced positive emotions less persistently aligns with their diminished sensory awareness and integration of bodily sensations within emotional experiences (31). Individuals with such characteristics may encounter difficulties in discerning physiological changes accompanying positive emotions and find it challenging to completely recognise or acknowledge such emotional experiences, resulting in transient emotional episodes that are subsequently disregarded or overlooked. By contrast, higher interoceptive attention may augment the duration of felt positive emotions due to heightened salience and awareness of physiological arousal (72).

Conversely, latent mind-body connection profiles did not significantly affect reactivity for negative emotions. Moreover, we observed weaker correlations between BMCQ-10 scales and MEQ frequency, intensity, and persistence scales for negative emotions when compared to positive emotions. These findings align with evidence indicating that the association between self-reported interoception and negative affectivity is tenuous (27, 61, 73), and that adaptive interoceptive aspects, such as those assessed by the MAIA, are less strongly related to reactivity for negative emotions (28). Individuals with impaired emotional awareness, as seen with high alexithymia, seem to have relatively intact capacities for experiencing and verbally expressing negative emotions (66), which may explain this null finding.

Regarding regulation, we found that, in the absence of psychological disorder, individuals within the Weak Mind-Body Connection profile indicated significantly greater difficulty regulating both positive and negative emotions compared to those with a Strong-Mind Body Connection profile. These difficulties can be attributed to the elevated alexithymic characteristics underpinning the profile. Alexithymia restricts the quality of emotional information accessible to individuals, influencing their strategy selection (39, 47). Our findings complement previous research reliably linking high alexithymia to emotion dysregulation and the selection of maladaptive regulatory strategies, marked by suppression, avoidance, and withdrawal (e.g., 6, 74). Inflexible employment of maladaptive strategies can consequently increase physiological activation and responses, due to the effort required for inhibiting ongoing emotional experiences (6, 7, 75).

Application of the Johnson-Neyman procedure revealed that disorder status did not affect the regulation of positive emotions between profiles. This contrasts with evidence suggesting heightened positive emotion dysregulation in disorders such as depression (76) and anxiety (77). Irrespective of mind-body connection profiles, stronger beliefs in the controllability and usefulness of positive emotions could reduce perceived difficulties in regulating these emotions, as indicated by reduced maladaptive strategy employment (e.g., suppression) and lower depressive and anxious symptomatology (78, 79).

In contrast, the presence of a psychological disorder predicted greater difficulty regulating negative emotions for those with Strong and Weak Mind-Body Connection profiles. Higher interoceptive attention in these profiles may lead to maladaptive strategies (e.g., distraction; 61, 80), increasing perceived regulation difficulties due to their stronger awareness of physiological changes. Conversely, individuals with a Mind-Body Disconnection and psychological disorder perceived easier regulation of negative emotions when compared to Strong and Weak Mind-Body Connection profiles. Persons with low interoceptive abilities express passivity toward negative emotions and preferences for maladaptive, inefficient regulatory strategies, which enables them to feel less impacted by stimuli and events evoking negative emotions (61). Additionally, higher alexithymic propensity, observed in the profile, relates to early avoidance and lower allocation of attention to stimuli evoking negative emotionality (81, 82), leading to reduced engagement with negative emotions which may augment perceptions of easier regulation. Moreover, the co-occurrence of alexithymia and lack of insight in psychiatric disorders (83) possibly enhances perceived emotion controllability, reducing the sense of being overwhelmed by unpleasant emotions that are not fully experienced.

The Johnson-Neyman procedure revealed that differences in regulation of negative emotions between profiles are particularly pronounced in the absence of a psychological disorder. Amongst individuals without a psychological disorder, there may be greater variability in levels of external support (e.g., therapy, medication), influencing regulation of negative emotions. In contrast, consistent access to effective treatments might reduce regulation variability amongst those with psychological disorders.

Implications

Persons with lived experience of mental health conditions emphasise the importance of recognising and addressing the mind-body connection to enhance outcomes and wellbeing, highlighting the need to address and improve their emotional reactions (84). This study introduces a novel classification of distinct mind-body connection profiles, grounded in salient, verified constituents of interoceptive attentional control, emotional capacities, and health and wellbeing beliefs. These findings therefore hold significant clinical implications, considering the observed influence of such profiles on the frequency, intensity, and persistence of positive emotions, as well as the ease of regulating emotions. Positive emotions are essential contributors to momentary and long-term wellbeing; their cultivation can effectively prevent and treat issues arising from negative emotionality (8, 9). The present findings offer valuable insight into mind-body connection profiles that either promote or hinder this cultivation.

Mindfulness is an increasingly popular intervention for the treatment of such conditions, which may facilitate flexibility in the use of adaptive cognitive appraisals by enhancing interoceptive attention to sensations (85). According to the identified latent profiles, interventions targeted at enhancing attention to sensations could benefit individuals with a Mind-Body Disconnection profile. Doing so may support individuals to recognise and value their bodily sensations, providing a basis for incorporating physiological arousal into ongoing emotional experiences (31, 86, 87) and secondarily reduce dualistic views that may reinforce these characteristics.

However, enhancing attention to sensations has the potential to be anxiogenic (88), particularly for individuals exhibiting Weak Mind-Body Connection profile traits. This profile exhibits characteristics reflective of alexithymia, which can affect treatment outcomes for various psychiatric conditions (89), contributes to somatisation (68, 90), and relates to heightened physiological reactivity (7). In the presence of elevated interoceptive attentional control characterised by hypervigilance, mindfulness-based interventions may seek to initially target maladaptive interoceptive interpretations, encouraging non-judgemental acceptance of sensations (87). This approach could precede efforts to enhance emotional identification and labelling (91), promoting the cultivation of emotions grounded in adaptive interoceptive interpretations, reducing experiences of somatic symptoms, and fostering healthy wellbeing perspectives and practices.

Interventions should thus consider perceived interoceptive and/or emotion deficits alongside wellbeing attitudes. Addressing these identified barriers to adaptive emotional reactivity and regulation may enhance capacities to cultivate positive emotions with precision and specificity and promote employment of flexible regulatory strategies, thus fostering holistic wellbeing. Accordingly, mind-body researchers and clinicians may seek to screen and monitor changes in mind-body connection perceptions using the BMCQ-10 to assess whether targeted, individualised interventions are effectively cultivating characteristics associated with a strong mind-body connection.

Limitations

Despite these insights, several limitations must be considered. The retention of item 9 from the original 13-item BMCQ affected the internal consistency reliability of the Sensation-Emotion Articulation scale. Revising this item to improve measurement of 'internally oriented thinking' within the BMCQ-10 may enhance the scale’s construct validity and reliability. Further, test-retest reliability was not assessed, which remains an important consideration for future investigations. Our sample primarily consisted of relatively young, healthy individuals, offering a preliminary basis for score interpretation following refinement of BMCQ-10 scales. Moreover, as validity was not assessed in psychiatric populations, utilisation of the BMCQ-10 with such cohorts requires caution. Although generalisability is currently limited, the findings illuminate understandings of mind-body connection perceptions within a typically developed sample, giving rise to future investigations within clinical populations. Whilst the sample size for CFA and LPA was adequate (40, 49), investigation in larger samples would offer more robust normative references for clinicians. Furthermore, following LPA, a small profile (Mind-Body Disconnection) was identified and retained based on model fit statistics, conceptual relevance, and empirical precedent. However, its small size likely reduced statistical power, limiting detection of its influence on emotional reactivity and regulation. Methodologically, psychological disorder status was a dichotomous variable; the disorder category comprised individuals with arguably heterogenous conditions varying in nature, symptomatology, and severity, thus differentially impacting emotion regulation strategy employment (92). Moreover, MEQ items measuring regulation (*'How easy to regulate'*) lacked consideration of diverse strategy employment. Future research should examine specific strategy selections within specific conditions.

Conclusion

Our study supports the validity of the BMCQ-10 as a measure of the mind-body connection among typically developed adults, reinforcing the notion that salient mind-body constituents include interoceptive attentional control (Interoceptive Attention), capacities for identifying and describing the link between sensations and emotions (Sensation-Emotion Articulation), and beliefs regarding physical and mental wellbeing (Body-Mind Values). While future research should focus on improving item clarity and confirming its validity across larger, diverse populations, the BMCQ-10 holds promise as a valuable tool for both mind-body research and clinical applications. To our knowledge, this study is the first to differentiate mind-body connection profiles based on the salient constituents of interoceptive attentional control, emotional capacities, and wellbeing beliefs. This differentiation enabled a holistic, nuanced investigation of how distinct profiles affect the typical frequency, intensity, persistence, and regulation of emotions. The findings underscore the distinct, significant impact of mind-body connection profiles on typical experiences of positive emotions and the regulation of positive and negative emotions. This study lays the foundation for investigating how mind-body connection profiles relate to emotional reactivity and regulation in clinical populations, which can inform the development of tailored interventions to cultivate strong mind-body connections and positive emotions that promote adaptive emotional functioning.

Declarations

Ethics approval and consent to participate: Ethical approval for the study was obtained from the Victoria University Human Research Ethics Committee (Application ID: HRE21-001). Participants indicated their consent to participate in the study by selecting this option via the survey hosted on Qualtrics. All participants provided informed consent prior to commencing the questionnaires..

Consent for publication: Not applicable.

Availability of data and materials: The dataset used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding Details: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions: KVB conceived and designed the project, acquired and processed the data, performed analyses, and drafted the article. JS, ES, and MB conceived and designed the project and supervised the work. All authors participated in data interpretation and revising the article critically and gave final approval for the version to be submitted.

Acknowledgements: Stjepan Sambol for providing guidance and assisting with the latent profile analysis.

6.7. References

1. Damasio A, Carvalho GB. The nature of feelings: evolutionary and neurobiological origins. Nature reviews neuroscience. 2013;14(2):143-52.

2. Gross JJ, Feldman Barrett L. Emotion generation and emotion regulation: One or two depends on your point of view. Emotion review. 2011;3(1):8-16.

3. Davidson RJ. Affective Style and Affective Disorders: Perspectives from Affective Neuroscience. Cognition & Emotion. 1998;12(3):307-30.

4. Davidson RJ. Comment: Affective chronometry has come of age. Emotion Review. 2015;7(4):368-70.

5. Preece D, Becerra R, Campitelli G. Assessing Emotional Reactivity: Psychometric Properties of the Perth Emotional Reactivity Scale and the Development of a Short Form. Journal of Personality Assessment. 2019;101(6):589-97.

6. Panayiotou G, Panteli M, Vlemincx E. Adaptive and maladaptive emotion processing and regulation, and the case of alexithymia. Cognition & Emotion. 2021;35(3):488-99.

7. Panayiotou G, Panteli M, Vlemincx E. Processing emotions in alexithymia: A systematic review of physiological markers. Alexithymia: Advances in research, theory, and clinical practice. New York, NY: Cambridge University Press; 2018. p. 291-320.

8. Fredrickson BL. The Role of Positive Emotions in Positive Psychology: The Broaden-and-Build Theory of Positive Emotions. 2001:218-26.

9. Fredrickson BL. Cultivating Positive Emotions to Optimize Health and Well-Being. Prevention and Treatment. 2000;3.

10. Schenk HM, Jeronimus BF, Van Der Krieke L, Bos EH, De Jonge P, Rosmalen JGM. Associations of Positive Affect and Negative Affect with Allostatic Load: A Lifelines Cohort Study. Psychosomatic Medicine. 2018;80(2):160-6.

11. Kubzansky LD, Kawachi I. Going to the heart of the matter: do negative emotions cause coronary heart disease? Journal of Psychosomatic Research. 2000;48(4):323-37.

12. Critchley HD, Garfinkel SN. Interoception and emotion. Current opinion in psychology. 2017;17:7-14.

13. Kanbara K, Fukunaga M. Links among emotional awareness, somatic awareness and autonomic homeostatic processing. BioPsychoSocial Medicine. 2016;10(1):1-11.

14. Barrett LF. The theory of constructed emotion: an active inference account of interoception and categorization. Social cognitive and affective neuroscience. 2017;12(1):1-23.

15. Carvalho GB, Damasio A. Interoception and the origin of feelings: A new synthesis. BioEssays. 2021;43(6):2000261.

16. Feldman MJ, Bliss-Moreau E, Lindquist KA. The neurobiology of interoception and affect. Trends in Cognitive Sciences. 2024.

17. Craig AD. A new view of pain as a homeostatic emotion. Trends in neurosciences. 2003;26(6):303-7.

18. Barrett LF, Quigley KS, Hamilton P. An active inference theory of allostasis and interoception in depression. Philosophical Transactions of the Royal Society B: Biological Sciences. 2016;371(1708):20160011.

19. Jungilligens J, Paredes-Echeverri S, Popkirov S, Barrett LF, Perez DL. A new science of emotion: implications for functional neurological disorder. Brain. 2022;145(8):2648-63.

20. Bogaerts K, Walentynowicz M, Van Den Houte M, Constantinou E, Van den Bergh O. The Interoceptive Sensitivity and Attention Questionnaire: Evaluating aspects of self-reported interoception in patients with persistent somatic symptoms, stress-related syndromes, and healthy controls. Psychosomatic medicine. 2022;84(2):251-60.

21. Henningsen P, Gündel H, Kop WJ, Löwe B, Martin A, Rief W, et al. Persistent physical symptoms as perceptual dysregulation: a neuropsychobehavioral model and its clinical implications. Psychosomatic medicine. 2018;80(5):422-31.

22. Mehling WE, Gopisetty V, Daubenmier J, Price CJ, Hecht FM, Stewart A. Body Awareness: Construct and Self-Report Measures. PLoS ONE. 2009;4(5):1-18.

23. Mehling W. Differentiating attention styles and regulatory aspects of self-reported interoceptive sensibility. Philosophical Transactions of the Royal Society B: Biological Sciences. 2016;371(1708):20160013.

24. Marcus DK, Gurley JR, Marchi MM, Bauer C. Cognitive and perceptual variables in hypochondriasis and health anxiety: A systematic review. Clinical Psychology Review. 2007;27(2):127-39.

25. Trevisan DA, Mehling WE, McPartland JC. Adaptive and Maladaptive Bodily Awareness: Distinguishing Interoceptive Sensibility and Interoceptive Attention from Anxiety-Induced Somatization in Autism and Alexithymia. Autism Res. 2021;14(2):240-7.

26. Gaggero G, Bizzego A, Dellantonio S, Pastore L, Lim M, Esposito G. Clarifying the relationship between alexithymia and subjective interoception. PLoS One. 2021;16(12):e0261126.

27. Vig L, Köteles F, Ferentzi E. Questionnaires of interoception do not assess the same construct. Plos one. 2022;17(8):e0273299.

28. Yun-Hsin H, Yu-Ting H, Nai-Shing Y. Interoceptive sensibility differentiates the predictive pattern of emotional reactivity on depression. Frontiers in Psychology. 2023;14:1-9.

29. Aronson KR, Barrett LF, Quigley K. Emotional reactivity and the overreport of somatic symptoms: Somatic sensitivity or negative reporting style? Journal of Psychosomatic Research. 2006;60(5):521-30.

30. Köteles F, Witthöft M. Somatosensory amplification – An old construct from a new perspective. Journal of Psychosomatic Research. 2017;101:1-9.

31. MacCormack JK, Bonar AS, Lindquist KA. Interoceptive beliefs moderate the link between physiological and emotional arousal during an acute stressor. Emotion. 2024;24(1):269-90.

32. Pollatos O, Herbert BM. Alexithymia and body awareness. Alexithymia: Advances in research, theory, and clinical practice. New York, NY, US: Cambridge University Press; 2018. p. 321-33.

33. Brewer R, Cook R, Bird G. Alexithymia: a general deficit of interoception. Royal Society open science. 2016;3(10):150664.

34. Van Bael K, Ball M, Scarfo J, Suleyman E. Assessment of the mind-body connection: preliminary psychometric evidence for a new self-report questionnaire. BMC Psychology. 2023;11(1):309.

35. Mehling WE, Acree M, Stewart A, Silas J, Jones A. The multidimensional assessment of interoceptive awareness, version 2 (MAIA-2). PloS one. 2018;13(12):e0208034.

36. Becerra R, Preece D, Campitelli G, Scott-Pillow G. The Assessment of Emotional Reactivity Across Negative and Positive Emotions: Development and Validation of the Perth Emotional Reactivity Scale (PERS). Assessment. 2019;26(5):867-79.

37. Klonsky ED, Victor SE, Hibbert AS, Hajcak G. The multidimensional emotion questionnaire (MEQ): Rationale and initial psychometric properties. Journal of Psychopathology and Behavioral Assessment. 2019;41:409-24.

38. Preece DA, Hasking P, Boyes M, Clarke P, Notebaert L, Kiekens G, et al. Emotion generation and emotion regulation: The role of emotion beliefs. Journal of Affective Disorders Reports. 2022;9.

39. Gross JJ. Emotion Regulation: Current Status and Future Prospects. Psychological Inquiry. 2015;26(1):1-26.

40. Kline RB. Principles and practice of structural equation modeling / Rex B. Kline. Fourth edition. ed: Guilford Press; 2016.

41. Tabachnick BG, Fidell LS. Using multivariate statistics. 6 ed: Pearson; 2013.

42. Byrne BM. Structural equation modeling with AMOS : basic concepts, applications, and programming / Barbara M. Byrne. Third edition. ed: Routledge/Taylor & Francis Group; 2016.

43. Pituch KA. Applied multivariate statistics for the social sciences : analyses with SAS and IBM's SPSS / Keenan A. Pituch and James P. Stevens. Sixth edition. ed: Routledge; 2016.

44. Spurk D, Hirschi A, Wang M, Valero D, Kauffeld S. Latent profile analysis: A review and "how to" guide of its application within vocational behavior research. Journal of Vocational Behavior. 2020;120.

45. Field AP. Discovering statistics using IBM SPSS statistics / Andy Field. 5th edition. ed: SAGE Publications; 2018.

46. Myers RH. Classical and modern regression with applications: Duxbury press Belmont, CA; 1990.

47. Preece D, Becerra R, Allan A, Robinson K, Dandy J. Establishing the theoretical components of alexithymia via factor analysis: Introduction and validation of the attention-appraisal model of alexithymia. Personality and individual differences. 2017;119:341-52.

48. Preece DA, Gross JJ. Conceptualizing alexithymia. Personality and Individual Differences. 2023;215:112375.

49. Weller BE, Bowen NK, Faubert SJ. Latent class analysis: A guide to best practice. Journal of Black Psychology. 2020;46(4):287-311.

50. D'Alonzo KT. The Johnson-Neyman Procedure as an Alternative to ANCOVA. Western Journal of Nursing Research2004. p. 804-12.

51. Montoya AK. Extending the Johnson-Neyman procedure to categorical independent variables: Mathematical derivations and computational tools [Master's thesis]: The Ohio State University; 2016.

52. Ferentzi E, Olaru G, Geiger M, Vig L, Köteles F, Wilhelm O. Examining the factor structure and validity of the multidimensional assessment of interoceptive awareness. Journal of Personality Assessment. 2021;103(5):675-84.

53. Mattila AK, Saarni SI, Salminen JK, Huhtala H, Sintonen H, Joukamaa M. Alexithymia and Health-Related Quality of Life in a General Population. Psychosomatics. 2009;50(1):59-68.

54. Burgmer P, Forstmann M. Mind-Body Dualism and Health Revisited: How Belief in Dualism Shapes Health Behavior. Social Psychology. 2018;49(4):219-30.

55. Shah P, Hall R, Catmur C, Bird G. Alexithymia, not autism, is associated with impaired interoception. Cortex. 2016;81:215-20.

56. Joshi V, Graziani P, Del-Monte J. The Role of Interoceptive Attention and Appraisal in Interoceptive Regulation. Frontiers in Psychology. 2021;12.

57. Zamariola G, Vlemincx E, Corneille O, Luminet O. Relationship between interoceptive accuracy, interoceptive sensibility, and alexithymia. Personality and Individual Differences. 2018;125:14-20.

58. Aaron RV, Park S, Blain SD, Snodgress MA. Quadratic Relationship Between Alexithymia and Interoceptive Accuracy, and Results From a Pilot Mindfulness Intervention. Frontiers in Psychiatry. 2020;11.

59. Panayiotou G, Leonidou C, Constantinou E, Hart J, Rinehart KL, Sy JT, et al. Do alexithymic individuals avoid their feelings? Experiential avoidance mediates the association

between alexithymia, psychosomatic, and depressive symptoms in a community and a clinical sample. Comprehensive Psychiatry. 2015;56:206-16.

60. Desdentado L, Miragall M, Llorens R, Baños RM. Disentangling the role of interoceptive sensibility in alexithymia, emotion dysregulation, and depression in healthy individuals. Current Psychology. 2022:1-13.

61. Zamariola G, Luminet O, Mierop A, Corneille O. Does it help to feel your body? Evidence is inconclusive that interoceptive accuracy and sensibility help cope with negative experiences. Cognition and Emotion. 2019;33(8):1627-38.

62. Tünte M, R., Petzke T M, Brand S, Murphy J, Witthöft M, Hoehl S, et al. Differential Effects of Self-Reported Interoceptive Attention and Accuracy on Subclinical Psychopathology. *Journal of Personality Assessment*. 2024.

63. Taylor GJ, Bagby RM, Parker JDA. Disorders of affect regulation: Alexithymia in medical and psychiatric illness: Cambridge University Press; 1999.

64. Scarpazza C, Zangrossi A, Huang Y-C, Sartori G, Massaro S. Disentangling interoceptive abilities in alexithymia. Psychological research. 2022;86(3):844-57.

65. Wotschack C, Klann-Delius G. Alexithymia and the conceptualization of emotions: A study of language use and semantic knowledge. Journal of Research in Personality. 2013;47(5):514-23.

66. Tull MT, Medaglia E, Roemer L. An investigation of the construct validity of the 20-Item Toronto Alexithymia Scale through the use of a verbalization task. Journal of Psychosomatic Research. 2005;59(2):77-84.

67. Lee KS, Murphy J, Catmur C, Bird G, Hobson H. Furthering the language hypothesis of alexithymia: An integrated review and meta-analysis. Neuroscience & Biobehavioral Reviews. 2022;141:104864.

68. Porcelli P, Taylor GJ. Alexithymia and physical illness: A psychosomatic approach. Alexithymia: Advances in research, theory, and clinical practice. New York, NY: Cambridge University Press; 2018. p. 105-26.

69. Ferentzi E, Horváth Á, Köteles F. Do body-related sensations make feel us better? Subjective well-being is associated only with the subjective aspect of interoception. Psychophysiology. 2019;56(4):N.PAG-N.PAG.

70. Lyvers M, Ryan N, Thorberg FA. Alexithymia, negative moods, and fears of positive emotions. Current Psychology. 2022.

71. Jacob S, Hautekeete M. Alexithymia is associated with a low self-estimated affective intensity. Personality and Individual Differences. 1999;27(1):125-33.

72. Critchley HD, Wiens S, Rotshtein P, Öhman A, Dolan RJ. Neural systems supporting interoceptive awareness. Nature Neuroscience. 2004;7(2):189-95.

73. Vlemincx E, Walentynowicz M, Zamariola G, Van Oudenhove L, Luminet O. A novel self-report scale of interoception: the three-domain interoceptive sensations questionnaire (THISQ). Psychology & Health. 2021:1-20.

74. Preece DA, Mehta A, Petrova K, Sikka P, Bjureberg J, Becerra R, et al. Alexithymia and emotion regulation. Journal of affective disorders. 2023;324:232-8.

75. Gross JJ. Emotion regulation: Affective, cognitive, and social consequences. Psychophysiology. 2002;39(3):281-91.

76. Silton RL, Kahrilas IJ, Skymba HV, Smith J, Bryant FB, Heller W. Regulating positive emotions: Implications for promoting well-being in individuals with depression. Emotion. 2020;20(1):93-7.

77. Eisner LR, Johnson SL, Carver CS. Positive affect regulation in anxiety disorders. Journal of Anxiety Disorders. 2009;23(5):645-9.

78. Becerra R, Naragon-Gainey K, Gross JJ, Ohan J, Preece DA. Beliefs about emotions: Latent structure and links with emotion regulation and psychopathology. Journal of Affective Disorders Reports. 2024;16.

79. Becerra R, Preece DA, Gross JJ. Assessing beliefs about emotions: Development and validation of the Emotion Beliefs Questionnaire. PLoS ONE. 2020;15(4).

80. Tan Y, Wang X, Blain SD, Jia L, Qiu J. Interoceptive attention facilitates emotion regulation strategy use. International Journal of Clinical and Health Psychology. 2023;23(1):100336.

81. Lee SH, Lee KT. Attentional Processing of Unpleasant Stimuli in Alexithymia. Psychological Reports. 2022.

82. Leonidou C, Constantinou E, Panteli M, Panayiotou G. Attentional processing of unpleasant stimuli in alexithymia: Early avoidance followed by attention maintenance bias. Cogent Psychology. 2022;9(1):1-16.

83. Honkalampi K, De Berardis D, Vellante F, Viinamäki H. Relations between alexithymia and depressive and anxiety disorders and personality. Alexithymia: Advances in research, theory, and clinical practice. New York, NY, US: Cambridge University Press; 2018. p. 142-57.

84. Jenkinson PM, Fotopoulou A, Ibañez A, Rossell S. Interoception in anxiety, depression, and psychosis: a review. eClinicalMedicine. 2024;73.

85. Garland EL, Farb NA, R. Goldin P, Fredrickson BL. Mindfulness Broadens Awareness and Builds Eudaimonic Meaning: A Process Model of Mindful Positive Emotion Regulation. Psychological Inquiry. 2015;26(4):293-314.

86. Shalev I. Motivated cue integration in alexithymia: improving interoception and emotion information processing by awareness-of-sensation techniques. Frontiers in Psychiatry. 2019;10:329.

87. Weng HY, Feldman JL, Leggio L, Napadow V, Park J, Price CJ. Interventions and manipulations of interoception. Trends in neurosciences. 2021;44(1):52-62.

88. Aizik-Reebs A, Shoham A, Bernstein A. First, do no harm: An intensive experience sampling study of adverse effects to mindfulness training. Behaviour Research and Therapy. 2021;145.

89. Pinna F, Manchia M, Paribello P, Carpiniello B. The impact of alexithymia on treatment response in psychiatric disorders: a systematic review. Frontiers in Psychiatry. 2020;11:311.

90. Mattila AK, Koivisto AM, Joukamaa M, Kronholm E, Jula A, Salminen JK, et al. Alexithymia and somatization in general population. Psychosomatic Medicine. 2008;70(6):716-22.

91. Wilson-Mendenhall CD, Dunne JD. Cultivating Emotional Granularity. Frontiers in Psychology. 2021;12.

92. D'Avanzato C, Joormann J, Siemer M, Gotlib IH. Emotion regulation in depression and anxiety: Examining diagnostic specificity and stability of strategy use. Cognitive Therapy and Research. 2013;37(5):968-80.

Chapter 7. General Discussion

7.1. Summary

The aims of this thesis were fourfold: (1) elucidate the salient psychological constituents of the mind-body connection; (2) clarify the association between specific aspects of self-reported interoception and alexithymia; (3) develop and validate a new self-report questionnaire to measure the hypothesised psychological constituents of the mind-body connection; and (4) examine how mind-body connection constituents influence typical experiences of positive and negative emotions.

Through a thorough review of the literature, this thesis identified that subjective interoception, the identification and articulation of emotions, and mind-body beliefs formed salient psychological constituents and subsequent indicators of one's connection between their mind and body, thereby addressing the first aim. On face, the association between interoception and alexithymia—a dysfunction of emotion identification and articulation—seemed relatively robust. However, previous conclusions were ultimately obfuscated as a consequence of the pervasive incongruence between construct definitions and measurements in interoceptive research. As such, previous findings prompted questions regarding their reliability, validity, and generalisability.

To substantiate the hypothesis that interoception and emotion identification and articulation form psychological constituents of the mind-body connection and demonstrate an empirical association necessitated conducting a systematic review and meta-analysis of the relationship between specific interoceptive self-report scales and alexithymia. By employing a unique and theoretically grounded approach to data disaggregation, Paper 1 clarified this association, thus addressing the first and second aims of this thesis. This endeavour acknowledged the complexities of subjective interoception and considered empirical evidence suggesting that self-report scales capture distinct and relatively unrelated factors.

Paper 1 found that the association between self-reported interoception and alexithymia is contingent upon both how self-reported interoception is measured and alexithymic facets. This is because specific interoceptive questionnaires consistently maintained either a positive or negative association with global and facet-level alexithymia, with observed associations stronger for DIF and DDF facets compared to EOT. These findings underscored previously theorised contributions of maladaptive interoception in the propagation of alexithymia, and the importance of adaptive interoceptive aspects in the mitigation of alexithymic propensities. Together, these findings indicated that interoceptive and alexithymic processes should be concurrently measured. Notably, however, no interoceptive self-report scale administered in mind-body research assesses these two constructs within the one questionnaire. Accordingly, the findings of Paper 1 substantiated both the development of a new self-report questionnaire assessing salient psychological constituents of the mind-body connection and the inclusion of interoceptive and inversely conceptualised alexithymic facets: the BMCQ.

Overall, a suite of interoceptive self-report scales were deemed to lack measurement of DDF and EOT alexithymia facets and explicit mind-body connection beliefs and behaviours known to influence health-promoting behaviour. Although these measures were not designed to measure the mind-body connection per se, they should not be regarded as replete measures of this construct, given the omission of equally important and related aspects. As detailed in Paper 2, the BMCQ was developed to unify and more holistically assess these constructs within the one self-report, therefore addressing the third aim of this research. Paper 2 operationalised the hypothesis that the mind-body connection comprises three salient psychological factors: Interoceptive Attention, Sensation-Emotion Articulation, and Body-Mind Values. The preliminary psychometric evaluation of the BMCQ in a sample of typically developed adults supported the three proposed factors underpinning the mind-body connection, resulting in a parsimonious, valid, and reliable 13-item self-report questionnaire. The findings suggested that the mind-body connection is multidimensional, consisting of distinct but related factors, each differing in the magnitude of their relationship with theoretically associated constructs, including adaptive interoceptive processes and alexithymia. In doing so, Paper 2 also addressed the first aim of the research.

Paper 3 subsequently validated the BMCQ in a new sample of typically developed adults, confirmed the hypothesised three-factor structure of the BMCQ, and refined the item pool from 13 to 10 items. Results indicated that the measure is suitable for use in mind-body research and clinical practice, thereby fulfilling the third aim of this thesis. The revised BMCQ subscales were further included in an LPA, which enabled the identification of latent mind-body connection profiles and a nuanced exploration of how mind-body connection constituents interact to influence typical experiences of positive and negative emotions. Therefore, Paper 3 also addressed the fourth aim of this thesis. Using LPA, three distinct profiles emerged, encapsulating a Strong Mind-Body Connection (high Interoceptive Attention, Sensation-Emotion Articulation, Body-Mind Values), Weak Mind-Body Connection (moderate Interoceptive Attention, low Sensation-Emotion Articulation, low Body-Mind Values), and Mind-Body Disconnection (low Interoceptive Attention, Sensation-Emotion Articulation, Body-Mind Values). A series of multivariate and univariate analyses indicated that differences in reactivity for positive emotions were significantly associated with mind-body connection profiles in clinical and non-clinical samples. Individuals classified with a Strong Mind-Body Connection profile experienced positive emotions most frequently, intensely, and persistently when compared to the Weak Mind-Body Connection profile. Additionally, individuals with a Weak Mind-Body Connection had the greatest difficulty regulating both positive and negative emotions when compared to those with a Strong Mind-Body Connection profile.

Accordingly, individuals with a Strong Mind-Body Connection profile demonstrate characteristics suggestive of a robustly cultivated mind-body connection that serves to promote adaptive emotional functioning, whereas individuals within Mind-Body Disconnection and Weak Mind-Body Connection profiles exhibit characteristics indicative of poor mind-body integration, thus hindering the cultivation of adaptive and flexible emotional repertoires. While further research is required, these findings add weight to arguments calling for tailored interventions targeting distinct aspects of the mind-body connection to facilitate greater adaptability and wellbeing (e.g., Grimble et al., 2024; Yun-Hsin et al., 2023), depending on an individual's interoceptive, emotional, and mind-body connection beliefs.

7.2. Elucidation of Psychological Mind-Body Constituents

The first aim of this thesis was to elucidate the salient psychological constituents of the mind-body connection. Underscoring the importance of identifying key processes influencing physical and mental wellbeing, accumulating evidence for the role of psychological processes in the onset and progression of illness and recovery is leading to greater acceptance of mind-body perspectives in clinical and research applications (e.g., Brower, 2006; Taylor et al., 2010). Guided by the broad notion that the mind-body connection represents the link between thoughts, feelings, behaviours, and physical and mental health, a thorough review of the literature, meta-analysis, and scale development phases iteratively revealed that the salient psychological constituents contributing to one's mind-body connection included interoceptive attention, alexithymia, and mind-body beliefs. The findings of Studies 1 and 2 provided cumulative support for this conclusion.

7.2.1. Interoceptive Attention

The meta-analyses conducted in Paper 1 and construct validity evidence presented in Paper 2 provided support for the identification of Interoceptive Attention as a salient psychological constituent of the Mind-Body Connection. Neuroanatomically (Haruki & Ogawa, 2021; Wang et al., 2019) and conceptually distinct from interoceptive accuracy (Gabriele et al., 2022; Khalsa et al., 2018; Murphy et al., 2020), interoceptive attention in a subjective context has been defined as “beliefs regarding the degree to which interoceptive signals are the object of attention” (Murphy et al., 2019, p. 1469). Various interoceptive self-reports measure this construct according to this definition, including the IATS and, arguably, the BPQ-BA (Gabriele et al., 2022; Murphy et al., 2020; Tünte et al., 2024).

However, attention is not a uniform process; it is multifaceted and controlled via both bottom-up and top-down mechanisms (Corbetta & Shulman, 2002). This set of cognitive abilities facilitates both the efficient processing of information and appropriate responses to salient stimuli. (Corbetta & Shulman, 2002). Indeed, distinctions have been made with respect to attentional control in an interoceptive context, involving the capacity to direct attentional resources toward internal bodily sensations in bottom-up, stimulus-dependent or top-down, purposeful manners (Khalsa et al., 2018; Khalsa & Lapidus, 2016). This definition appears more in line with how interoceptive attention may be engaged in everyday interoceptive processing, underscoring the importance of operationalising such notions.

Attentional control is essential in interoception. This active process can modify, filter, or heighten sensory inputs from the body, affecting the intensity and quality of attentional engagement (Mehling et al., 2009). In supporting wellbeing, adaptive attention involves bodily sensations being regarded as important, confidence in the capacity to orient, sustain, and control attention to sensations, and non-judgmental awareness of immediate experience. Such characteristics may promote a stronger incorporation of bodily sensations into mental representations of emotions (MacCormack et al., 2023). In turn, this coupling could facilitate more fluid constructions of ad-hoc emotion categories and concepts, thus supporting the flexible and context-sensitive experience, communication, and regulation of emotions (e.g., Barrett, 2017b; Hoemann et al., 2019; Panayiotou et al., 2021).

Results presented in Paper 1 collectively suggested that adaptive interoceptive beliefs are measured using the BAQ and MAIA scales of Noticing, ND, AR, SR, and BL. Whether at the global or facet level of alexithymia, higher scores on each of these questionnaires and subscales were associated with lower alexithymia. These findings make important contributions to current knowledge on adaptive interoceptive attention characteristics, as robust adaptive interoceptive attention repertoires are also associated with better psychological wellbeing, inclusive of self-acceptance, life purpose, environmental mastery, positive relationships, personal growth, and autonomy (Hanley et al., 2017).In primary care patients with current or past lower back pain, such capacities are related to lower levels of stress, depression, and avoidance-based strategies to cope with pain (Mehling et al., 2013).

Conversely, maladaptive attention can involve dysfunctional orienting, including hypervigilance, dismissal of bodily sensations, insufficient reflection, or rumination. Such tendencies are observed to be higher in patients with persistent somatic symptoms (e.g., irritable bowel syndrome, fibromyalgia, medically unexplained dyspnea) and stress-related syndromes (e.g., panic disorder, burnout) when compared to healthy controls (Bogaerts et al., 2022; Schmitz et al., 2021). Indeed, meta-analyses conducted in Paper 1 showed that higher scores on the IATS—evaluated as tapping into homeostatic disturbance—were associated with higher alexithymia. However, the BPQ-BA was not significantly associated with any alexithymic outcome. Due to these findings, it was determined that high IATS scores may provide clearer indications of maladaptive interoceptive attention (i.e., hypervigilance) toward various interoceptive sensations when compared to the BPQ-BA. Given that alexithymia is a psychological variable that significantly impacts disease and recovery (Sirri et al., 2013), these findings support previous assertions that interoceptive attention similarly forms an important factor that influences the onset of and recovery from disease (Mehling, 2016).

Moreover, convergent evidence outlined in Paper 2 found that stronger bottom-up and top-down interoceptive attentional control (BMCQ Interoceptive Attention scale) was related to higher interoceptive attention regulation (MAIA-AR), noticing (MAIA-Noticing), body listening (MAIA-BL), and extero-interoceptive integration (BAQ). The insula functions as a central hub for interoceptive processes, with its structure hypothesised to progress from the posterior to anterior, each contributing uniquely to the conscious experience of internal bodily states (Craig, 2008, 2009a, 2009b, 2014). This progression, involving complex integrations and re-representations of sensory and emotional data, is possibly tied to various beliefs of self-reported interoceptive attention. Within this hypothesised progression, the posterior insula generates initial interoceptive representations, providing the foundation for feelings, thus necessitating foundational attention oriented to interoceptive sensations. It is possible that bottom-up attentional processing (BMCQ Interoceptive Attention) and interoceptive noticing (MAIA-Noticing) form foundational beliefs enabling such primary representations. As these signals move to the mid insula, they integrate with visual, auditory, and vestibular feedback, which could be engendered through stronger beliefs enabling extero-interoceptive integration (BAQ). These beliefs may facilitate communication with the amygdala and hypothalamus regarding emotional significance and autonomic states. The mid insula also interacts with higher-order brain regions (e.g., temporal pole, NA, and OFC) to assess salience., which arguably engages purposeful top-down attentional control (BMCQ Interoceptive Attention). Then, in the AIC, interoceptive signals are re-represented and integrated with motivational, social, and cognitive inputs through connections with the ACC, vmPFC, and dlPFC, making interoception conscious. In doing so, beliefs in attuning to the body to guide decision-making may strengthen these conscious experiences (MAIA-BL).

Taken together, preexisting evidence and the findings of this thesis indicate that interoceptive attention forms a salient psychological constituent of the mind-body connection that may modulate the intensity of perceived interoceptive and emotional stimuli, thus influencing whether signals are deemed important for wellbeing.

7.2.2. Sensation-Emotion Articulation

In various accounts of emotion, the interpretation of physiological changes results in an emotional experience when they are categorised and conceptualised as such (e.g., Barrett, 2017b; Lindquist, 2013; Schachter & Singer, 1962; Seth, 2013). Affective interpretation of sensations plays a significant role in survival, supporting motivated responses to address bodily integrity (e.g., thirst, pain, temperature; Craig, 2003a), social integration (e.g., love, happiness, empathy), success (e.g., joy, pride), and physical safety and survival (e.g., fear, anger; Craig, 2014; Damasio, 2018; Damasio & Carvalho, 2013). From an evolutionary perspective, recognition of subjective feelings and emotional behaviours are proposed to have developed, so as to enhance the efficiency and complexity of emotional communication (Craig, 2008).

Alexithymia represents the quintessence of a mind-body disconnection, given that the trait is encompassed by difficulty identifying feelings, describing them to others, and an externally oriented thinking mode (Taylor et al., 1991, 1999). Such traits are associated with deficits in attention to emotions and emotional clarity, hindering capacities for accurately perceiving and interpreting emotional stimuli (Boden & Thompson, 2017). Moreover, alexithymia is associated with lower confidence in both perceptual and emotion recognition tasks, indicating challenges in proficiently identifying and understanding emotions (Luminet et al., 2021). This altered processing of emotional stimuli can lead to difficulties in recognising and labelling emotions with specificity and precision, contributing to impaired mental representation of emotions observed in alexithymic individuals (Hoemann et al.,

2021) and greater allostatic load (Panayiotou et al., 2018; Panayiotou et al., 2021). Indeed, the meta-analytic findings of Paper 1 provide further evidence for the cooccurrence of poorer, inefficient detection and processing of interoceptive and emotional stimuli.

When alexithymic facets are inverted, they become the capacities of identification of feelings, description of feelings, and internally oriented thinking—qualities reflecting emotional expertise that augment stronger mental representations of emotions (Hoemann et al., 2021). Whilst increased attention to emotions may precede and promote greater emotional clarity (Boden & Thompson, 2017), this is likely insufficient for unambiguously identifying, labelling, representing, and expressing emotions. If attention to emotions regards the extent to which people attend to and value their emotions, an embodied view suggests that attending to and valuing interoceptive sensations should also accompany this (Mehling et al., 2009). Collectively, such orientations and values would be advantageous for adaptation to challenges and adjustment to life circumstances (Price & Hooven, 2018).

In this thesis, the inverted qualities of alexithymia that explicitly considered the coupling of physiological sensations and emotional categories were termed 'Sensation-Emotion Articulation'. This construct was measured through the eponymously labelled BMCQ scale. The convergent evidence presented in Paper 2 found that greater sensation-emotion articulation was most strongly negatively related to alexithymia at global and facet levels, as assessed by the PAQ. This supported the theoretical notion that these mind-body connection characteristics reflect the inverse of alexithymia, thus representing competencies supporting stronger emotional expertise (Hoemann et al., 2021). Moreover, stronger capacities for sensation-emotion articulation related to stronger interoceptive emotional awareness (MAIA-EA) and body listening (MAIA-BL). Together, these findings emphasise that sensation-emotion articulation entails the coupling of interoception and emotion, each of which are highly and equally valued internal sources of information informing subjective emotional experiences. These characteristics may further serve to foster the construction of adaptive, flexible emotion categories and employment of regulatory strategies that complement goals and augment survival and wellbeing (Farb et al., 2015). Accordingly, this evidence indicates that alexithymia and sensation-emotion articulation form a salient psychological constituent of the mind-body connection.

7.2.3. Mind-Body Beliefs

Existing concepts of mind-body beliefs in an interoceptive context include trusting body sensations and mind-body integration (Köteles, 2021; Mehling et al., 2012). Trusting body sensations involves viewing sensations as beneficial for decision-making and health. This aspect can be assessed through the adaptive interoceptive interpretation scale, MAIA-Trusting. Mind-body integration, the pinnacle of mind-body therapy, encompasses awareness of physical sensations as components of emotions (MAIA-EA), self-regulation of emotions, sensations, and behaviour (e.g., behavioural homeostatic regulation; MAIA-AR, MAIA-SR, MAIA-BL), therein fostering a sense of interconnectedness among mental, emotional, and physical processes (Köteles, 2021; Mehling et al., 2012). Whilst these aspects are crucial for health and wellbeing, they tacitly reflect mind-body connection beliefs contrasted with dualistic beliefs, whereby mind and body are regarded as distinct, separate entities. Beliefs of this nature have not been wholly considered in either the interoceptive or emotional literature.

Dualism is a prevalent, intuitive view in Western cultures (Demertzi et al., 2009; Forstmann & Burgmer, 2015). Stronger dualistic beliefs are associated with lower health-promoting attitudes and behaviours, whereas stronger mind-body connection beliefs relate to stronger recognition of the impact of bodily states on mental wellbeing, and higher health-sustaining behaviours and values (Burgmer & Forstmann, 2018; Forstmann et al., 2012). If mind-body beliefs in this context significantly influence health-related values and behaviours (Burgmer & Forstmann, 2018; Forstmann & Burgmer, 2017), it is possible that bodily trusting, sensation-emotion identification, interoceptive self-regulation, and overall sense of interconnectedness—constructs captured within MAIA subscales—stem from explicit mind-body connection beliefs. This is particularly tenable, as mind-body connection beliefs underpin the perspective that mental wellbeing is contingent upon physical wellbeing and that caring for the body is necessary for holistic health (Burgmer & Forstmann, 2018). Conversely, rejecting this value typifies the belief that mental wellbeing is independent of physical wellbeing, which can lead to bodily neglect—emblematic of strong dualistic endorsement. This cumulatively suggests that mind-body beliefs and higher-order interoceptive factors significantly influence health-related values and behaviours.

In this thesis, mind-body beliefs pertain to explicit beliefs regarding the connection between mind and body, valuation of physical and mental wellbeing, and bodily-motivated behaviour. During the scale development phase delineated in Paper 2, such attitudes were termed ‘Body-Mind Values’ for inclusion in the BMCQ. Convergent evidence from Paper 2 determined that stronger body-mind values were related to heightened bodily trust (MAIA-Trusting), interoceptive body listening (MAIA-BL), self-regulation (MAIA-SR), emotional awareness (MAIA-EA), and attention regulation (MAIA-AR). This highlights the significance of mind-body beliefs in shaping attitudes towards health and wellbeing, and initiating behaviours aimed at achieving this. These theoretical notions and findings emphasise the role of mind-body values as a salient psychological constituent of the mind-body connection, making them an essential target for mind-body therapies.

7.3. The Association between Self-Reported Interoception and Alexithymia

Due to the pervasive inconsistencies between interoceptive constructs and measurements in the literature, determining whether alexithymia and subjective interoceptive beliefs were significantly associated constructs was complex. As such, the conceptualisation of ‘Sensation-Emotion Articulation’ and inclusion of interoceptive and alexithymic dimensions within the BMCQ was based on equivocal evidence. Accordingly, this thesis aimed to clarify the association between specific aspects of self-reported interoception and alexithymia. This aim was therefore addressed in Paper 1 of this thesis.

The systematic review and meta-analysis findings from Paper 1 determined that scales which measure maladaptive interoceptive sensing, involving interoceptive confusion and inaccuracy (ICQ, ISQ, EDI-IAw), are positively associated with alexithymia: greater confusion about interoceptive signals and poorer accuracy beliefs coincide with higher levels of global alexithymia, DIF, DDF, and EOT. Moreover, scales measuring perceived ANS dysfunction and negative interpretations of bodily sensations (BPQ-R, SAQ) also showed a positive association with alexithymia, suggesting that increased ANS reactivity and negative interpretation of sensations relate to higher alexithymia. Additionally, scales assessing neutral attention to body sensations (IATS) relate positively to alexithymia, indicating that heightened attention to interoceptive sensations is linked to higher alexithymia. Conversely, scales assessing adaptive interoceptive sensing, attention, interpretation, and memory (IAS, MAIA-Noticing, MAIA-ND, MAIA-NW, MAIA-AR, MAIA-EA, MAIA-SR, MAIA-BL, MAIA-Trusting, BAQ, THISQ) are negatively associated with alexithymia, suggesting that the accurate, non-judgmental, mindful processing of interoceptive sensations, and integration of such sensations with exteroceptive information, is linked to lower levels of alexithymia.

These findings supported the view that atypical interoceptive interpretational styles and poor perceptions of interoceptive sensing and attention indeed coincide with alexithymia (Brewer et al., 2016; Brewer et al., 2015; Shah, Catmur, et al., 2016; Shah, Hall, et al., 2016), but especially DIF and DDF facets when compared to EOT. Neurobiological evidence could provide further context for these associations. For instance, reduced activity in interoceptive hubs within the default mode network of individuals with high alexithymia (Reker et al., 2010; van der Velde et al., 2013) aligns with the observed associations between scales tapping into maladaptive interoceptive beliefs and perceptions and alexithymia. This network facilitates prediction with emotion concepts (Barrett, 2017b). Reduced activity in these interoceptive hubs suggests that alexithymic individuals experience challenges using emotion concepts to predict and make sense of their bodily sensations. In particular, the positive association between alexithymia and scales measuring maladaptive interoceptive sensing may indicate that confusion about interoceptive signals may stem from reduced neural engagement in these hubs. Moreover, amongst individuals with high alexithymia, increased activity in the dorsal ACC has been observed. This area is linked to subjective reports of negativity, pain processing, and the amplification of somatic symptoms (Vogt, 2005). This increased activity complements the observed positive association between alexithymia and scales measuring perceived ANS dysfunction and negative interpretations of bodily sensations, suggesting that individuals with alexithymia often report somatic symptoms and negative affect without experiencing them as emotional (Porcelli & Taylor, 2018).

Collectively, these findings provided partial support for the interoceptive hypothesis of alexithymia (e.g, Brewer et al., 2016). The systematic review and meta-analyses from Paper 1 provided greater clarity concerning the association between self-reported interoceptive beliefs of accuracy, attention, and interpretation and alexithymia. Taken together, the results substantiated the inclusion of interoceptive attention beliefs within the mind-body connection construct proposed in this thesis. Moreover, these findings substantiate that the conceptualisation of alexithymia in this thesis should involve an unambiguous awareness and articulation of the connection between bodily sensations and emotional states.

7.4. Development and Validation of the BMCQ

The current thesis also aimed to develop and validate a new self-report questionnaire to measure the hypothesised psychological constituents of the mind-body connection. The development and validation of the BMCQ, presented in Paper 2 and Paper 3, followed a comprehensive and systematic process, following best practice guidelines to ensure its methodological rigor. This process began with establishing a solid theoretical basis. Drawing from existing literature and theoretical frameworks relevant to the mind-body connection, three salient psychological constituents of this construct were identified: subjective interoception, sensation-emotion articulation, and body-mind values. These constituents thus represented key domains and variables essential for inclusion in the questionnaire. Partially substantiated by the findings of Paper 1, this solid theoretical and empirical foundation ensured that the BMCQ would comprehensively capture the targeted constructs.

The development of the BMCQ encompassed in Paper 2 was a meticulously structured process, which ensured both methodological rigor and the inclusive, holistic capture of the mind-body connection. This process unfolded in several key stages recommended by Boateng et al. (2018), beginning with a thorough theoretical grounding. Drawing from an extensive review of relevant literature, theoretical frameworks, and empirical studies, the salient psychological constituents of the mind-body connection were identified and thus deemed essential for inclusion in the questionnaire. This theoretical underpinning was critical to ensuring that the instrument would accurately encapsulate the mind-body connection.

The item generation phase was multifaceted, incorporating multiple methodologies to ensure breadth and depth. Initially, a comprehensive review of existing instruments provided inspiration and a comparative baseline for item phrasing and content. To ensure that the BMCQ remained a warranted measure, screening of BMCQ items relative to existing scales was imperative. Removal of redundant items refined the interoceptive domain to entail attentional control processes only. An expert panel was subsequently consulted to review potential items, providing insights into the theoretical and practical aspects of the construct.

Following this, a small-scale study involving individuals from the target population was conducted. These phases were instrumental in refining the language and ensuring the relevance and comprehensibility of the items as reflective of the mind-body connection.

The initial pool of items underwent rigorous psychometric evaluation to determine their validity and reliability in Paper 2. EFA was performed in two phases to uncover the underlying factor structure of the BMCQ. This provided an accurate representation of the data leading to more meaningful and reliable solutions. This analysis involved a sufficiently large sample of typically developed adults to establish properties for a non-clinical population, which yielded three distinct factors underlying the mind-body connection, reflecting interoceptive attention, sensation-emotion articulation with internal focus, and mind-body values. These findings therefore supported the hypothesis that these are salient constituents of the mind-body connection.

Furthermore, convergent validity was established through significant correlations with established measures of related constructs, including measures of interoceptive attention and interpretation, and alexithymia. Specifically, the hypotheses formulated to demonstrate convergent and discriminant validity for the individual BMCQ scales were generally supported. Table 7.1 provides an overview of these hypotheses and evidence for support.

Table 7.1

Overview of Construct Validity Hypotheses Tested in Paper 2.

BMCQ Scale	Hypothesis	Aspect of Construct Validity	Evidence for Hypothesis Support
Body-Mind Values	Strong positive with MAIA-Trusting.	Convergent	Supported
	Strong positive with MAIA-BL.	Convergent	Supported
	Moderate positive with MAIA-SR.	Convergent	Not supported Strong magnitude
	Moderate positive with MAIA-AR.	Convergent	Supported
	Moderate positive with BAQ.	Convergent	Supported
	Weak positive with MAIA-ND.	Discriminant	Supported
	Weak positive with MAIA-NW.	Discriminant	Not supported *n.s.*
Sensation-Emotion Articulation	Strong negative with PAQ-Total.	Convergent	Not supported Moderate magnitude
	Moderate negative with PAQ-DIF.	Convergent	Supported
	Moderate negative with PAQ-DDF.	Convergent	Supported
	Moderate negative with PAQ-EOT.	Convergent	Not supported Strong magnitude
	Moderate positive with MAIA-EA.	Convergent	Supported
	Weak positive with BAQ.	Discriminant	Supported
	Weak positive with BPQ-BA.	Discriminant	Supported
Interoceptive Attention	Strong positive with MAIA-AR.	Convergent	Not supported Moderate magnitude
	Moderate positive with MAIA-Noticing.	Convergent	Supported
	Moderate positive with BAQ	Convergent	Supported
	Weak positive with HSPS	Discriminant	Supported
	Weak positive with HSPS-EOE	Discriminant	Not supported *n.s.*
	Weak positive with HSPS-AES	Discriminant	Not supported Moderate magnitude
	Weak positive with HSPS-LST	Discriminant	Not supported *n.s.*

Note. BAQ: Body Awareness Questionnaire; BPQ-BA: Body Perception Questionnaire - Body Awareness subscale; HSPS: Highly Sensitive Person Scale; HSPS-AES: Aesthetic Sensitivity; HSPS-EOE: Ease of Excitation; HSPS-LST: Low Sensory Threshold; MAIA: Multidimensional Assessment of Interoceptive Awareness; MAIA-AR: Attention Regulation; MAIA-BL: Body Listening; MAIA-EA: Emotional Awareness; MAIA-ND: Non-Distracting; MAIA-Noticing: Noticing; MAIA-NW: Non-Worrying; MAIA-SR: Self-Regulation; PAQ: Perth Alexithymia Questionnaire; PAQ-DDF: Difficulty Describing Feelings; PAQ-DIF: Difficulty Identifying Feelings; PAQ-EOT: Externally Oriented Thinking; PAQ-Total: Total score on the Perth Alexithymia Questionnaire.

As can be seen in Table 7.1, five of seven hypotheses were supported for Body-Mind Values and Sensation-Emotion Articulation, and three out of seven supported for Interoceptive Attention. Where hypotheses were not supported these were either stronger or marginally weaker than expected for convergent validity, or not significant where weak correlations were specified in the case of discriminant validity. Despite these relative discrepancies, the findings indicated that the BMCQ subscales demonstrated adequate construct validity and does not inadvertently capture extraneous constructs.

Following the EFA, a CFA was conducted on a separate sample of typically developed adults in Paper 3 to validate the 3-factor structure derived following EFA in Paper 2. The results of the CFA confirmed the hypothesised factor structure, with 10 of 13 items demonstrating significant loadings on their respective factors, indicating that the BMCQ-10 has sound construct validity. This process was necessary for ensuring the robustness of the factor structure and minimising the risk of overfitting. Again, these findings reinforced the strong theoretical basis that informed elucidation of salient psychological constituents of the mind-body connection, supporting these hypothesised constructs. Internal consistency reliability was assessed using Cronbach's alpha for each subscale. Values at and above the generally accepted threshold of 0.70 indicate acceptable internal consistency across the BMCQ subscales, which was observed in both preliminary (Paper 2) and confirmatory investigations (Paper 3). This therefore indicates that the items within each subscale are acceptably correlated and measuring the same underlying construct.

Accordingly, the research phases delineated in Paper 2 and Paper 3 fulfilled the third aim of this thesis. The BMCQ-10 demonstrates strong psychometric properties, providing a reliable and valid measure of salient mind-body connection constituents. The rigorous development process, grounded in theory and empirical investigation, has resulted in a questionnaire that is parsimonious and precise. With further refinement, validation, and extended assessment of the scale’s psychometric properties (i.e., temporal stability, incremental validity), particularly in diverse populations, the BMCQ-10 holds promise for widespread application in research and practice. Doing so will promote greater use of this questionnaire, enhance the understanding and assessment of the mind-body connection, aid researchers and clinicians in their work, and improve outcomes for patients.

7.5. Identification of Mind-Body Connection Profiles

This research aimed to examine how mind-body connection constituents influence typical experiences of positive and negative emotions. Whilst a body of evidence concerns the association between some of these aspects, existing understandings have been generated following correlational or regression-based analysis. Within-sample heterogeneity has seldom been considered and investigated in terms of its contribution to variance in reactivity for and regulation of positive and negative emotions. Paper 3 of this thesis embraced this heterogeneity through the identification of mind-body profiles comprised of the three salient constituents assessed through their corresponding BMCQ scales by employing LPA.

Results presented by Yun-Hsin and colleagues (2023) provided a solid basis for understanding how different interoceptive clusters, comprising MAIA scales, relate to emotional reactivity phases. Whilst their findings are valuable, the MAIA scales—though suitable and effective measures of interoceptive sensing, attention and interpretation—do not completely measure all facets of alexithymia and beliefs regarding physical and mental health. Consequently, this self-report should not be considered a replete measure of the mind-body connection, and clusters solely comprising MAIA factors should not be regarded as mind-body connection clusters.

With reference to alexithymia, this contention is particularly supported by the results of Paper 1, which identified weaker associations between MAIA factors and alexithymia at global and facet levels. Moreover, the convergent validity findings of Paper 2 demonstrated stronger relationships between Sensation-Emotion Articulation and alexithymia relative to MAIA dimensions. Alexithymia is known to influence emotional reactivity (e.g., Panayiotou et al., 2021) and often co-occurs with depression (e.g., Honkalampi et al., 2001). Whilst noting interrelations between IS, alexithymia, and emotional reactivity, Yun-Hsin et al. (2023) did not incorporate alexithymia into the study design nor interpretation of their results. The inclusion of Sensation-Emotion Articulation and Body-Mind Values in profiles identified through LPA in Paper 3 therefore expands on previously identified clusters, providing more holistic mind-body connection profiles which can inform tailored treatments that consider factors beyond interoceptive beliefs. The use of LPA to produce distinct profiles provided a granular understanding of mind-body connection variations amongst typically developed and clinically diagnosed individuals, ranging from strong and adaptive (Strong Mind-Body Connection) to fragmented (Weak Mind-Body Connection) and externally oriented (Mind-Body Disconnection). The nuances within the mind-body connection profiles identified in this thesis demonstrate that individuals significantly differ in their collective perceptions of interoceptive attentional control, capacities for identifying and describing the association between their sensations and emotions, internal and external foci, and prioritisation of physical and mental wellbeing, This provided a considered foundation for interrogating how mind-body connection constituents influence typical experiences of positive and negative emotions and indicators of emotional functioning.

7.6. Influence of Mind-Body Connection Profiles on Emotional Functioning

Paper 3 determined that mind-body connection profiles significantly affect the typical frequency, intensity, and persistence of positive emotions, as well as the relative ease with which positive and negative emotions are easily regulated. Above and beyond a diagnosis of a psychological disorder, mind-body connection profiles significantly affected reactivity for positive emotions. Fredrickson's (1998, 2000, 2001, 2004) broaden-and-build theory posits that positive emotions broaden an individual's momentary thought-action repertoire, which, in turn, builds their enduring personal physical, intellectual, social, and psychological resources. Emotional granularity is essential for the cultivation of positive emotions and processes outlined in the broaden-and-build theory (Tan et al., 2022; Tugade et al., 2004; Wilson-Mendenhall & Dunne, 2021). As latent mind-body connection profiles influenced perceived experiences of positive emotions, how they may promote or inhibit the cultivation of positive emotions and flexible emotion regulation warrants consideration.

Within the Strong Mind-Body Connection profile, the evidence suggests capacities for accurately identifying and differentiating between various discrete positive emotions (Ventura-Bort et al., 2021). More precise identification may facilitate more nuanced and flexible understanding, response, and regulation of emotional states (Barrett et al., 2001). Enhanced positive emotional granularity could contribute to greater savouring and appreciation of positive emotions, resulting in more frequent activation, heightened intensity, and enduring experiences of these emotions. Such frequent, intense, persistent emotions could subsequently broaden cognitive and behavioural repertoires, thereby fostering exploration, creativity, and social interaction (Davidson, 1994, 1998; Fredrickson, 2000; Hoemann et al., 2023). Effective regulation amongst these individuals may foster the accumulation of enduring personal resources such as resilience, social support, and problem-solving skills. Furthermore, their capacity to differentiate and experience positive emotions could aid in mitigating the adverse effects of negative emotions, thereby promoting personal growth and resource accumulation (Garland et al., 2010).

Conversely, individuals with a Weak Mind-Body Connection profile may endorse relatively intact interoceptive attention but indicate low Sensation-Emotion Articulation, indicative of a tendency toward alexithymia. As such, these individuals may have low emotional granularity (Hoemann et al., 2021; Ventura-Bort et al., 2021), rendering it challenging to identify and distinguish emotions with specificity and precision, which in turn leads to generalised, undifferentiated emotional experiences (Wilson-Mendenhall & Dunne, 2021). Low emotional granularity may therefore limit the frequency, intensity, and duration of positive emotions experienced in this profile (Ventura-Bort et al., 2021). In the absence of clear emotional differentiation (Lee et al., 2022) and presence of withdrawal tendencies (Davidson, 1994, 1998), individuals may struggle to engage in activities that could broaden their thought-action repertoires, potentially stemming from fear of positive emotions and experiential avoidance (Lyvers et al., 2022; Panayiotou et al., 2015). Difficulties in identifying, differentiating, and regulating emotions could consequently impede the development of personal resources. As such, these individuals may face challenges in developing effective coping strategies and building resilience (Tugade et al., 2004), ultimately affecting their overall wellbeing and personal growth.

Individuals with Mind-Body Disconnection profile characteristics also arguably possess low emotional granularity (Duarte & Pinto-Gouveia, 2017; Ventura-Bort et al., 2021), potentially arising from a profound disconnection from and disregard for their physiological and emotional states (MacCormack et al., 2024). The pronounced disconnection from their bodily sensations and states arguably exacerbates and contextualises their transient experiences of positive emotions when compared to the Weak Mind-Body Connection Profile. An inability to attend to interoceptive changes and identify and savour positive emotions could further constrain the broadening of cognitive and behavioural repertoires, causing them to miss or avoid opportunities for exploration and growth (Fredrickson, 2000). Poorer, inflexible emotional regulation, stemming from low emotional granularity and disconnection characteristics, may therefore hinder the development of enduring personal resources (Kalokerinos et al., 2019; Kuppens et al., 2013). Accordingly, disconnected individuals may struggle with maintaining social connections, developing resilience, and enhancing their health and wellbeing (Garland et al., 2010; Tan et al., 2022; Tugade et al., 2004). As such, the classification of mind-body connections can facilitate identification of specific needs for targeted interventions. Treatments aimed at cultivating strong mind-body connections could therefore be individualised, thus promoting adaptive emotional functioning and greater wellbeing.

7.7. Limitations and Future Research

7.7.1. Cross-Sectional Data

When conducting mind-body research, it is important to consider the caveats of reliance on cross-sectional data. Compared to more sophisticated designs, cross-sectional studies are advantageous in several ways, including their simplicity, cost-effectiveness, short data collection periods, lower participant burden, and attrition (Taris et al., 2021). Such studies often carry lower ethical risks and issues, providing valuable snapshots of data at a single point in time, and offering glimpses into associations, thus facilitating hypothesis generation (Wang & Cheng, 2020). This is a particularly advantageous method for probing equivocal, conflicting findings, such as those previously noted in the context of self-reported interoception and alexithymia which lead to conducting the systematic review and meta-analysis. Whilst the exclusive employment of questionnaires is noted to result in low response rates, the present thesis was not hindered by this downside of cross-sectional design. Self-reported data are rich, valuable, valid sources of information in research (Barrett, 2004; Quigley et al., 2014) and clinical practice (Fleischmann & Vaughan, 2018; Kyzar & Denfield, 2023; Meadows, 2011), providing important insights into the phenomenology of subjective experiences. They provide snapshots of data at a single timepoint, offering glimpses into associations; however, they fail to capture temporal changes and trends or establish causality (Spector, 2019; Wang & Cheng, 2020). Consequently, this hinders the ability to draw robust conclusions about the future based on current contexts. Longitudinal studies are therefore recommended in future to assess the BMCQ's sensitivity to change over time. This approach could enable determining its suitability for measuring the effects of interventions or developmental changes (e.g., Fleischmann & Vaughan, 2018).

7.7.2. Revision and Psychometric Evaluation of the BMCQ

Whilst the development of the BMCQ was designed to be purposely rigorous, this occurred during COVID-19 lockdowns, which presented methodological constraints that must be acknowledged. Regarding the target population review phase, the use of textboxes for respondents to record their experiences allowed for the provision of qualitative feedback. However, they were not obligated to provide this; data were missing for many items, thus overlooking critical nuances of lived experience. The absence of cognitive interviews, essential for understanding how respondents interpret items (Boateng et al., 2018), likely missed subtle misunderstandings or ambiguities within items. For instance, some issues are noted with regard to the Sensation-Emotion Articulation scale. It is acknowledged that the scale consists entirely of reverse-scored items, which potentially reflects a method factor. Such items require respondents to detect the reversed wording and use the opposite end of the rating scale to provide responses consistent with preceding items (Carlson et al., 2011), potentially introducing response bias. Moreover, as identified in Paper 3, an item intended to capture the *internally oriented thinking* subdomain of Sensation-Emotion Articulation was retained. Despite its theoretical importance, this item showed a low factor loading, indicating issues in effectively measuring this construct. This is potentially due to the psychoanalytic conceptualisation of the EOT domain (e.g., Bagby et al., 1994), which influenced the generation of items. Such conceptualisations regard EOT as encompassing not only difficulties in attending to emotions, but also preferences for focusing on external environmental features (for discussion, see Preece & Gross, 2024). The latter aspect of this facet played a significant role in informing item development and does not expressly pertain to emotion.

To address these limitations, several strategies are proposed for future revision of the BMCQ. First, enhancing the use of textboxes with structured feedback forms and employing thematic analysis can ensure more focused and interpretable feedback. Second, incorporating cognitive interviews, even remotely via video conferencing, can provide deeper insights into respondents' thought processes. Third, revising the Sensation-Emotion Articulation domain within the mind-body connection conceptual framework to align with the cognitive-behavioural conceptualisation of EOT—outlined in the attention-appraisal model of alexithymia (Preece et al., 2017), which emphasises difficulties in attending to emotions—and reformulating *'internally oriented thinking'* items to capture orientation toward internal emotional indicators. Fourth, revising Sensation-Emotion Articulation items to be positively worded, which may enhance reliability and improve the factor structure (Dodeen, 2023). By implementing such strategies, future iterations of the BMCQ can more accurately capture Sensation-Emotion Articulation, thus enhancing scale reliability and validity across diverse contexts and populations.

EFA and CFA are recommended analyses for evaluating the validity and reliability of questionnaires (Boateng et al., 2018; Tabachnick & Fidell, 2013; Worthington & Whittaker, 2006) and commonly employed in the development and evaluation of interoceptive self-report scales (e.g., Desmedt, Heeren, et al., 2022; Mehling et al., 2018; Mehling et al., 2012; Vlemincx et al., 2021). Despite the strengths of EFA and CFA in facilitating identification of meaningful factors and subsequent confirmation of proposed factor structures, the incorporation of alternative psychometric techniques such as item response theory (IRT) in future research could provide deeper insights into each item's performance across different levels of the construct (Boateng et al., 2018). IRT can identify items that do not perform well across all levels of the mind-body connection, facilitating their refinement. This approach could further enhance the precision and reliability of the BMCQ, ensuring that it accurately captures the intended constructs.

7.7.3. The Pursuit of Parsimony

The BMCQ measures three salient components of the mind-body connection. Although convergent validity was demonstrated in Paper 2, it is acknowledged that the mind-body connection contains multitudes of psychological processes that can influence the onset, progression, and recovery of illnesses. Accordingly, this scale should not be considered as a comprehensive measure of this broad construct, and some caution is recommended if using the term in the context of the BMCQ. The BMCQ set out to assess salient mind-body constituents and to improve how interoception and emotional processes are concurrently measured via self-report. The questionnaire adequately does so in typically developed adult samples. Considering the parsimony of this measure, several future directions are suggested to enhance measurement and conceptualisation of the mind-body connection.

First, future questionnaires may seek to incorporate additional aspects of subjective interoception, including accuracy, interpretation, and memory, and regulation. Second, it is acknowledged that the Interoceptive Attention scale produces a summary score for top-down and bottom-up interoceptive attentional control—separate, albeit complementary processes. Given the multidimensionality of interoceptive attentional processing (i.e., top-down vs. bottom-up, selective, divided, sustained), development of future scales could consider consolidating these mechanisms in the one questionnaire. Doing so would expand the current measurement of self-reported interoceptive attention, which is presently rather disparate. Alternatively, to develop specific scales solely focused on a specific mechanism. Third, future scales may seek to incorporate and operationalise other theoretically-related constructs implicating embodied processes, such as somatoception (e.g., the perception of stimuli interacting with the body surface; Desmedt et al., 2023; Van den Bergh et al., 2018), and homeostatic emotion (Craig, 2003a). In particular, a measure of homeostatic emotion would have been included if it was available, given its theoretical relevance to the mind-body connection construct. Development of such measures would collectively serve to expand the measurable psychological constituents of the mind-body connection, which may modulate the initiation of actions to restore physiological integrity and support physical and mental wellbeing. These endeavours would promote greater precision in defining mind-body connection (and interoceptive) constructs and their dimensions.

7.7.4. Emotional Outcomes

Emotions are clearly integral for imbuing meaning into our experiences, and in promoting adaptive responsivity to challenging, dynamic environments (Cox & McAdams, 2014; Panayiotou et al., 2021). Two essential indicators of emotional functioning were examined in this thesis: emotional reactivity and ease of regulation. The observed findings underscore their embodied nature, providing a foundation for understanding how mind-body connection constituents interact to subsequently inform typical emotional experiences. This gives rise to future investigations interrogating such interactions with other emotional constructs. Indeed, a worthwhile pursuit would be to thoroughly examine emotion regulation, investigating how mind-body connection profiles inform the selection and use of adaptive and maladaptive regulation strategies.

Self-reports were employed in this study and represent the most valid method for the assessment of subjective emotional experiences (Quigley et al., 2014). Whist they are immensely valuable, self-reports of emotion can lack ecological validity, as they involve respondents recalling or imagining prior emotional experiences and relying on semantic knowledge and beliefs about emotions, which may not reflect the content of unfolding, real-time experiences (Barrett, 2006b; Barrett, Mesquita, et al., 2007). To enhance ecological validity, future research could incorporate ecological momentary assessment (EMA), a method facilitating the situated collection of repeated thoughts, feelings, and behaviours close in time experience (Reis et al., 2014). This approach is useful for naturalistically examining aspects of emotional reactivity and the unfolding of emotion regulation (Colombo et al., 2020; Sun et al., 2023). EMA also enables quantification of emotional granularity (Barrett, 2004). Examining the associations between mind-body connection profiles, emotional granularity, reactivity, and regulation through EMA represents a promising avenue of research. Doing so could elucidate whether particular mind-body connection profiles indeed promote or inhibit the cultivation of emotions and flexible employment of regulatory strategies.

7.8 Implications and Recommendations

7.8.1. The Measurement of Self-Reported Interoception

The results presented in Paper 1 of this thesis clearly supported arguments for the employment of specific terminology and complementary measurements in interoceptive research and practice (Desmedt, Heeren, et al., 2022; Desmedt et al., 2023; Khalsa et al., 2018). Distinguishing between adaptive and maladaptive aspects of interoception is vital for contextualising conflicting research findings and facilitating the selection of appropriate interoception measures that serve to complement research objectives (Trevisan et al., 2021). This is an imperative step toward enhancing the application of interoceptive constructs in health research and treatment settings (Khalsa et al., 2018)

Paper 1 proposed a construct validity framework of subjective interoceptive constructs measured through self-report scales. The study describes key differences in scales that were clarified through systematic review and meta-analysis, which disaggregated self-report scales to isolate their association with alexithymia at the global and facet level. Distinctions between interoceptive attentional dispositions have previously been made, according to pre-existing measurement tools, reflecting maladaptive and adaptive attentional styles (Mehling, 2016). The meta-analytic results reported by Trevisan et al. (2019) quantified these notions and substantiated deeper elaboration on how adaptive and maladaptive interoceptive attention mechanisms differentially relate to clinical outcomes, including somatisation and alexithymia (Trevisan et al., 2021). Most prominently, these styles are proposed as best operationalised through employment of the BPQ, as a measure of maladaptive interoceptive attention, or the MAIA, whereby the eight scales enable more granular discernment regarding whether adaptive or maladaptive attentional dispositions and regulatory propensities are present. Alexithymia therefore serves as an appropriate construct to determine differences between a suite of interoceptive self-report scales, given its characterisation as a proxy of atypical interoception amongst proponents of this view (Brewer et al., 2016; Brewer et al., 2015; Murphy et al., 2017).

The methodology and results of Paper 1, together with reference to emergent interoceptive frameworks and prior correlational research, enabled preliminary determination of key differences underlying interoceptive self-report scales which contribute to the differential relationships observed in research. This included adaptive and maladaptive interoceptive beliefs of sensing, attention, interpretation, and memory. To assess maladaptive interoceptive sensing, involving inaccuracy, confusion with, and poor discrimination of bodily signals, the ICQ, ISQ, and EDI-IAw are recommended. For adaptive interoceptive sensing, comprising accurate detection, localisation, and discrimination between sensations, the IAS, MAIA Noticing scale, THISQ, and BAQ are suggested. Certain BAQ subscales and items are also proposed to measure adaptive interoceptive memory, given that capacities for accurately predicting future body states are captured, thus implicating effective encoding and consolidating memory processes to optimise allostatic-interoceptive regulation (Sterling, 2012; Barrett, 2017b). Maladaptive interoceptive attention tendencies, comprising hypervigilance to sensations, are proposed as best measured using the IATS. In contrast, adaptive interoceptive attention, involving acceptance of uncomfortable sensations, attentional control toward interoceptive cues, and distress regulation through interoceptively focused attention is argued as best measured with the following MAIA scales: ND, AR, and SR. For assessing maladaptive interoceptive interpretation, reflecting negatively biased processing of unpleasant sensations, the BPQ-R and SAQ are recommended. Finally, adaptive interoceptive interpretation, involving positive, non-judgemental appraisals of internal bodily sensations, including emotional interpretations, can be effectively measured using the MAIA scales of NW, EA, BL, and Trusting. These recommendations serve to advance current theory by distinguishing between adaptive and maladaptive aspects of interoception beyond mere attention styles. Such distinctions can facilitate clearer interpretations of research findings and ensure that appropriate measures are employed, thus enhancing the alignment of interoception research with its objectives.

One example of how these distinctions enable clearer interpretations is evident in research on the correspondence between bottom-up and top-down processing of interoceptive signals. Though relatively underused, researchers examine ITPE, comprising the correspondence between objective interoceptive accuracy, assessed via cardioceptive tasks, and IS, using BPQ-BA scores (e.g., Garfinkel et al., 2016; Quadt et al., 2021; Rae et al., 2019; Sharp et al., 2021; Sojka et al., 2021). Although Study 1 examined the association between interoceptive self-report scales and alexithymia, meta-analyses indicated that BPQ-BA is not associated with alexithymia at the global or facet level. This finding is particularly illuminating, given the endorsement for measuring IS (Garfinkel et al., 2015; Khalsa et al., 2018) or self-reported interoceptive attention (Murphy et al., 2020) by prominent researchers, the frequent use of this scale in research (Desmedt, Heeren, et al., 2022), and its characterisation as a measure of maladaptive interoceptive attention (Mehling, 2016; Trevisan et al., 2021). This is especially noteworthy in light of previous meta-analytic findings showing a positive association with global alexithymia (Trevisan et al., 2019).

Whilst the findings of Paper 1 are ultimately limited to interoceptive and alexithymic associations, they raise questions regarding the suitability of the BPQ-BA as the most appropriate self-report scale for capturing top-down interoceptive processing. As indicated by present and previous findings, IS is not a unitary construct (Desmedt, Heeren, et al., 2022; Desmedt et al., 2023; Ferentzi et al., 2021; Vig et al., 2022), nor is it best measured with the BPQ-BA (Todd et al., 2022). The recommendations for measures of adaptive and maladaptive interoceptive sensing, attention, interpretation, and memory may enable the selection of measures to operationalise more specific top-down mechanisms implicated in the processing of bottom-up interoceptive signals. However, these recommendations must be considered with some caution in light of the meta-analytic findings, which indicate that the questionnaires capture distinct beliefs and should not be uniformly applied. Echoing the advice of Desmedt et al. (2023), it is imperative that a conservative approach is adopted, where it is assumed that these measures assess different constructs until robust convergent evidence is established.

7.8.2. The Interoceptive Hypothesis of Alexithymia

The interoceptive hypothesis of alexithymia proposes that alexithymia primarily reflects a deficit in interoceptive ability rather than a multifaceted construct, arising from confusion and poor differentiation between bodily and emotional states. Moreover, that alexithymia cannot occur without atypical interoception, characterised by atypically low or high sensitivity to bodily sensations and changes (Brewer et al., 2016; Brewer et al., 2015; Shah, Catmur, et al., 2016; Shah, Hall, et al., 2016). The findings of the systematic review and meta-analyses delineated in Paper 1 provide partial support for this hypothesis.

This thesis identified that certain subjective interoceptive beliefs, measured through self-report scales, do indeed coincide with alexithymia. However, the present results do not suggest that "alexithymia can be considered a proxy of atypical interoception" (Murphy et al., 2017, p. 53) —at least in the context of specific beliefs and perceptions of interoceptive sensations. The results indicated that maladaptive, negatively biased interpretational styles, interoceptive confusion and inaccuracy, and heightened interoceptive attention are associated with higher alexithymia, but especially DIF and DDF facets when compared to EOT. As it stands, conceptualising alexithymia as a general deficit of interoception rather than as a multifaceted construct might be an overgeneralisation, given the involvement of EOT in the construct (Preece et al., 2017; Taylor et al., 1991).

However, it warrants mentioning that the TAS-20 EOT subscale demonstrates poor internal consistency reliability with Cronbach's alpha coefficients ranging from 0.50–0.60 (Preece & Gross, 2024). As most included studies examined TAS-20 EOT, >50 % of the scores are attributable to error variance, thus hindering more definitive conclusions about the relationship between EOT and interoception. As previously noted (see Section 7.7.2.), TAS-20 EOT was formulated to align with psychoanalytic conceptualisations of alexithymia. Considered alongside recent evidence indicating that TAS-20 EOT is weakly related to clinical indicators (e.g., somatic symptoms, depression; Preece & Gross, 2024), this may explain why the meta-analyses identified overall weak associations between EOT and self-reported interoceptive constructs.

Moreover, emerging evidence indicates that TAS-20 DIF demonstrates problematic discriminant validity properties, with a large proportion of variance explained by people's current levels of psychological distress (e.g., stress), rather than alexithymia (Preece et al., 2024). Such findings are feasibly attributable to several scale items directly referring to the presence of somatic symptoms (e.g., I have physical sensations that even doctors don't understand"; Bagby et al., 1994). Taken together, these properties may further contextualise the moderate to strong associations observed between various subjective interoceptive constructs and TAS- 20 DIF—particularly pertaining to higher BPQ-Reactivity scores, which indicate homeostatic disturbance and heightened ANS activation.

Despite these factors, evidence from the present thesis indeed suggests that alexithymia and subjective interoceptive processes are empirically related, and exhibit overlap in some respects, carrying consequences for the identification and articulation of emotions arising from poor affective discernment, categorisation, and conceptualisation of physiological changes. The findings carry important implications for researching, understanding and treating alexithymia.

Although patterns between interoceptive questionnaires and facets of alexithymia were observed to be consistent, they were stronger in magnitude for DIF and DDF when compared to EOT. In this body of research, Paper 1 determined that studies tended to examine alexithymia globally, and almost exclusively employed the TAS-20. Conversely, the PAQ exists (Preece et al., 2017), which conceptualises and measures alexithymia within a cognitive-behavioural framework, emphasising difficulties in attending to and appraising emotions. This measure was rarely administered by the included studies, and thus, the observed associations are largely contingent upon psychoanalytic conceptualisation and measurement of alexithymia. Unlike TAS-20 EOT, PAQ-EOT encompasses rare focussing of attention on one's positive and negative emotions. It is possible this PAQ specification may yield clearer insights into how specific interoceptive aspects relate to emotional attention difficulties. Cumulatively, such methodological factors hinder clarification of how maladaptive and adaptive interoceptive aspects may propagate or ameliorate DIF, DDF, and EOT—related yet distinct facets within the construct (Bagby et al., 1994; Preece et al., 2017; Preece & Gross, 2023). Doing so is critical for further expanding conceptualisations of alexithymia as involving deficits in emotion processing (Preece & Gross, 2023) to further incorporate the role of atypical interoceptive processing in its manifestation and maintenance

(Brewer et al., 2016; Murphy et al., 2017). Future studies may therefore seek to explore the relationship between interoception and alexithymia using the PAQ to further clarify the interconnection between interoceptive and emotional deficits. Despite the methodological factors affecting thorough disentanglement across pre-existing studies, Paper 1 provides a foundation for elucidating these relationships.

Overall, the findings underscore the cooccurrence of maladaptive beliefs in interoceptive sensing, attention, memory, and interpretation and alexithymia, highlighting a need for these aspects to be clinically considered and assessed. Doing so is particularly important, as alexithymia is characterised by diffuse mental representations of emotions, and confusion between bodily states and emotional arousal, which can impede treatment gains for individuals diagnosed with both physical and psychiatric conditions (e.g., Pinna et al., 2020; Porcelli et al., 2003; Porcelli & Taylor, 2018). The findings, however, illuminate interoceptive beliefs and perceptions that could be targeted in mind-body therapies to improve adaptive processing of bodily sensations. This could serve to promote the cultivation of more granular emotions imbued with physiology, therein reducing alexithymia and fostering improvements in physiological and emotional regulation.

7.8.3. Expanded Consequences of Dualistic Beliefs

Forstmann and Burgmer (2017) explicated various manifestations and consequences of beliefs in mind-body dualism on behaviour, emphasising the permeating role of culture in shaping dualistic beliefs and spiritualism. Their work has highlighted that low health-promoting behaviours are a consequence of strong beliefs in mind-body dualism (Burgmer & Forstmann, 2018; Forstmann et al., 2012). They proposed future avenues of research regarding the consequences of mind-body dualism, suggesting that dualists may assume that physiological states have less impact on regulatory capacities compared to individuals endorsing a strong mind-body association. Additionally, they hypothesise that a mind-body disconnection may lead dualists to disregard bodily states when assessing how they feel, reflecting lower introspection accuracy and reduced sensitivity to aversive or pleasant bodily states. This thesis cumulatively addresses these avenues.

Throughout this thesis, mind-body values emerge as a salient psychological constituent of the mind-body connection. As demonstrated in Paper 2, mind-body connection beliefs correlate with stronger interoceptive trusting, sensation-emotion awareness, self-regulation, and sense of interconnectedness, as assessed by the MAIA subscales of Trusting, EA, SR, and BL, respectively. These findings imply that individuals with stronger mind-body connection beliefs and higher health prioritisation perceive physiological states as influential on and crucial for regulatory capacities, which further promotes sensitivity to aversive and pleasant bodily sensations and states. Conversely, individuals with weaker mind-body beliefs, suggestive of dualism, may perceive of physiological states as less impactful on regulatory capacities, exhibiting reduced sensitivity to bodily states and sensations. This thesis contributes novel evidence supporting the proposal that individual differences in experiences of bodily states stem from mind-body dualism and connection beliefs, thereby expanding understandings of its impact on cognition and behaviour.

Furthermore, it extends the consequences of mind-body dualism to reactivity for and ease of regulating positive and negative emotions. Correlational evidence presented in Paper 3 demonstrates that mind-body values coincide with varying emotional experiences and regulation ease. LPA revealed distinct profiles incorporating mind-body beliefs, with the Strong Mind-Body Connection profile exhibiting the highest prioritisation of physical and mental health, along with greater attentional control to sensations, capacities for identifying and describing the connection between sensations and emotion, and an internally oriented focus. This is contrasted with Weak Mind-Body Connection Profiles and Mind-Body Disconnection profiles who exhibited moderate and deficient levels of attentional control, respectively, low sensation-emotion identification and articulation, and an externally oriented focus. This evidence presents a promising avenue for future research examining how other aspects of interoception and emotion are a consequence of mind-body dualism beliefs.

7.8.4. Assessment of the Mind-Body Connection

The BMCQ provides clinicians and researchers with a parsimonious measure of salient psychological mind-body connection constituents. This questionnaire—assessing interoceptive attention, alexithymic propensities, and beliefs regarding the importance of physical and mental health—will be useful in various fields, including psychology and psychiatry, physiotherapy, occupational therapy, and medicine.

The BMCQ shows promising clinical utility, with expressed interest in its application within psychological and psychiatric clinics (e.g., E. Furner, personal communication, January 30, 2024; M. Latessa, personal communication, November 17, 2023). In such settings, the BMCQ may be an appropriate tool for screening and assessment, thus informing case conceptualisation and treatment. Assessment of interoceptive attentional control (Interoceptive Attention) may assist with identifying whether atypical and maladaptive attention is present. This could prove useful for suspected presentations of anxiety and related disorders (Palser et al., 2018), depressive disorders (Dunne et al., 2021), feeding and eating disorders (Phillipou et al., 2022), ASD (Garfinkel et al., 2016), somatic symptom and related disorders (Flasinski et al., 2020; Ricciardi et al., 2021), substance-related disorders (Jakubczyk et al., 2019), and trauma- and stressor related disorders (Koch et al., 2016).

Similarly, assessment of confidence in capacities for recognising and verbally expressing sensations as physical components of emotions (Sensation-Emotion Articulation) can provide insights into tendencies toward alexithymia. This is particularly beneficial, as this trait is often observed in multiple psychiatric conditions (Taylor et al., 1997), adding complexity to the presentation. Screening for alexithymic tendencies can assist clinicians with understanding the full spectrum of their client's difficulties and address them more comprehensively. This would be useful, as alexithymia can disrupt engagement with treatment (Ogrodniczuk et al., 2018). Moreover, clients with alexithymia often present with somatic complaints. Identifying alexithymia can shift the focus of interventions to identifying and addressing psychosocial factors contributing to the onset and maintenance of symptomatology (e.g., adverse childhood experiences, somatisation, cultural influences; Porcelli & Taylor, 2018; Ryder et al., 2018; Schimmenti & Caretti, 2018)

Attitudes related to health are crucial to consider in clinical encounters, shaping lifestyle, symptom presentation, access to care, patient-professional interactions, volition, and engagement, adherence and response to treatments (Fava et al., 2023). Accordingly, screening for values regarding physical and mental wellbeing (Body-Mind Values) can provide useful indications into how beliefs may influence a patient's presentation and willingness to engage (Choudhry et al., 2016; Fava et al., 2023; Krämer et al., 2014; Lebowitz et al., 2021; Prins et al., 2008). Low health prioritisation can arise from dualistic beliefs, obscuring recognition of the role played by physical states in shaping mental wellbeing, and vice versa. Consequently, individuals with such beliefs may neglect their body and mind (e.g., Burgmer & Forstmann, 2018), exhibit pessimism concerning the potential success of psychotherapeutic treatments, and hold negative expectations regarding the development of a therapeutic alliance with clinicians (Lebowitz et al., 2021). Accordingly, clinicians may wish to understand health attitudes and behaviours to promote motivation to change, which in turn, may indicate whether psychoeducation regarding the mind-body connection is appropriate (Fava et al., 2023; Lebowitz et al., 2021).

The BMCQ is also appropriate for rehabilitative disciplines, including physiotherapy and occupational therapy. Screening of Interoceptive Attention, Sensation-Emotion Articulation, and Body-Mind Values may facilitate the development and application of exercises and therapies that enhance attentional control to sensations, which can produce beneficial effects for postural balance, gait, and functional movement control amongst patients with multiple sclerosis (Paolucci et al., 2022) and Parkinson’s disease (Sage & Almeida, 2009). In functional presentations (e.g., functional neurological disorder), dysfunctional attentional allocation to sensations is often present (Jungilligens et al., 2022). Screening for this can provide a rationale for specific treatments, such as motor rehabilitation programmes to challenge and change expectations regarding symptoms (Ricciardi et al., 2021). Moreover, understanding a client’s attitudes to health and wellbeing can promote discussion regarding their perceived needs, beliefs and values and appraisal of previous healthcare (Mose et al., 2023), motivating adherence to rehabilitation programs and promote a holistic approach to recovery. The BMCQ would be particularly useful for pain management, providing indications into how patients perceive and articulate physiological changes and their symptoms, including pain (Van den Bergh et al., 2017), allowing for personalised pain management strategies promoting mind-body integration to be adopted.

Occupational therapy employs a holistic approach to care, addressing both the physical and mental health of clients. The mind-body connection is embraced in occupational therapy, particularly amongst clinicians specialising in sensory integration (Schmitt & Schoen, 2022). Consideration of interoceptive signalling in an individual's physiological condition can inform clinical evaluations of issues, including digestive, gastrointestinal, and urinary function. Screening a client’s interoceptive and emotional capacities and health beliefs using BMCQ scales can facilitate identification of sensory processing and integration challenges and over-responsiveness to sensations. Assessment can therefore guide therapists to individualise treatments to promote stronger body-mind congruence and connections (Schmitt & Schoen, 2022).

The BMCQ further complements and promotes a biopsychosocial approach to medicine. Patients are increasingly involved in the care they receive, which is enabled through assessment of outcomes, based on the patient's perspective (Meadows, 2011). Patient-reported outcome measures (PROMs) can improve healthcare, as they provide insights into what is important to patients and issues that may impact on their treatment and care (Fleischmann & Vaughan, 2018; Meadows, 2011). The BMCQ could serve as a valuable PROM in several ways. Its brevity ensures that completing the questionnaire does not burden patients, making it practical for routine use (Fleischmann & Vaughan, 2018). Furthermore, salient aspects of the mind-body connection are covered, providing an understanding of the patient's interoceptive and emotional functioning that can influence the presentation and affect treatment and care. By providing insights into interoceptive attentional control, sensation-emotion articulation, and holistic health values, the BMCQ can inform development of individualised treatments, leading to effective patient-centred care (Fleischmann & Vaughan, 2018). Use of scales, such as the BMCQ, could facilitate communication between patients and professionals (Lordon et al., 2020). By quantifying subjective experiences of interoceptive attention, emotional capacities, and beliefs regarding health and wellbeing, the BMCQ can enable patients to articulate their feelings and treatment preferences, and enhance clinician understanding of their patients' perspectives, therein promoting enhanced collaboration in treatment. In addition to its clinical utility, the BMCQ can contribute to research efforts aimed at understanding the role of the mind-body connection in various health conditions and treatment outcomes, which could facilitate comparisons between different clinical presentations over time, thus informing the development and implementation of evidence-based care suited for particular conditions.

7.8.5. Clinical Application of Profiles

Persons with lived and living experience of psychological conditions express a desire to improve their emotional responses, emphasising a need for the mind-body connection to be considered in interventions (Jenkinson et al., 2024). Clinicians from various professions would benefit from understanding and acknowledging of the contribution of the mind-body connection to emotional experiences. The findings of this thesis give rise to the clinical application of mind-body connection profiles identified in Paper 3.

The three distinct profiles represent varying degrees of conscious connection with body and mind. Two profiles of clinical relevance include the Weak Mind-Body Connection and Mind Body Disconnection profiles. These profiles involved low Sensation-Emotion Articulation and Body-Mind Values, primarily differing in their endorsed levels of attentional control to interoceptive sensations. Both profiles experienced positive emotions less frequently, intensely, and persistently than the Strong Mind-Body Connection profile, suggesting they lack a robust, enduring resource reserve to draw upon during challenging circumstances, therein possibly possessing compromised resilience and experiencing poorer wellbeing (Fredrickson, 2004). Comparatively, a Strong Mind-Body Connection profile represents an ideal of cultivated mind-body connection, positive emotions, and resource reserves, therein promoting effective, adaptive emotional functioning. The Strong Mind-Body Connection profile may therefore constitute a comparator and veritable goal within treatment settings.

The Weak Mind-Body Connection profile expressed moderate levels of Interoceptive Attention, suggesting that they are aware of suddenly experienced and purposefully contemplated sensations. Higher levels of attention in this profile (along with low sensation-emotion articulation and low body-mind values) would be characteristic of hypervigilance to sensations and propensity for somatisation. This would arguably necessitate different approaches to treatment when compared to the Mind-Body Disconnection profile exhibiting deficient attentional control.

Any comprehensive mind-body approach to treatment and intervention should ideally encompass both bottom-up and top-down approaches (Jungilligens et al., 2022; Schmitt & Schoen, 2022). In a bottom-up approach (e.g., sensorimotor psychotherapy), therapeutic interventions target bodily movements and interoceptive sensations as primary entry points. These sensorimotor experiences play a pivotal role in shaping an individual's sense of self, fostering self-regulation, and facilitating meaningful engagement with life's activities. Through such approaches, a deeper understanding emerges from direct sensorimotor experiences. Conversely, top-down approaches (e.g., cognitive behavioural therapy), prioritise cognitive mechanisms as entry points. These mechanisms promote adaptive attentional shifts towards bodily sensations and reattribution of these sensations, consequently altering experiences through interpretation. Such endeavours can facilitate cultivation of new or refined emotion concepts, thereby enhancing both physiological and psychological regulatory processes, which are foundational for optimal health and well-being (Jungilligens et al., 2022; Schmitt & Schoen, 2022).

Given the nuanced variation in interoceptive attention levels observed within the Weak Mind-Body Connection and Disconnection profiles, it becomes apparent that appropriate intervention entry points may need to be tailored accordingly. For instance, individuals with Weak Mind-Body Connection characteristics may benefit from initially addressing top-down processing mechanisms to foster heightened granularity and regulatory capabilities. Conversely, those exhibiting traits associated with Mind-Body Disconnection may benefit more from an initial emphasis on bottom-up processing, thus augmenting better detection, appraisal, and valuing of bodily sensations. This individualised approach holds promise for cultivating a strong mind-body connection in therapeutic contexts.

7.9. Conclusions

This thesis concludes the following:

- Umbrella terms such as *interoceptive sensibility* fail to capture the complexity of subjective interoceptive processing and should be abandoned.
- Researchers must adopt more precise interoceptive terminology and employ appropriate measurements to enhance clinically meaningful interpretations and promote the application of interoception in health research and clinical practice.
- Beyond adaptive and maladaptive interoceptive attention, interoceptive sensing, interpretation, and memory are proposed as distinguishable and assessable constructs using existing interoceptive self-report scales.
- These adaptive and maladaptive aspects of self-reported interoception are differentially associated with alexithymia at the global and facet level—most strongly with DIF and DDF facets compared to EOT.
- Further empirical studies are required to confirm construct validity of the proposed adaptive and maladaptive interoceptive framework and determine that the questionnaires are assessing their intended construct.
- The mind-body connection is a similarly diffuse, complex concept involving various embodied aspects, with salient psychological constituents including interoceptive beliefs (such as interoceptive attention), identification and articulation of emotions associated with physiological changes, and mind-body beliefs.
- Current interoceptive self-report scales do not completely measure these mind-body connection constituents, as they largely omit the emotional component and fail to capture mind-body beliefs adequately.
- These constituents can be assessed using the Interoceptive Attention, Sensation-Emotion Articulation, and Body-Mind Values scales of the valid, reliable BMCQ-10.

- Salient mind-body connection components can be classified and profiled using the three BMCQ-10 scales in both typically developed and clinical samples.
- Considering these psychological mind-body connection constituents and profiles is vital for delivering targeted, individualised interventions that promote the cultivation of strong mind-body connections, thereby enhancing adaptive emotional functioning and wellbeing.

This thesis arose from the intuition that the contributions of the body to our lives has been largely neglected. This initial insight evolved into a tangible endeavour, offering significant understandings into and practical measurement of the mind-body connection. The field of mind-body research and practice is an exciting and rapidly growing area. The findings of this thesis significantly contribute to advancing the application of interoception and the mind-body connection in both clinical and research settings. “A purely disembodied human emotion is a nonentity” (James, 1884, p. 194); it is time we move beyond the comfort of basic and appraisal theories to wholly embrace the valuable contributions of interoception to our emotions and everyday experiences. Understanding the value of subjectivity, physiological underpinnings of emotions, and their interaction with cognitive processes and belief systems can ensure effective, person-focused therapeutic approaches. This thesis has provided a necessary psychological foundation for cultivating a strong mind-body connection, which has the potential to enhance emotional functioning. The integration of these insights into practice would represent a significant step forward in the holistic understanding of human emotion and wellbeing.

References

Adams, K. L., Edwards, A., Peart, C., Ellett, L., Mendes, I., Bird, G., & Murphy, J. (2022). The association between anxiety and cardiac interoceptive accuracy: A systematic review and meta-analysis. *Neuroscience and Biobehavioral Reviews*, *140*. https://doi.org/10.1016/j.neubiorev.2022.104754

Adolphs, R. (2017). How should neuroscience study emotions? By distinguishing emotion states, concepts, and experiences. *Social cognitive and affective neuroscience*, *12*(1), 24-31.

Adolphs, R., Mlodinow, L., & Barrett, L. F. (2019). What is an emotion? *Current biology*, *29*(20), R1060-R1064.

Ainley, V., Tsakiris, M., Pollatos, O., Schulz, A., & Herbert, B. M. (2020). Comment on "Zamariola et al.(2018), Interoceptive Accuracy Scores are Problematic: Evidence from Simple Bivariate Correlations"—The empirical data base, the conceptual reasoning and the analysis behind this statement are misconceived and do not support the authors' conclusions. *Biological psychology*, *152*, 107870.

Aldao, A., & Nolen-Hoeksema, S. (2010). Specificity of cognitive emotion regulation strategies: A transdiagnostic examination. *Behaviour Research and Therapy*, *48*(10), 974-983. https://doi.org/10.1016/j.brat.2010.06.002

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders : DSM-5* (Fifth edition. ed.). American Psychiatric Association.

Araujo, H. F., Kaplan, J., Damasio, H., & Damasio, A. (2015). Neural correlates of different self domains. *Brain & Behavior*, *5*(12), 1-N.PAG. https://doi.org/10.1002/brb3.409

Arksey, H., & O'Malley, L. (2005). Scoping Studies: Towards a Methodological Framework. *International Journal of Social Research Methodology*, *8*(1), 19-32. https://doi.org/10.1080/1364557032000119616

Arnold, M. B. (1960). *Emotion and personality*. Columbia University Press.

Aronson, K. R., Barrett, L. F., & Quigley, K. (2006). Emotional reactivity and the overreport of somatic symptoms: Somatic sensitivity or negative reporting style? *Journal of Psychosomatic Research*, *60*(5), 521-530. https://doi.org/10.1016/j.jpsychores.2005.09.001

Azari, B., Westlin, C., Satpute, A. B., Hutchinson, J. B., Kragel, P. A., Hoemann, K.,…Barrett, L. F. (2020). Comparing supervised and unsupervised approaches to emotion categorization in the human brain, body, and subjective experience. *Scientific Reports*, *10*(1), 1-17. https://doi.org/10.1038/s41598-020-77117-8

Bagby, R. M., Taylor, G. J., & Parker, J. D. A. (1994). The twenty-item Toronto Alexithymia Scale—II. Convergent, discriminant, and concurrent validity. *Journal of psychosomatic research*, *38*(1), 33-40.

Barrett, L. F. (2004). Feelings or Words? Understanding the Content in Self-Report Ratings of Experienced Emotion. *Journal of Personality and Social Psychology*, *87*(2), 266-281. https://doi.org/10.1037/0022-3514.87.2.266

Barrett, L. F. (2006a). Are emotions natural kinds? *Perspectives on psychological science*, *1*(1), 28-58.

Barrett, L. F. (2006b). Solving the emotion paradox: Categorization and the experience of emotion. *Personality and social psychology review*, *10*(1), 20-46.

Barrett, L. F. (2012). Emotions are real. *Emotion*, *12*(3), 413-429. https://doi.org/10.1037/a0027555

Barrett, L. F. (2017a). *How emotions are made: The secret life of the brain*. Houghton Mifflin Harcourt.

Barrett, L. F. (2017b). The theory of constructed emotion: an active inference account of interoception and categorization. *Social cognitive and affective neuroscience*, *12*(1), 1-23.
Barrett, L. F., & Bliss-Moreau, E. (2009). Affect as a psychological primitive. *Advances in experimental social psychology*, *41*, 167-218.
Barrett, L. F., & Finlay, B. L. (2018). Concepts, goals and the control of survival-related behaviors. *Current opinion in behavioral sciences*, *24*, 172-179.
Barrett, L. F., Gross, J., Christensen, T. C., & Benvenuto, M. (2001). Knowing what you're feeling and knowing what to do about it: Mapping the relation between emotion differentiation and emotion regulation. *Cognition and Emotion*, *15*(6), 713-724. https://doi.org/10.1080/02699930143000239
Barrett, L. F., Lindquist, K. A., Bliss-Moreau, E., Duncan, S., Gendron, M., Mize, J., & Brennan, L. (2007). Of mice and men: Natural kinds of emotions in the mammalian brain? A response to Panksepp and Izard. *Perspectives on psychological science*, *2*(3), 297-312.
Barrett, L. F., Marsella, S., Adolphs, R., Martinez, A. M., & Pollak, S. D. (2019). Emotional Expressions Reconsidered: Challenges to Inferring Emotion From Human Facial Movements. *Psychological Science in the Public Interest*, *20*(1), 1-68. https://doi.org/10.1177/1529100619832930
Barrett, L. F., Mesquita, B., Ochsner, K. N., & Gross, J. J. (2007). The experience of emotion. *Annu. Rev. Psychol.*, *58*, 373-403.
Barrett, L. F., Quigley, K. S., & Hamilton, P. (2016). An active inference theory of allostasis and interoception in depression. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1708), 20160011.
Barrett, L. F., & Satpute, A. B. (2013). Large-scale brain networks in affective and social neuroscience: Towards an integrative functional architecture of the brain. *Current Opinion in Neurobiology*, *23*(3), 361-372. https://doi.org/10.1016/j.conb.2012.12.012
Barrett, L. F., & Simmons, W. K. (2015). Interoceptive predictions in the brain. *Nature reviews neuroscience*, *16*(7), 419-429.
Bauer, J. (2022). A Primer to Latent Profile and Latent Class Analysis. In *Methods for Researching Professional Learning and Development : Challenges, Applications and Empirical Illustrations* (Vol. 33, pp. 243-268). Cham: Springer International Publishing.
Beatty, P. C., & Willis, G. B. (2007). Research synthesis: the practice of cognitive interviewing. *Public Opinion Quarterly*, *71*(2), 287-311. https://doi.org/10.1093/poq/nfm006
Becerra, R., & Campitelli, G. (2013). Emotional reactivity: Critical analysis and proposal of a new scale. *International Journal of Applied Psychology*, *3*(6), 161-168.
Becerra, R., Preece, D., Campitelli, G., & Scott-Pillow, G. (2019). The Assessment of Emotional Reactivity Across Negative and Positive Emotions: Development and Validation of the Perth Emotional Reactivity Scale (PERS). *Assessment*, *26*(5), 867-879. https://doi.org/10.1177/1073191117694455
Bernard, C. (1957). *An introduction to the study of experimental medicine* (Vol. 400). Courier Corporation. (1865)
Berntson, G. G., & Khalsa, S. S. (2021). Neural circuits of interoception. *Trends in Neurosciences*, *44*(1), 17-28. https://doi.org/10.1016/j.tins.2020.09.011
Boateng, G. O., Young, S. L., Neilands, T. B., Frongillo, E. A., & Melgar-Quiñonez, H. R. (2018). Best Practices for Developing and Validating Scales for Health, Social, and Behavioral Research: A Primer. *Frontiers in Public Health*, *6*. https://doi.org/10.3389/fpubh.2018.00149

Boden, M. T., & Thompson, R. J. (2017). Meta-analysis of the association between emotional clarity and attention to emotions. *Emotion Review*, *9*(1), 79-85. https://doi.org/10.1177/1754073915610640

Bogaerts, K., Walentynowicz, M., Van Den Houte, M., Constantinou, E., & Van den Bergh, O. (2022). The Interoceptive Sensitivity and Attention Questionnaire: Evaluating aspects of self-reported interoception in patients with persistent somatic symptoms, stress-related syndromes, and healthy controls. *Psychosomatic medicine*, *84*(2), 251-260.

Boiger, M., Ceulemans, E., De Leersnyder, J., Uchida, Y., Norasakkunkit, V., & Mesquita, B. (2018). Beyond Essentialism: Cultural Differences in Emotions Revisited. *18*(8), 1142-1162.

Bonaz, B., Lane, R. D., Oshinsky, M. L., Kenny, P. J., Sinha, R., Mayer, E. A., & Critchley, H. D. (2021). Diseases, disorders, and comorbidities of interoception. *Trends in neurosciences*, *44*(1), 39-51.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. John Wiley & Sons.

Brewer, R., Cook, R., & Bird, G. (2016). Alexithymia: a general deficit of interoception. *Royal Society open science*, *3*(10), 150664.

Brewer, R., Happé, F., Cook, R., & Bird, G. (2015). Commentary on “Autism, oxytocin and interoception”: Alexithymia, not Autism Spectrum Disorders, is the consequence of interoceptive failure. *Neuroscience & Biobehavioral Reviews*, *56*, 348-353.

Brewer, R., Murphy, J., & Bird, G. (2021). Atypical interoception as a common risk factor for psychopathology: A review. *Neuroscience & Biobehavioral Reviews*, *130*, 470-508. https://doi.org/https://doi.org/10.1016/j.neubiorev.2021.07.036

Brower, V. (2006). Mind–body research moves towards the mainstream. *7*(4), 358-361.

Burgmer, P., & Fors, M. (2018). Mind-Body Dualism and Health Revisited: How Belief in Dualism Shapes Health Behavior. *Social Psychology (18649335)*, *49*(4), 219-230. https://doi.org/10.1027/1864-9335/a000344

Burgmer, P., & Forstmann, M. (2018). Mind-Body Dualism and Health Revisited: How Belief in Dualism Shapes Health Behavior. *Social Psychology*, *49*(4), 219-230. https://doi.org/10.1027/1864-9335/a000344

Bush, G., Luu, P., & Posner, M. I. (2000). Cognitive and emotional influences in anterior cingulate cortex. *4*(6), 215-222.

Cabrera, A., Kolacz, J., Pailhez, G., Bulbena-Cabre, A., Bulbena, A., & Porges, S. W. (2018). Assessing body awareness and autonomic reactivity: Factor structure and psychometric properties of the Body Perception Questionnaire-Short Form (BPQ-SF). *International journal of methods in psychiatric research*, *27*(2), e1596.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, *56*(2), 81-105. https://doi.org/10.1037/h0046016

Cannon, W. B. (1939). The wisdom of the body.

Carlson, M., Wilcox, R., Chou, C. P., Chang, M., Yang, F., Blanchard, J.,…Clark, F. (2011). Psychometric properties of reverse-scored items on the CES-D in a sample of ethnically diverse older adults. *Psychol Assess*, *23*(2), 558-562. https://doi.org/10.1037/a0022484

Carvalho, G. B., & Damasio, A. (2021). Interoception and the origin of feelings: A new synthesis. *BioEssays*, *43*(6), 2000261.

Ceunen, E., Vlaeyen, J. W. S., & Van Diest, I. (2016). On the origin of interoception. *Frontiers in Psychology*, *7*.

Chen, W. G., Schloesser, D., Arensdorf, A. M., Simmons, J. M., Cui, C., Valentino, R.,…Langevin, H. M. (2021). The Emerging Science of Interoception: Sensing, Integrating, Interpreting, and Regulating Signals within the Self. *Trends in Neurosciences*, *44*(1), 3. https://doi.org/10.1016/j.tins.2020.10.007

Chikazoe, J., Lee, D. H., Kriegeskorte, N., & Anderson, A. K. (2014). Population coding of affect across stimuli, modalities and individuals. *Nature Neuroscience*, *17*(8), 1114-1122. https://doi.org/10.1038/nn.3749

Choudhry, F. R., Mani, V., Ming, L. C., & Khan, T. M. (2016). Beliefs and perception about mental health issues: a meta-synthesis. In *Neuropsychiatric Disease and Treatment* (Vol. ume 12, pp. 2807-2818): Dove Medical Press.

Clark, D. M., Salkovskis, P. M., Öst, L.-G., Breitholtz, E., Koehler, K. A., Westling, B. E.,…Gelder, M. (1997). Misinterpretation of body sensations in panic disorder. *Journal of consulting and clinical psychology*, *65*(2), 203.

Clark-Polner, E., Wager, T. D., Satpute, A. B., & Barrett, L. F. (2016). Neural fingerprinting: Meta-analysis, variation, and the search for brain-based essences in the science of emotion. In L. F. Barrett, M. Lewis, & J. M. Haviland-Jones (Eds.), *Handbook of emotions* (4 ed., pp. 146-165). Guilford.

Clore, G. L., & Ortony, A. (2013). Psychological construction in the OCC model of emotion. *Emotion Review*, *5*(4), 335-343. https://doi.org/10.1177/1754073913489751

Cohen, C. I. (1993). The biomedicalization of psychiatry: A critical overview. *Community Mental Health Journal*, *29*(6), 509-521. https://doi.org/10.1007/bf00754260

Cohen, J. (1960). A Coefficient of Agreement for Nominal Scales. *Educational and Psychological Measurement*, *20*(1), 37-46. https://doi.org/10.1177/001316446002000104

Colombo, D., Fernández-Álvarez, J., Suso-Ribera, C., Cipresso, P., Valev, H., Leufkens, T.,…Botella, C. (2020). The Need for Change: Understanding Emotion Regulation Antecedents and Consequences Using Ecological Momentary Assessment. *20*(1), 30-36.

Cooper, S. J. (2008). From Claude Bernard to Walter Cannon. Emergence of the concept of homeostasis. *Appetite*, *51*(3), 419-427. https://doi.org/10.1016/j.appet.2008.06.005

Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience*, *3*(3), 215-229. https://doi.org/10.1038/nrn755

Corneille, O., Desmedt, O., Zamariola, G., Luminet, O., & Maurage, P. (2020). A heartfelt response to Zimprich et al.(2020), and Ainley et al.(2020)'s commentaries: Acknowledging issues with the HCT would benefit interoception research. *Biological psychology*, *152*, 107869.

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation*, *10*(7).

Cox, K., & McAdams, D. P. (2014). Meaning making during high and low point life story episodes predicts emotion regulation two years later: How the past informs the future. *Journal of Research in Personality*, *50*, 66-70.

Craig, A. D. (2002). How do you feel? Interoception: the sense of the physiological condition of the body. *Nature reviews neuroscience*, *3*(8), 655-666.

Craig, A. D. (2003a). A new view of pain as a homeostatic emotion. *Trends in Neurosciences*, *26*(6), 303-307.

Craig, A. D. (2003b). Interoception: The sense of the physiological condition of the body. *Current Opinion in Neurobiology*, *13*(4), 500-505. https://doi.org/10.1016/S0959-4388(03)00090-4

Craig, A. D. (2008). Interoception and emotion: A neuroanatomical perspective. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions, 3rd ed.* (pp. 272-292). The Guilford Press.

Craig, A. D. (2009a). Emotional Moments across Time: A Possible Neural Basis for Time Perception in the Anterior Insula. *Philosophical Transactions: Biological Sciences*, *364*(1525), 1933-1942. https://doi.org/10.1098/rstb.2009.0008

Craig, A. D. (2009b). How do you feel — now? The anterior insula and human awareness. *10*(1), 59-70.

Craig, A. D. (2014). *How Do You Feel? An Interoceptive Moment with Your Neurobiological Self*. Princeton University Press.

Critchley, H. D. (2005). Neural mechanisms of autonomic, affective, and cognitive integration. *Journal of comparative neurology*, *493*(1), 154-166.

Critchley, H. D., & Garfinkel, S. N. (2017). Interoception and emotion. *Current opinion in psychology*, *17*, 7-14.

Critchley, Hugo D., & Harrison, Neil A. (2013). Visceral Influences on Brain and Behavior. *Neuron*, *77*(4), 624-638. https://doi.org/https://doi.org/10.1016/j.neuron.2013.02.008

Critchley, H. D., Wiens, S., Rotshtein, P., Öhman, A., & Dolan, R. J. (2004). Neural systems supporting interoceptive awareness. *Nature Neuroscience*, *7*(2), 189-195. https://doi.org/10.1038/nn1176

Damasio, A. (2018). *The strange order of things: Life, feeling, and the making of cultures*. Knopf Doubleday Publishing Group.

Damasio, A., & Carvalho, G. B. (2013). The nature of feelings: evolutionary and neurobiological origins. *Nature reviews neuroscience*, *14*(2), 143-152.

Darwin, C. (1965). The expression of the emotions in man and animals / Charles Darwin ; with a preface by Konrad Lorenz. In: University of Chicago Press.

Davidson, R. J. (1994). Asymmetric brain function, affective style, and psychopathology: The role of early experience and plasticity. *Development and Psychopathology*, *6*(4), 741-758. https://doi.org/10.1017/S0954579400004764

Davidson, R. J. (1998). Affective Style and Affective Disorders: Perspectives from Affective Neuroscience. *Cognition & Emotion*, *12*(3), 307-330. https://doi.org/10.1080/026999398379628

Davidson, R. J. (2015). Comment: Affective chronometry has come of age. *Emotion Review*, *7*(4), 368-370. https://doi.org/10.1177/1754073915590844

De Berardis, D., Campanella, D., Nicola, S., Gianna, S., Alessandro, C., Chiara, C.,…Ferro, F. M. (2008). The Impact of Alexithymia on Anxiety Disorders: a Review of the Literature. In *Current Psychiatry Reviews* (Vol. 4, pp. 80-86).

De Gucht, V., Fischler, B., & Heiser, W. (2004). Neuroticism, alexithymia, negative affect, and positive affect as determinants of medically unexplained symptoms. *Personality and Individual Differences*, *36*(7), 1655-1667. https://doi.org/10.1016/j.paid.2003.06.012

Deeks, A., Lombard, C., Michelmore, J., & Teede, H. (2009). The effects of gender and age on health related behaviors. *BMC Public Health*, *9*(1), 213-220. https://doi.org/10.1186/1471-2458-9-213

Demartini, B., Petrochilos, P., Ricciardi, L., Price, G., Edwards, M. J., & Joyce, E. (2014). The role of alexithymia in the development of functional motor symptoms (conversion disorder). *Journal of Neurology, Neurosurgery & Psychiatry*, *85*(10), 1132-1137.

Demertzi, A., Liew, C., Ledoux, D., Bruno, M. A., Sharpe, M., Laureys, S., & Zeman, A. (2009). Dualism persists in the science of mind. *Annals of the New York Academy of Sciences*, *1157*(1), 1-9.

Desdentado, L., Miragall, M., Llorens, R., & Baños, R. M. (2022). Disentangling the role of interoceptive sensibility in alexithymia, emotion dysregulation, and depression in healthy individuals. *Current Psychology*, 1-13.

Desmedt, O., Heeren, A., Corneille, O., & Luminet, O. (2022). What do measures of self-report interoception measure? Insights from a systematic review, latent factor analysis, and network approach. *Biological Psychology*, *169*, 108289.

Desmedt, O., Luminet, O., & Corneille, O. (2018). The heartbeat counting task largely involves non-interoceptive processes: Evidence from both the original and an adapted counting task. *Biological psychology*, *138*, 185-188.

Desmedt, O., Luminet, O., Maurage, P., & Corneille, O. (2023). Discrepancies in the Definition and Measurement of Human Interoception: A Comprehensive Discussion and Suggested Ways Forward. *Perspectives on Psychological Science*, 17456916231191537.

Desmedt, O., Van Den Houte, M., Walentynowicz, M., Dekeyser, S., Luminet, O., & Corneille, O. (2022). How does heartbeat counting task performance relate to theoretically-relevant mental health outcomes? A meta-analysis. *Collabra: Psychology*, *8*(1), 33271.

Dettori, J. R., Norvell, D. C., & Chapman, J. R. (2022). Fixed-Effect vs Random-Effects Models for Meta-Analysis: 3 Points to Consider. In *Global spine journal* (Vol. 12, pp. 1624-1626). England: SAGE Publications.

Devinsky, O., Morrell, M. J., & Vogt, B. A. (1995). Contributions of anterior cingulate cortex to behaviour. *Brain: A Journal of Neurology*, *118*(1), 279-306. https://doi.org/10.1093/brain/118.1.279

Diener, E., & Emmons, R. A. (1984). The independence of positive and negative affect. *Journal of Personality and Social Psychology*, *47*(5), 1105-1117. https://doi.org/10.1037/0022-3514.47.5.1105

Dodeen, H. (2023). The effects of changing negatively worded items to positively worded items on the reliability and the factor structure of psychological scales. *Journal of Psychoeducational Assessment*, *41*(3), 298-310.

Duarte, J., & Pinto-Gouveia, J. (2017). Correlates of psychological inflexibility mediate the relation between alexithymic traits and positive emotions. *Journal of Contextual Behavioral Science*, *6*(1), 96-103. https://doi.org/10.1016/j.jcbs.2016.12.002

Dunne, J., Flores, M., Gawande, R., & Schuman-Olivier, Z. (2021). Losing trust in body sensations: Interoceptive awareness and depression symptom severity among primary care patients. *Journal of Affective Disorders*, *282*, 1210-1219. https://doi.org/10.1016/j.jad.2020.12.092

Duval, S., & Tweedie, R. (2000). Trim and Fill: A Simple Funnel-Plot-Based Method of Testing and Adjusting for Publication Bias in Meta-Analysis. *Biometrics*, *56*(2), 455-463.

D'Alonzo, K. T. (2004). The Johnson-Neyman Procedure as an Alternative to ANCOVA. In *Western Journal of Nursing Research* (Vol. 26, pp. 804-812).

Edwards, D. J., & Lowe, R. (2021). Associations between mental health, interoception, psychological flexibility, and self-as-context, as predictors for alexithymia: A deep artificial neural network approach. *Frontiers in Psychology*, *12*, 637802.

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in Meta-Analysis Detected by a Simple, Graphical Test. *BMJ: British Medical Journal*, *315*(7109), 629-634.

Ekman, P. (1971). Universals and cultural differences in facial expressions of emotion. *Nebraska Symposium on Motivation*, *19*, 207-283.

Ekman, P. (1999). Basic emotions. In T. Dalgleish & M. J. Power (Eds.), *Handbook of cognition and emotion.* (pp. 45-60). John Wiley & Sons Ltd. https://doi.org/10.1002/0470013494.ch3

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, *17*(2), 124-129. https://doi.org/10.1037/h0030377

Ekman, P., Levenson, R. W., & Friesen, W. V. (1983). Autonomic nervous system activity distinguishes among emotions. *Science*, *221*(4616), 1208-1210. https://doi.org/10.1126/science.6612338

Elliott, R., Zahn, R., Deakin, J. F. W., & Anderson, I. M. (2011). Affective cognition and its disruption in mood disorders. In *Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology* (Vol. 36, pp. 153-182). England: Nature Publishing Group.

Ellsworth, P. C. (2013). Appraisal theory: Old and new questions. *Emotion Review*, *5*(2), 125-131. https://doi.org/10.1177/1754073912463617

Engel, G. L. (1992). The need for a new medical model: A challenge for biomedicine. *Family Systems Medicine*, *10*(3), 317-331. https://doi.org/10.1037/h0089260

Engen, H. G., & Singer, T. (2015). Compassion-based emotion regulation up-regulates experienced positive affect and associated neural networks. *Social Cognitive & Affective Neuroscience*, *10*(9), 1291-1301. https://doi.org/10.1093/scan/nsv008

Erbas, Y., Ceulemans, E., Lee Pe, M., Koval, P., & Kuppens, P. (2014). Negative emotion differentiation: Its personality and well-being correlates and a comparison of different assessment methods. *Cognition & Emotion*, *28*(7), 1196-1213. https://doi.org/10.1080/02699931.2013.875890

Farb, N., Daubenmier, J., Price, C. J., Gard, T., Kerr, C., Dunn, B. D.,…Mehling, W. E. (2015). Interoception, contemplative practice, and health. In *Frontiers in Psychology* (Vol. 6): eScholarship, University of California.

Fava, G. A., Cosci, F., Sonino, N., & Guidi, J. (2023). Understanding health attitudes and behavior. *The American Journal of Medicine*, *136*(3), 252-259.

Feldman, M. J., Bliss-Moreau, E., & Lindquist, K. A. (2024). The neurobiology of interoception and affect. *Trends in Cognitive Sciences*. https://doi.org/10.1016/j.tics.2024.01.009

Ferentzi, E., Olaru, G., Geiger, M., Vig, L., Köteles, F., & Wilhelm, O. (2021). Examining the factor structure and validity of the multidimensional assessment of interoceptive awareness. *Journal of Personality Assessment*, *103*(5), 675-684.

Ferentzi, E., Szabolcs, Z., Csala, B., Bogdány, T., Horváth, Á., & Köteles, F. (2018). Multichannel investigation of interoception: Sensitivity is not a generalizable feature. *Frontiers in Human Neuroscience*, *12*. https://doi.org/10.3389/fnhum.2018.00223

Field, A. P. (2018). Discovering statistics using IBM SPSS statistics / Andy Field. In (5th edition. ed.): SAGE Publications.

Field, A. P., & Gillett, R. (2010). How to do a meta-analysis. *British Journal of Mathematical and Statistical Psychology*, *63*(3), 665-694. https://doi.org/https://doi.org/10.1348/000711010X502733

Fiene, L., Ireland, M. J., & Brownlow, C. (2018). The Interoception Sensory Questionnaire (ISQ): A scale to measure interoceptive challenges in adults. *Journal of Autism and Developmental Disorders*, *48*(10), 3354-3366.

Flasinski, T., Dierolf, A. M., Rost, S., Lutz, A. P. C., Voderholzer, U., Koch, S.,…Mertens, V.-C. (2020). Altered interoceptive awareness in high habitual symptom reporters and patients with somatoform disorders. *Frontiers in psychology*, *11*, 1859.

Fleischmann, M., & Vaughan, B. (2018). The challenges and opportunities of using patient reported outcome measures (PROMs) in clinical practice. In: Elsevier.
Forkmann, T., Scherer, A., Meessen, J., Michal, M., Schächinger, H., Vögele, C., & Schulz, A. (2016). Making sense of what you sense: Disentangling interoceptive awareness, sensibility and accuracy. *International Journal of Psychophysiology*, *109*, 71-80. https://doi.org/10.1016/j.ijpsycho.2016.09.019
Forstmann, M., & Burgmer, P. (2015). Adults are intuitive mind-body dualists. *Journal of Experimental Psychology: General*, *144*(1), 222.
Forstmann, M., & Burgmer, P. (2017). Antecedents, manifestations, and consequences of belief in mind-body dualism. In *The science of lay theories: How beliefs shape our cognition, behavior, and health.* (pp. 181-205). Springer International Publishing/Springer Nature. https://doi.org/10.1007/978-3-319-57306-9_8
Forstmann, M., Burgmer, P., & Mussweiler, T. (2012). "The Mind Is Willing, but the Flesh Is Weak": The Effects of Mind-Body Dualism on Health Behavior. *Psychological Science*, *23*(10), 1239-1245. https://doi.org/10.1177/0956797612442392
Fournier, A., Luminet, O., Dambrun, M., Dutheil, F., Pellissier, S., & Mondillon, L. (2019). Importance of considering interoceptive abilities in alexithymia assessment. *PeerJ*, *7*, e7615.
Fredrickson, B. L. (1998). What Good Are Positive Emotions? *Review of General Psychology*, *2*(3), 300-319. https://doi.org/10.1037/1089-2680.2.3.300
Fredrickson, B. L. (2000). Cultivating Positive Emotions to Optimize Health and Well-Being. *Prevention and Treatment*, *3*. https://doi.org/10.1037/1522-3736.3.1.31a
Fredrickson, B. L. (2001). The Role of Positive Emotions in Positive Psychology: The Broaden-and-Build Theory of Positive Emotions. *56*(3), 218-226.
Fredrickson, B. L. (2004). The Broaden-and-Build Theory of Positive Emotions. *Philosophical Transactions: Biological Sciences*, *359*(1449), 1367-1377.
Frijda, N. H. (1986). *The emotions*. Cambridge University Press.
Frijda, N. H. (1993). Appraisal and beyond. *Cognition & Emotion*, *7*(3/4), 225-231. https://doi.org/10.1080/02699939308409188
Friston, K. (2010). The free-energy principle: a unified brain theory? *Nature Reviews Neuroscience*, *11*(2), 127. https://doi.org/10.1038/nrn2787
Gabriele, E., Spooner, R., Brewer, R., & Murphy, J. (2022). Dissociations between self-reported interoceptive accuracy and attention: Evidence from the Interoceptive Attention Scale. *Biological psychology*, *168*, 108243.
Gaggero, G., Bizzego, A., Dellantonio, S., Pastore, L., Lim, M., & Esposito, G. (2021). Clarifying the relationship between alexithymia and subjective interoception. *PLoS One*, *16*(12), e0261126.
Gaggero, G., Dellantonio, S., Pastore, L., Sng, K. H. L., & Esposito, G. (2022). Shared and unique interoceptive deficits in high alexithymia and neuroticism. *Plos one*, *17*(8), e0273922.
Garfinkel, S. N., Seth, A. K., Barrett, A. B., Suzuki, K., & Critchley, H. D. (2015). Knowing your own heart: distinguishing interoceptive accuracy from interoceptive awareness. *Biological psychology*, *104*, 65-74.
Garfinkel, S. N., Tiley, C., O'Keeffe, S., Harrison, N. A., Seth, A. K., & Critchley, H. D. (2016). Discrepancies between dimensions of interoception in autism: Implications for emotion and anxiety. *Biological psychology*, *114*, 117-126.
Garland, E. L., Fredrickson, B., Kring, A. M., Johnson, D. P., Meyer, P. S., & Penn, D. L. (2010). Upward spirals of positive emotions counter downward spirals of negativity: Insights from the broaden-and-build theory and affective neuroscience on the

treatment of emotion dysfunctions and deficits in psychopathology. *Clinical Psychology Review*, *30*(7), 849-864. https://doi.org/10.1016/j.cpr.2010.03.002

Garner, D. M., Olmstead, M. P., & Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *International journal of eating disorders*, *2*(2), 15-34.

Gendron, M., & Barrett, L. F. (2009). Reconstructing the past: A century of ideas about emotion in psychology. *Emotion Review*, *1*(4), 316-339. https://doi.org/10.1177/1754073909338877

Gendron, M., Crivelli, C., & Barrett, L. F. (2018). Universality Reconsidered : Diversity in Making Meaning of Facial Expressions. *Current Directions in Psychological Science*, *27*(4), 211-219.

Gendron, M., Hoemann, K., Crittenden, A. N., Mangola, S. M., Ruark, G. A., & Barrett, L. F. (2020). Emotion Perception in Hadza Hunter-Gatherers. *Scientific Reports*, *10*(1), 1-17. https://doi.org/10.1038/s41598-020-60257-2

Gendron, M., Mesquita, B., & Barrett, L. F. (2020). The Brain as a Cultural Artifact: Concepts, Actions, and Experiences within the Human Affective Niche. In L. J. Kirmayer, C. M. Worthman, S. Kitayama, R. Lemelson, & C. A. Cummings (Eds.), *Culture, Mind, and Brain: Emerging Concepts, Models, and Applications* (pp. 188-222). Cambridge University Press.

Gendron, M., Roberson, D., van der Vyver, J. M., & Barrett, L. F. (2014). Perceptions of emotion from facial expressions are not culturally universal: Evidence from a remote culture. *Emotion*, *14*(2), 251-262. https://doi.org/10.1037/a0036052

Goldstein, D. S. (2019). How does homeostasis happen? Integrative physiological, systems biological, and evolutionary perspectives. *American journal of physiology. Regulatory, integrative and comparative physiology*, *316*(4), R301-R317. https://doi.org/10.1152/ajpregu.00396.2018

Grabe, H. J., Schwahn, C., Barnow, S., Spitzer, C., John, U., Freyberger, H. J.,…Völzke, H. (2010). Alexithymia, hypertension, and subclinical atherosclerosis in the general population. *Journal of Psychosomatic Research*, *68*(2), 139-147. https://doi.org/10.1016/j.jpsychores.2009.07.015

Grimble, N., Scarfo, J., Katherveloo, J., Ganci, M., Ball, M., & Suleyman, E. (2024). The relationship between interoceptive emotional awareness, neuroticism, and depression, anxiety, and stress. *PLoS ONE*, *19*(4), e0299835. https://doi.org/10.1371/journal.pone.0299835

Gross, J. J. (1998). The Emerging Field of Emotion Regulation: An Integrative Review. *Review of General Psychology*, *2*(3), 271-299.

Gross, J. J. (1998). The Emerging Field of Emotion Regulation: An Integrative Review. *2*(3), 271-299.

Gross, J. J. (2015). Emotion Regulation: Current Status and Future Prospects. *Psychological Inquiry*, *26*(1), 1-26.

Gross, J. J., & Feldman Barrett, L. (2011). Emotion generation and emotion regulation: One or two depends on your point of view. *Emotion review*, *3*(1), 8-16.

Grossi, D., Di Vita, A., Palermo, L., Sabatini, U., Trojano, L., & Guariglia, C. (2014). The brain network for self-feeling: A symptom-lesion mapping study. *Neuropsychologia*, *63*, 92-98. https://doi.org/10.1016/j.neuropsychologia.2014.08.004

Guidi, J., Lucente, M., Sonino, N., & Fava, G. A. (2020). Allostatic load and its impact on health: a systematic review. *Psychotherapy and psychosomatics*, *90*(1), 11-27.

Gurevitch, J., Koricheva, J., Nakagawa, S., & Stewart, G. (2018). Meta-analysis and the science of research synthesis. *Nature*, *555*, 175-182. https://doi.org/10.1038/nature25753

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7 ed.). Prentice Hall.

Hanley, A. W., Mehling, W. E., & Garland, E. L. (2017). Holding the body in mind: Interoceptive awareness, dispositional mindfulness and psychological well-being. In: eScholarship, University of California.

Haruki, Y., & Ogawa, K. (2021). Role of anatomical insular subdivisions in interoception: Interoceptive attention and accuracy have dissociable substrates. *European Journal of Neuroscience*, *53*(8), 2669-2680. https://doi.org/10.1111/ejn.15157

Haynes, S. N., Richard, D. C. S., & Kubany, E. S. (1995). Content validity in psychological assessment: a functional approach to concepts and methods. *Psychological Assessment*, *7*(3), 238.

Henningsen, P., Gündel, H., Kop, W. J., Löwe, B., Martin, A., Rief, W.,…Van Den Bergh, O. (2018). Persistent physical symptoms as perceptual dysregulation: a neuropsychobehavioral model and its clinical implications. *Psychosomatic medicine*, *80*(5), 422-431.

Herbert, B. M., & Pollatos, O. (2012). The Body in the Mind: On the Relationship Between Interoception and Embodiment. *Topics in Cognitive Science*, *4*(4), 692-704. https://doi.org/10.1111/j.1756-8765.2012.01189.x

Higgins, J. P. T., & Green, S. (2008). Cochrane handbook for systematic reviews of interventions.

Hinkin, T. R. (1995). A review of scale development practices in the study of organizations. *Journal of Management*, *21*(5), 967-988. https://doi.org/10.1177/014920639502100509

Hoemann, K., Gendron, M., Crittenden, A. N., Mangola, S. M., Endeko, E. S., Dussault, È.,…Mesquita, B. (2024). What we can learn about emotion by talking with the Hadza. *Perspectives on Psychological Science*, *19*(1), 173-200. https://doi.org/10.1177/17456916231178555

Hoemann, K., Khan, Z., Feldman, M. J., Nielson, C., Devlin, M., Dy, J.,…Quigley, K. S. (2020). Context-aware experience sampling reveals the scale of variation in affective experience. *Scientific Reports*, *10*(1), 1-16. https://doi.org/10.1038/s41598-020-69180-y

Hoemann, K., Lee, Y., Kuppens, P., Gendron, M., & Boyd, R. L. (2023). Emotional Granularity is Associated with Daily Experiential Diversity. *Affective Science*, 1-16. https://doi.org/10.1007/s42761-023-00185-2

Hoemann, K., Nielson, C., Yuen, A., Gurera, J. W., Quigley, K. S., & Barrett, L. F. (2021). Expertise in emotion: A scoping review and unifying framework for individual differences in the mental representation of emotional experience. *Psychological Bulletin*, *147*(11), 1159.

Hoemann, K., Wu, R., LoBue, V., Oakes, L. M., Xu, F., & Barrett, L. F. (2019). Developing an understanding of emotion categories: Lessons from objects. *Trends in Cognitive Sciences*. https://doi.org/10.1016/j.tics.2019.10.010

Honkalampi, K., Hintikka, J., Laukkanen, E., Lehtonen, J., & Viinamäki, H. (2001). Alexithymia and depression: A prospective study of patients with major depressive disorder. *Psychosomatics: Journal of Consultation and Liaison Psychiatry*, *42*(3), 229-234. https://doi.org/10.1176/appi.psy.42.3.229

Izard, C. E. (1977). *Human Emotions* Springer New York.

Izard, C. E. (1993). *Four Systems for Emotion Activation: Cognitive and Noncognitive Processes* (0033-295X). (Psychological Review, Issue. https://research.ebsco.com/linkprocessor/plink?id=7b354b3d-f1cc-3051-8c2e-e4dbad9149b9

Izard, C. E. (2007). Basic Emotions, Natural Kinds, Emotion Schemas, and a New Paradigm. *Perspectives on Psychological Science*, *2*(3), 260-280.

Jablonski, M. E., & Lange, A. E. (2022). Overcoming Treatment Obstacles in Functional Movement Disorder. In *Functional Movement Disorder: An Interdisciplinary Case-Based Approach* (pp. 415-431). Springer.

Jakubczyk, A., Skrzeszewski, J., Trucco, E. M., Suszek, H., Zaorska, J., Nowakowska, M.,…Kopera, M. (2019). Interoceptive accuracy and interoceptive sensibility in individuals with alcohol use disorder–Different phenomena with different clinical correlations? *Drug and Alcohol dependence*, *198*, 34-38.

James, W. (1884). What is emotion? *Mind*, *9*(34), 188-205.

James, W. (1894). Discussion: The physical basis of emotion. *Psychological Review*, *1*(5), 516-529. https://doi.org/10.1037/h0065078

Jenkinson, P. M., Fotopoulou, A., Ibañez, A., & Rossell, S. (2024). Interoception in anxiety, depression, and psychosis: a review. *eClinicalMedicine*, *73*. https://doi.org/10.1016/j.eclinm.2024.102673

Johnson, S. B. (2013). Increasing psychology's role in health research and health care. *American Psychologist*, *68*(5), 311-321. https://doi.org/10.1037/a0033591

Jungilligens, J., Paredes-Echeverri, S., Popkirov, S., Barrett, L. F., & Perez, D. L. (2022). A new science of emotion: implications for functional neurological disorder. *Brain*, *145*(8), 2648-2663.

Kalokerinos, E. K., Erbas, Y., Ceulemans, E., & Kuppens, P. (2019). Differentiate to Regulate: Low Negative Emotion Differentiation Is Associated With Ineffective Use but Not Selection of Emotion-Regulation Strategies. *Psychological Science*, *30*(6), 863-879. https://doi.org/10.1177/0956797619838763

Kano, M., & Fukudo, S. (2013). The alexithymic brain: the neural pathways linking alexithymia to physical disorders. *BioPsychoSocial Medicine*, *7*(1), 1-9. https://doi.org/10.1186/1751-0759-7-1

Karatsoreos, I. N., & McEwen, B. S. (2011). Psychobiological allostasis: resistance, resilience and vulnerability. *Trends in Cognitive Sciences*, *15*(12), 576-584. https://doi.org/10.1016/j.tics.2011.10.005

Kashdan, T. B., Barrett, L. F., & McKnight, P. E. (2015). Unpacking Emotion Differentiation: Transforming Unpleasant Experience by Perceiving Distinctions in Negativity. *Current Directions in Psychological Science*, *24*(1), 10-16.

Khalsa, S. S., Adolphs, R., Cameron, O. G., Critchley, H. D., Davenport, P. W., Feinstein, J. S.,…Mehling, W. E. (2018). Interoception and mental health: a roadmap. *Biological psychiatry: cognitive neuroscience and neuroimaging*, *3*(6), 501-513.

Khalsa, S. S., & Lapidus, R. C. (2016). Can interoception improve the pragmatic search for biomarkers in psychiatry? *Frontiers in psychiatry*, *7*, 121.

Khalsa, S. S., Rudrauf, D., Feinstein, J. S., & Tranel, D. (2009). The pathways of interoceptive awareness. *Nature Neuroscience*, *12*(12), 1494-1496. https://doi.org/10.1038/nn.2411

Kinnaird, E., Stewart, C., & Tchanturia, K. (2019). Investigating alexithymia in autism: A systematic review and meta-analysis. *European Psychiatry*, *55*, 80-89.

Kittel, R., Brauhardt, A., & Hilbert, A. (2015). Cognitive and emotional functioning in binge-eating disorder: A systematic review. *International Journal of Eating Disorders*, *48*(6), 535-554. https://doi.org/10.1002/eat.22419

Kleckner, I. R., Zhang, J., Touroutoglou, A., Chanes, L., Xia, C., Simmons, W. K.,…Feldman Barrett, L. (2017). Evidence for a large-scale brain system supporting allostasis and interoception in humans. *Nature Human Behaviour*, *1*(5). https://doi.org/10.1038/s41562-017-0069

Kline, P. (2013). *Handbook of psychological testing*. Routledge.
Kline, R. B. (2016). Principles and practice of structural equation modeling / Rex B. Kline. In (Fourth edition. ed.): Guilford Press.
Klonsky, E. D., Victor, S. E., Hibbert, A. S., & Hajcak, G. (2019). The multidimensional emotion questionnaire (MEQ): Rationale and initial psychometric properties. *Journal of Psychopathology and Behavioral Assessment*, *41*, 409-424.
Koch, S. B. J., van Zuiden, M., Nawijn, L., Frijling, J. L., Veltman, D. J., & Olff, M. (2016). Aberrant resting-state brain activity in posttraumatic stress disorder: a meta-analysis and systematic review. In *Depression and anxiety* (Vol. 33, pp. 592-605). United States: Wiley.
Kontopantelis, E., & Reeves, D. (2012). Performance of statistical methods for meta-analysis when true study effects are non-normally distributed: A simulation study. *21*(4), 409-426.
Koreki, A., Garfkinel, S. N., Mula, M., Agrawal, N., Cope, S., Eilon, T.,…Yogarajah, M. (2020). Trait and state interoceptive abnormalities are associated with dissociation and seizure frequency in patients with functional seizures. *Epilepsia*, *61*(6), 1156-1165.
Krämer, L. V., Helmes, A. W., Seelig, H., Fuchs, R., & Bengel, J. (2014). Correlates of reduced exercise behaviour in depression: The role of motivational and volitional deficits. *Psychology & Health*, *29*(10), 1206-1225.
Kuppens, P., Tuerlinckx, F., Russell, J. A., & Barrett, L. F. (2013). The relation between valence and arousal in subjective experience. *Psychological Bulletin*, *139*(4), 917-940. https://doi.org/10.1037/a0030811
Kurlansik, S. L., & Maffei, M. S. (2016). Somatic Symptom Disorder. In *American family physician* (Vol. 93, pp. 49-54). United States: American Academy of General Practice.
Kurz, A. (2008). Physiology of Thermoregulation. *Best Practice & Research Clinical Anaesthesiology*, *22*(4), 627-644. https://doi.org/https://doi.org/10.1016/j.bpa.2008.06.004
Kyzar, E. J., & Denfield, G. H. (2023). Taking subjectivity seriously: towards a unification of phenomenology, psychiatry, and neuroscience. *Molecular Psychiatry*, *28*(1), 10-16. https://doi.org/10.1038/s41380-022-01891-2
Köteles, F. (2021). Body sensations : the conscious aspects of interoception / Ferenc Köteles. In: Springer.
Köteles, F., & Witthöft, M. (2017). Somatosensory amplification – An old construct from a new perspective. *Journal of Psychosomatic Research*, *101*, 1-9. https://doi.org/10.1016/j.jpsychores.2017.07.011
Lane, R. D., Ahern, G. L., Schwartz, G. E., & Kaszniak, A. W. (1997). Is alexithymia the emotional equivalent of blindsight? *Biological Psychiatry*, *42*(9), 834-844. https://doi.org/10.1016/S0006-3223(97)00050-4
Lange, C. G. (1885). The mechanism of the emotions. *The classical psychologists*, 672-684.
Larsen, R. J., & Diener, E. (1987). Affect intensity as an individual difference characteristic: A review. *Journal of Research in Personality*, *21*(1), 1-39. https://doi.org/https://doi.org/10.1016/0092-6566(87)90023-7
Larsson, D. E. O., Dienes, Z., Esposito, G., Critchley, H. D., & Garfinkel, S. N. (2021). Sensitivity to changes in rate of heartbeats as a measure of interoceptive ability. *Journal of Neurophysiology*, *126*(5), 1799-1813. https://doi.org/10.1152/jn.00059.2021
Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford University Press.

Lebowitz, M. S., & Appelbaum, P. S. (2019). Biomedical explanations of psychopathology and their implications for attitudes and beliefs about mental disorders. *Annual Review of Clinical Psychology*, *15*, 555-577. https://doi.org/10.1146/annurev-clinpsy-050718-095416

Lebowitz, M. S., Dolev-Amit, T., & Zilcha-Mano, S. (2021). Relationships of Biomedical Beliefs About Depression to Treatment-Related Expectancies in a Treatment-Seeking Sample. *Psychotherapy*, *58*(3), 366-371. https://doi.org/https://doi.org/10.1037/pst0000320

LeDoux, J. (2012). Rethinking the emotional brain. *Neuron*, *73*(4), 653-676.

LeDoux, J. E., & Hofmann, S. G. (2018). The subjective experience of emotion: a fearful view. *Current Opinion in Behavioral Sciences*, *19*, 67-72.

Lee, K. S., Murphy, J., Catmur, C., Bird, G., & Hobson, H. (2022). Furthering the language hypothesis of alexithymia: An integrated review and meta-analysis. *Neuroscience and Biobehavioral Reviews*, *141*. https://doi.org/10.1016/j.neubiorev.2022.104864

Lemon, J. C., & Wagner, B. (2013). Exploring the mind-body connection: therapeutic practices and techniques. *American: American Counseling Association*.

Lin, L., & Chu, H. (2018). Quantifying Publication Bias in Meta-Analysis. *Biometrics*, *74*(3), 785-794.

Lindquist, K. A. (2013). Emotions emerge from more basic psychological ingredients: A modern psychological constructionist model. *Emotion Review*, *5*(4), 356-368. https://doi.org/10.1177/1754073913489750

Lindquist, K. A., & Barrett, L. F. (2008). Constructing Emotion: The Experience of Fear as a Conceptual Act. *Psychological Science*, *19*(9), 898-903.

Lindquist, K. A., Satpute, A. B., Wager, T. D., Weber, J., & Barrett, L. F. (2016). The Brain Basis of Positive and Negative Affect: Evidence from a Meta-Analysis of the Human Neuroimaging Literature. In *Cerebral cortex (New York, N.Y. : 1991)* (Vol. 26, pp. 1910-1922). United States: Oxford University Press.

Lindquist, K. A., Wager, T. D., Kober, H., Bliss-Moreau, E., & Barrett, L. F. (2012). The brain basis of emotion: A meta-analytic review. *Behavioral and Brain Sciences*, *35*(3), 121. https://doi.org/10.1017/S0140525X11000446

Linstone, H. A., & Turoff, M. (1975). *The delphi method*. Addison-Wesley Reading, MA.

Little, R. J. A. (1988). A Test of Missing Completely at Random for Multivariate Data with Missing Values. *Journal of the American Statistical Association*, *83*(404), 1198-1202. https://doi.org/10.1080/01621459.1988.10478722

Longarzo, M., D'Olimpio, F., Chiavazzo, A., Santangelo, G., Trojano, L., & Grossi, D. (2015). The relationships between interoception and alexithymic trait. The Self-Awareness Questionnaire in healthy subjects. *Frontiers in psychology*, *6*, 1149.

Lordon, R. J., Mikles, S. P., Kneale, L., Evans, H. L., Munson, S. A., Backonja, U., & Lober, W. B. (2020). How patient-generated health data and patient-reported outcomes affect patient–clinician relationships: A systematic review. *Health Informatics Journal*, *26*(4), 2689-2706. https://doi.org/10.1177/1460458220928184

Luminet, O., Nielson, K. A., & Ridout, N. (2021). Cognitive-emotional processing in alexithymia: an integrative review. *Cognition & Emotion*, *35*(3), 449-487. https://doi.org/10.1080/02699931.2021.1908231

Lyvers, M., Ryan, N., & Thorberg, F. A. (2022). Alexithymia, negative moods, and fears of positive emotions. *Current Psychology*. https://doi.org/10.1007/s12144-021-02555-0

Ma-Kellams, C. (2014). Cross-cultural differences in somatic awareness and interoceptive accuracy: A review of the literature and directions for future research. *Frontiers in Psychology*, *5*(DEC). https://doi.org/10.3389/fpsyg.2014.01379

MacCormack, J. K., Bonar, A. S., & Lindquist, K. A. (2024). Interoceptive beliefs moderate the link between physiological and emotional arousal during an acute stressor. *Emotion*, *24*(1), 269-290. https://doi.org/10.1037/emo0001270
MacCormack, J. K., & Lindquist, K. A. (2019). Feeling Hangry? When Hunger Is Conceptualized as Emotion. *19*(2), 301-319.
Marcus, D. K., Gurley, J. R., Marchi, M. M., & Bauer, C. (2007). Cognitive and perceptual variables in hypochondriasis and health anxiety: A systematic review. *Clinical Psychology Review*, *27*(2), 127-139. https://doi.org/10.1016/j.cpr.2006.09.003
Martino, G., Caputo, A., Vicario, C. M., Catalano, A., Schwarz, P., & Quattropani, M. C. (2020). The relationship between alexithymia and type 2 diabetes: A systematic review. *Frontiers in Psychology*, *11*. https://doi.org/10.3389/fpsyg.2020.02026
Matsumoto, D., Keltner, D., Shiota, M. N., O'Sullivan, M., & Frank, M. (2008). Facial expressions of emotion. In *Handbook of emotions, 3rd ed.* (pp. 211-234). The Guilford Press.
Matsumoto, D., & Wilson, M. (2022). A Half-Century Assessment of the Study of Culture and Emotion. *Journal of Cross-Cultural Psychology*, *53*(7-8), 917-934. https://doi.org/10.1177/00220221221084236
McCoach, D. B., Gable, R. K., & Madura, J. P. (2013). Defining, Measuring, and Scaling Affective Constructs. In D. B. McCoach, R. K. Gable, & J. P. Madura (Eds.), *Instrument Development in the Affective Domain: School and Corporate Applications* (pp. 33-90). Springer New York. https://doi.org/10.1007/978-1-4614-7135-6_2
McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York academy of sciences*, *840*(1), 33-44.
McEwen, B. S. (2005). Stressed or stressed out: what is the difference? *Journal of Psychiatry and Neuroscience*, *30*(5), 315-318.
McEwen, B. S., & Gianaros, P. J. (2010). Central role of the brain in stress and adaptation: Links to socioeconomic status, health, and disease. *1186*, 190-222.
McEwen, B. S., & Stellar, E. (1993). Stress and the individual: Mechanisms leading to disease. *Archives of internal medicine*, *153*(18), 2093-2101.
Meadows, K. A. (2011). Patient-reported outcome measures: an overview. *British journal of community nursing*, *16*(3), 146-151.
Medford, N., & Critchley, H. D. (2010). Conjoint activity of anterior insular and anterior cingulate cortex: awareness and response. *Brain Structure and Function*, *214*(5-6), 535-549. https://doi.org/10.1007/s00429-010-0265-x
Mehling, W. (2016). Differentiating attention styles and regulatory aspects of self-reported interoceptive sensibility. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1708), 20160013.
Mehling, W. E., Acree, M., Stewart, A., Silas, J., & Jones, A. (2018). The multidimensional assessment of interoceptive awareness, version 2 (MAIA-2). *PloS one*, *13*(12), e0208034.
Mehling, W. E., Daubenmier, J., Price, C. J., Acree, M., Bartmess, E., & Stewart, A. L. (2013). Self-reported interoceptive awareness in primary care patients with past or current low back pain. *Journal of Pain Research*, *6*, 403-418.
Mehling, W. E., Gopisetty, V., Daubenmier, J., Price, C. J., Hecht, F. M., & Stewart, A. (2009). Body Awareness: Construct and Self-Report Measures. *PLoS ONE*, *4*(5), 1-18. https://doi.org/10.1371/journal.pone.0005614
Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The multidimensional assessment of interoceptive awareness (MAIA). *PloS one*, *7*(11), e48230.

Menon, V., & Uddin, L. Q. (2010). Saliency, switching, attention and control: a network model of insula function. *Brain Structure and Function*, *214*(5-6), 655-667. https://doi.org/10.1007/s00429-010-0262-0

Miller, L. C., Murphy, R., & Buss, A. H. (1981). Consciousness of body: Private and public. *Journal of Personality and Social Psychology*, *41*(2), 397-406. https://doi.org/10.1037/0022-3514.41.2.397

Montoya, A. K. (2016). *Extending the Johnson-Neyman procedure to categorical independent variables: Mathematical derivations and computational tools* [Master's thesis, The Ohio State University]. OhioLINK. https://rave.ohiolink.edu/etdc/view?acc_num=osu1469104326

Montoya-Hurtado, O., Gómez-Jaramillo, N., Bermúdez-Jaimes, G., Correa-Ortiz, L., Cañón, S., Juárez-Vela, R.,…Criado-Gutiérrez, J. (2023). Psychometric Properties of the Multidimensional Assessment of Interoceptive Awareness (MAIA) Questionnaire in Colombian University Students. *Journal of Clinical Medicine*, *12*(8), 2937. https://doi.org/10.3390/jcm12082937

Morgado, F. F. R., Meireles, J. F. F., Neves, C. M., Amaral, A. C. S., & Ferreira, M. E. C. (2018). Scale development: ten main limitations and recommendations to improve future research practices. *Psicologia: Reflexão e Crítica: Psychology: Research and Review*, *30*(1), 1-20. https://doi.org/10.1186/s41155-016-0057-1

Moriguchi, Y., & Komaki, G. (2013). Neuroimaging studies of alexithymia: Physical, affective, and social perspectives. *BioPsychoSocial Medicine*, *7*. https://doi.org/10.1186/1751-0759-7-8

Mose, S., Budtz, C. R., Rønn Smidt, H., Kent, P., Smith, A., Hviid Andersen, J., & Christiansen, D. H. (2023). How do people with chronic pain explain their use, or non-use, of pain-related healthcare services? A qualitative study of patient experiences. *Disability and Rehabilitation: An International, Multidisciplinary Journal*, *45*(25), 4207-4217. https://doi.org/10.1080/09638288.2022.2147589

Murphy, J., Brewer, R., Catmur, C., & Bird, G. (2017). Interoception and psychopathology: A developmental neuroscience perspective. *Developmental Cognitive Neuroscience*, *23*, 45-56. https://doi.org/10.1016/j.dcn.2016.12.006

Murphy, J., Brewer, R., Plans, D., Khalsa, S. S., Catmur, C., & Bird, G. (2020). Testing the independence of self-reported interoceptive accuracy and attention. *Quarterly Journal of Experimental Psychology*, *73*(1), 115-133.

Murphy, J., Catmur, C., & Bird, G. (2019). Classifying individual differences in interoception: Implications for the measurement of interoceptive awareness. *Psychonomic bulletin & review*, *26*, 1467-1471.

Niedenthal, P. M., Barsalou, L. W., Winkielman, P., Krauth-Gruber, S., & Ric, F. (2005). Embodiment in attitudes, social perception, and emotion. *Personality and social psychology review*, *9*(3), 184-211.

Nuske, H., Vivanti, G., & Dissanayake, C. (2013). Are emotion impairments unique to, universal, or specific in autism spectrum disorder? A comprehensive review. *Cognition & Emotion*, *27*(6), 1042-1061. https://doi.org/10.1080/02699931.2012.762900

Ogrodniczuk, J. S., Kealy, D., Hadjipavlou, G. A., & Cameron, K. (2018). Therapeutic issues. In *Alexithymia: Advances in research, theory, and clinical practice.* (pp. 190-206). Cambridge University Press. https://doi.org/10.1017/9781108241595.014

Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, *42*(1), 15-29. https://doi.org/10.1016/j.im.2003.11.002

Oldershaw, A., Lavender, T., Sallis, H., Stahl, D., & Schmidt, U. (2015). Emotion generation and regulation in anorexia nervosa: A systematic review and meta-analysis of self-report data. *39*, 83-95.

Oosterwijk, S., Touroutoglou, A., & Lindquist, K. A. (2015). The neuroscience of construction: What neuroimaging approaches can tell us about how the brain creates the mind. In *The psychological construction of emotion.* (pp. 111-143). The Guilford Press.

Oppenheim, A. N. (1992). Questionnaire design, interviewing, and attitude measurement / A.N. Oppenheim. In (New ed.): Pinter Publishers.

Ortony, A. (2022). Are all 'basic emotions' emotions? A problem for the (basic) emotions construct. *Perspectives on Psychological Science*, *17*(1), 41-61. https://doi.org/10.1177/1745691620985415

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D.,…Brennan, S. E. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International journal of surgery*, *88*, 105906.

Palan, S., & Schitter, C. (2018). Prolific.ac—A subject pool for online experiments. *Journal of Behavioral and Experimental Finance*, *17*, 22-27. https://doi.org/10.1016/j.jbef.2017.12.004

Palser, E. R., Palmer, C. E., Galvez-Pol, A., Hannah, R., Fotopoulou, A., & Kilner, J. M. (2018). Alexithymia mediates the relationship between interoceptive sensibility and anxiety. *PloS one*, *13*(9), e0203212.

Panayiotou, G., Leonidou, C., Constantinou, E., Hart, J., Rinehart, K. L., Sy, J. T., & Björgvinsson, T. (2015). Do alexithymic individuals avoid their feelings? Experiential avoidance mediates the association between alexithymia, psychosomatic, and depressive symptoms in a community and a clinical sample. *Comprehensive Psychiatry*, *56*, 206-216. https://doi.org/10.1016/j.comppsych.2014.09.006

Panayiotou, G., Panteli, M., & Vlemincx, E. (2018). Processing emotions in alexithymia: A systematic review of physiological markers. In *Alexithymia: Advances in research, theory, and clinical practice.* (pp. 291-320). Cambridge University Press. https://doi.org/10.1017/9781108241595.018

Panayiotou, G., Panteli, M., & Vlemincx, E. (2021). Adaptive and maladaptive emotion processing and regulation, and the case of alexithymia. *Cognition & Emotion*, *35*(3), 488-499. https://doi.org/10.1080/02699931.2019.1671322

Panksepp, J. (2004). Affective Neuroscience : the Foundations of Human and Animal Emotions. In: Oxford University Press, USA.

Panksepp, J. (2005). Affective consciousness: Core emotional feelings in animals and humans. *Consciousness and cognition*, *14*(1), 30-80.

Panksepp, J. (2007). Neurologizing the psychology of affects: How appraisal-based constructivism and basic emotion theory can coexist. *Perspectives on psychological science*, *2*(3), 281-296.

Panksepp, J. (2008). Cognitive conceptualism—where have all the affects gone? additional corrections for Barrett et al.(2007). *Perspectives on Psychological Science*, *3*(4), 305-308.

Panksepp, J. (2011). The basic emotional circuits of mammalian brains: do animals have affective lives? *Neuroscience & Biobehavioral Reviews*, *35*(9), 1791-1804.

Paolucci, T., de Sire, A., Ammendolia, A., Agostini, F., Bernetti, A., Salomè, A.,…Di Piero, V. (2022). Efficacy of interoceptive and embodied rehabilitative training protocol in patients with mild multiple sclerosis: A randomized controlled trial. *Frontiers in Neurology*, *13*. https://doi.org/10.3389/fneur.2022.1095180

Paré, G., Trudel, M.-C., Jaana, M., & Kitsiou, S. (2015). Synthesizing information systems knowledge: A typology of literature reviews. *Information & Management*, *52*(2), 183-199. https://doi.org/10.1016/j.im.2014.08.008

Paulus, M. P., & Stein, M. B. (2010). Interoception in anxiety and depression. *Brain structure and Function*, *214*, 451-463.

Paulus, M. P., & Yu, A. J. (2012). Emotion and decision-making: affect-driven belief systems in anxiety and depression. *Trends in Cognitive Sciences*, *16*(9), 476-483. https://doi.org/10.1016/j.tics.2012.07.009

Payne, H., & Brooks, S. (2018). Different Strokes for Different Folks: The BodyMind Approach as a Learning Tool for Patients With Medically Unexplained Symptoms to Self-Manage. In *Frontiers in Psychology* (Vol. 9): Frontiers Media S.A.

Peters, A., McEwen, B. S., & Friston, K. (2017). Uncertainty and stress: Why it causes diseases and how it is mastered by the brain. *Progress in neurobiology*, *156*, 164-188.

Petzschner, F. H., Garfinkel, S. N., Paulus, M. P., Koch, C., & Khalsa, S. S. (2021). Computational Models of Interoception and Body Regulation. *Trends Neurosci*, *44*(1), 63-76. https://doi.org/10.1016/j.tins.2020.09.012

Petzschner, F. H., Weber, L. A., Wellstein, K. V., Paolini, G., Do, C. T., & Stephan, K. E. (2019). Focus of attention modulates the heartbeat evoked potential. *NeuroImage*, *186*, 595-606. https://doi.org/https://doi.org/10.1016/j.neuroimage.2018.11.037

Phillipou, A., Rossell, S. L., Castle, D. J., & Gurvich, C. (2022). Interoceptive awareness in anorexia nervosa. *Journal of Psychiatric Research*, *148*, 84-87. https://doi.org/10.1016/j.jpsychires.2022.01.051

Pinna, F., Manchia, M., Paribello, P., & Carpiniello, B. (2020). The impact of alexithymia on treatment response in psychiatric disorders: a systematic review. *Frontiers in Psychiatry*, *11*, 311.

Plans, D., Ponzo, S., Morelli, D., Cairo, M., Ring, C., Keating, C. T.,…Bird, G. (2021). Measuring interoception: The phase adjustment task. *Biological Psychology*, *165*. https://doi.org/10.1016/j.biopsycho.2021.108171

Plutchik, R. (1982). A psychoevolutionary theory of emotions. *Social Science Information/sur les sciences sociales*, *21*(4-5), 529-553. https://doi.org/10.1177/053901882021004003

Pollatos, O., & Herbert, B. M. (2018a). Alexithymia and body awareness. In *Alexithymia: Advances in research, theory, and clinical practice.* (pp. 321-333). Cambridge University Press. https://doi.org/10.1017/9781108241595.019

Pollatos, O., & Herbert, B. M. (2018b). Interoception: Definitions, dimensions, neural substrates. *Embodiment in psychotherapy: A practitioner's guide*, 15-27.

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M.,…Duffy, S. (2006). Guidance on the conduct of narrative synthesis in systematic reviews. *A product from the ESRC methods programme Version*, *1*(1), b92.

Porcelli, P., Bagby, R. M., Taylor, G. J., De Carne, M., Leandro, G., & Todarello, O. (2003). Alexithymia as Predictor of Treatment Outcome in Patients with Functional Gastrointestinal Disorders. *Psychosomatic Medicine*, *65*(5), 911-918. https://doi.org/10.1097/01.PSY.0000089064.13681.3B

Porcelli, P., & Taylor, G. J. (2018). Alexithymia and physical illness: A psychosomatic approach. In *Alexithymia: Advances in research, theory, and clinical practice.* (pp. 105-126). Cambridge University Press. https://doi.org/10.1017/9781108241595.009

Porges, S., W. (1993). *Body Perception Questionnaire*.

Powers, D., & Xie, Y. (2008). *Statistical methods for categorical data analysis*. Emerald Group Publishing.

Preece, D., Becerra, R., Allan, A., Robinson, K., & Dandy, J. (2017). Establishing the theoretical components of alexithymia via factor analysis: Introduction and validation of the attention-appraisal model of alexithymia. *Personality and individual differences*, *119*, 341-352.

Preece, D., Becerra, R., & Campitelli, G. (2019). Assessing Emotional Reactivity: Psychometric Properties of the Perth Emotional Reactivity Scale and the Development of a Short Form. *Journal of Personality Assessment*, *101*(6), 589-597. https://doi.org/10.1080/00223891.2018.1465430

Preece, D. A., & Gross, J. J. (2023). Conceptualizing alexithymia. *Personality and Individual Differences*, *215*, 112375.

Preece, D. A., & Gross, J. J. (2024). Defining alexithymia: The clinical relevance of cognitive behavioral vs psychoanalytic conceptualizations. *Personality and Individual Differences*, *228*, 112732.

Preece, D. A., Mehta, A., Petrova, K., Sikka, P., Bjureberg, J., Becerra, R., & Gross, J. J. (2023). Alexithymia and emotion regulation. *Journal of affective disorders*, *324*, 232-238.

Preece, D. A., Petrova, K., Mehta, A., Sikka, P., & Gross, J. J. (2024). Alexithymia or general psychological distress? Discriminant validity of the Toronto Alexithymia Scale and the Perth Alexithymia Questionnaire. *J Affect Disord*, *352*, 140-145. https://doi.org/10.1016/j.jad.2024.01.271

Price, C. J., & Hooven, C. (2018). Interoceptive awareness skills for emotion regulation: Theory and approach of mindful awareness in body-oriented therapy (MABT). *Frontiers in Psychology*, *9*(MAY). https://doi.org/10.3389/fpsyg.2018.00798

Prins, M. A., Verhaak, P. F. M., Bensing, J. M., & van der Meer, K. (2008). Health beliefs and perceived need for mental health care of anxiety and depression—The patients' perspective explored. *Clinical Psychology Review*, *28*(6), 1038-1058. https://doi.org/10.1016/j.cpr.2008.02.009

Quadt, L., Critchley, H. D., & Garfinkel, S. N. (2018). Interoception and emotion: Shared mechanisms and clinical implications. In M. Tsikaris & H. De Preester (Eds.), *The Interoceptive Mind: From Homeostasis to Awareness* (pp. 123-143).

Quadt, L., Garfinkel, S. N., Mulcahy, J. S., Larsson, D. E. O., Silva, M., Jones, A.-M.,…Critchley, H. D. (2021). Interoceptive training to target anxiety in autistic adults (ADIE): A single-center, superiority randomized controlled trial. *EClinicalMedicine*, *39*.

Quigley, K. S., Lindquist, K. A., & Barrett, L. F. (2014). Inducing and measuring emotion and affect: Tips, tricks, and secrets. In *Handbook of research methods in social and personality psychology, 2nd ed.* (pp. 220-252). Cambridge University Press.

Rae, C. L., Larsson, D. E. O., Garfinkel, S. N., & Critchley, H. D. (2019). Dimensions of interoception predict premonitory urges and tic severity in Tourette syndrome. *Psychiatry Research*, *271*, 469-475.

Raz, G., Touroutoglou, A., Wilson-Mendenhall, C., Gilam, G., Lin, T., Gonen, T.,…Barrett, L. F. (2016). Functional connectivity dynamics during film viewing reveal common networks for different emotional experiences. *Cognitive, Affective & Behavioral Neuroscience*, *16*(4), 709-723. https://doi.org/10.3758/s13415-016-0425-4

Reis, H. T., Gable, S. L., & Maniaci, M. R. (2014). Methods for studying everyday experience in its natural context. In *Handbook of research methods in social and personality psychology, 2nd ed.* (pp. 373-403). Cambridge University Press.

Reker, M., Ohrmann, P., Rauch, A. V., Kugel, H., Bauer, J., Dannlowski, U.,…Suslow, T. (2010). Individual differences in alexithymia and brain response to masked emotion faces. *Cortex*, *46*(5), 658-667. https://doi.org/10.1016/j.cortex.2009.05.008

Ricciardi, L., Demartini, B., Fotopoulou, A., & Edwards, M. J. (2015). Alexithymia in neurological disease: a review. *The Journal of neuropsychiatry and clinical neurosciences*, *27*(3), 179-187.

Ricciardi, L., Nisticò, V., Andrenelli, E., Cunha, J. M., Demartini, B., Kirsch, L. P.,…Fotopoulou, A. (2021). Exploring three levels of interoception in people with functional motor disorders. *Parkinsonism & Related Disorders*, *86*, 15-18.

Ring, C., & Brener, J. (2018). Heartbeat counting is unrelated to heartbeat detection: A comparison of methods to quantify interoception. *Psychophysiology*, *55*(9), e13084.

Ring, C., Brener, J., Knapp, K., & Mailloux, J. (2015). Effects of heartbeat feedback on beliefs about heart rate and heartbeat counting: A cautionary tale about interoceptive awareness. *Biological psychology*, *104*, 193-198.

Robinson, E., Foote, G., Smith, J., Higgs, S., & Jones, A. (2021). Interoception and obesity: a systematic review and meta-analysis of the relationship between interoception and BMI. *International Journal of Obesity*, *45*(12), 2515. https://doi.org/10.1038/s41366-021-00950-y

Rocca, E., & Anjum, R. L. (2020). Complexity, Reductionism and the Biomedical Model. In R. L. Anjum, S. Copeland, & E. Rocca (Eds.), *Rethinking Causality, Complexity and Evidence for the Unique Patient: A CauseHealth Resource for Healthcare Professionals and the Clinical Encounter* (pp. 75-94). Springer International Publishing. https://doi.org/10.1007/978-3-030-41239-5_5

Roseman, I. J., & Smith, C. A. (2001). Appraisal theory. In K. R. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 3-19). Oxford University Press.

Russell, J. A. (1991). Culture and the categorization of emotions. *Psychological Bulletin*, *110*(3), 426-450. https://doi.org/10.1037/0033-2909.110.3.426

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological review*, *110*(1), 145.

Russell, J. A., & Barrett, L. F. (1999). Core Affect, Prototypical Emotional Episodes, and Other Things Called Emotion: Dissecting the Elephant. *76*(5), 805-819.

Ryder, A. G., Sunohara, M., Dere, J., & Chentsova-Dutton, Y. E. (2018). The cultural shaping of alexithymia. In *Alexithymia: Advances in research, theory, and clinical practice.* (pp. 33-48). Cambridge University Press. https://doi.org/10.1017/9781108241595.005

Sage, M. D., & Almeida, Q. J. (2009). Symptom and gait changes after sensory attention focused exercise vs aerobic training in Parkinson's disease. In *Movement disorders : official journal of the Movement Disorder Society* (Vol. 24, pp. 1132-1138). United States: Wiley-Liss.

Saxena, A., Godena, E., Maggio, J., & Perez, D. L. (2020). Towards an Outpatient Model of Care for Motor Functional Neurological Disorders: A Neuropsychiatric Perspective. In *Neuropsychiatric Disease and Treatment* (Vol. ume 16, pp. 2119-2134): Dove Medical Press.

Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. In *Psychological Review* (Vol. 69, pp. 379-399).

Schandry, R. (1981). Heart Beat Perception and Emotional Experience. *Psychophysiology*, *18*(4), 483-488.

Schenk, H. M., Jeronimus, B. F., Van Der Krieke, L., Bos, E. H., De Jonge, P., & Rosmalen, J. G. M. (2018). Associations of Positive Affect and Negative Affect with Allostatic Load: A Lifelines Cohort Study. *Psychosomatic Medicine*, *80*(2), 160-166. https://doi.org/10.1097/PSY.0000000000000546

Scherer, K. R. (1984). Emotion as a multicomponent process: A model and some cross-cultural data. *Review of Personality & Social Psychology*, *5*, 37-63.
Schimmenti, A., & Caretti, V. (2018). Attachment, trauma, and alexithymia. In *Alexithymia: Advances in research, theory, and clinical practice.* (pp. 127-141). Cambridge University Press. https://doi.org/10.1017/9781108241595.010
Schinka, J. A., Velicer, W. F., & Weiner, I. B. (2013). *Handbook of psychology: Research methods in psychology, Vol. 2*. John Wiley & Sons, Inc.
Schmitt, C. M., & Schoen, S. (2022). Interoception: a multi-sensory foundation of participation in daily life. *Frontiers in Neuroscience*, *16*. https://doi.org/10.3389/fnins.2022.875200
Schmitt, M. C., Vogelsmeier, L. V. D. E., Erbas, Y., Stuber, S., & Lischetzke, T. (2024). Exploring Within-Person Variability in Qualitative Negative and Positive Emotional Granularity by Means of Latent Markov Factor Analysis. *Multivariate Behavioral Research*, 1-20. https://doi.org/10.1080/00273171.2024.2328381
Schmitz, N., Napieralski, J., Schroeder, D., Loeser, J., Gerlach, A. L., & Pohl, A. (2021). Interoceptive sensibility, alexithymia, and emotion regulation in individuals suffering from fibromyalgia. *Psychopathology*, *54*(3), 144-149.
Schuette, S. A., Zucker, N. L., & Smoski, M. J. (2021). Do interoceptive accuracy and interoceptive sensibility predict emotion regulation? *Psychological Research*, *85*(5), 1894-1908. https://doi.org/10.1007/s00426-020-01369-2
Schulkin, J., & Sterling, P. (2019). Allostasis: a brain-centered, predictive mode of physiological regulation. *Trends in neurosciences*, *42*(10), 740-752.
Sekely, A., Bagby, R. M., & Porcelli, P. (2018). Assessment of the alexithymia construct. In *Alexithymia: Advances in research, theory, and clinical practice.* (pp. 17-32). Cambridge University Press. https://doi.org/10.1017/9781108241595.004
Sercu, C., & Bracke, P. (2017). Stigma, Social Structure, and the Biomedical Framework: Exploring the Stigma Experiences of Inpatient Service Users in Two Belgian Psychiatric Hospitals. *Qualitative Health Research*, *27*(8), 1249-1261. https://doi.org/10.1177/1049732316648112
Seth, A. K. (2013). Interoceptive inference, emotion, and the embodied self. *Trends in cognitive sciences*, *17*(11), 565-573.
Seth, A. K., & Friston, K. J. (2016). Active interoceptive inference and the emotional brain. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1708), 20160007.
Seth, A. K., Suzuki, K., & Critchley, H. D. (2012). An interoceptive predictive coding model of conscious presence. *Frontiers in psychology*, *2*, 18458.
Shaffer, C., Westlin, C., Quigley, K. S., Whitfield-Gabrieli, S., & Barrett, L. F. (2022). Allostasis, action, and affect in depression: Insights from the theory of constructed emotion. *Annual review of clinical psychology*, *18*, 553-580.
Shah, P., Catmur, C., & Bird, G. (2016). Emotional decision-making in autism spectrum disorder: the roles of interoception and alexithymia. *Molecular Autism*, *7*, 1-10. https://doi.org/10.1186/s13229-016-0104-x
Shah, P., Hall, R., Catmur, C., & Bird, G. (2016). Alexithymia, not autism, is associated with impaired interoception. *Cortex*, *81*, 215-220. https://doi.org/10.1016/j.cortex.2016.03.021
Sharp, H., Themelis, K., Amato, M., Barritt, A., Davies, K., Harrison, N.,…Eccles, J. (2021). The role of interoception in the mechanism of pain and fatigue in fibromyalgia and myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS). In *European Psychiatry* (Vol. 64, pp. S139-S139): Cambridge University Press.

Sherrington, C. S. (1906). *The integrative action of the nervous system* [doi:10.1037/13798-000]. Yale University Press. https://doi.org/10.1037/13798-000

Shields, S. A., Mallory, M. E., & Simon, A. (1989). The body awareness questionnaire: reliability and validity. *Journal of personality Assessment*, *53*(4), 802-815.

Sidik, K., & Jonkman, J. N. (2006). Robust variance estimation for random effects meta-analysis. *Computational Statistics and Data Analysis*, *50*(12), 3681-3701. https://doi.org/10.1016/j.csda.2005.07.019

Siegel, E. H., Sands, M. K., Van den Noortgate, W., Condon, P., Chang, Y., Dy, J.,…Barrett, L. F. (2018). Emotion fingerprints or emotion populations? A meta-analytic investigation of autonomic features of emotion categories. *Psychological Bulletin*, *144*(4), 343-393. https://doi.org/10.1037/bul0000128

Sifneos, P. E. (1973). The prevalence of "alexithymic" characteristics in psychosomatic patients. *Psychotherapy and Psychosomatics*, *22*(2-6), 255–262. https://doi.org/https://doi.org/10.1159/000286529

Sirri, L., & Fava, G. A. (2013). Diagnostic criteria for psychosomatic research and somatic symptom disorders. In *International review of psychiatry (Abingdon, England)* (Vol. 25, pp. 19-30). England: Informa Healthcare.

Smakowski, A., Hüsing, P., Völcker, S., Löwe, B., Rosmalen, J. G. M., Shedden-Mora, M., & Toussaint, A. (2024). Psychological risk factors of somatic symptom disorder: A systematic review and meta-analysis of cross-sectional and longitudinal studies. *Journal of Psychosomatic Research*. https://doi.org/10.1016/j.jpsychores.2024.111608

Smidt, K. E., & Suvak, M. K. (2015). A brief, but nuanced, review of emotional granularity and emotion differentiation research. *Current Opinion in Psychology*, *3*, 48-51. https://doi.org/10.1016/j.copsyc.2015.02.007

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, *48*(4), 813-838. https://doi.org/10.1037/0022-3514.48.4.813

Smith, R., Feinstein, J. S., Kuplicki, R., Forthman, K. L., Stewart, J. L., Paulus, M. P.,…Khalsa, S. S. (2021). Perceptual insensitivity to the modulation of interoceptive signals in depression, anxiety, and substance use disorders. *Scientific Reports*, *11*(1). https://doi.org/10.1038/s41598-021-81307-3

Smith, R., Thayer, J. F., Khalsa, S. S., & Lane, R. D. (2017). The hierarchical basis of neurovisceral integration. *Neuroscience and Biobehavioral Reviews*, *75*, 274-296. https://doi.org/10.1016/j.neubiorev.2017.02.003

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333-339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sojka, P., Diez, I., Bareš, M., & Perez, D. L. (2020). Individual differences in interoceptive accuracy and prediction error in motor functional neurological disorders: A DTI study. *Human Brain Mapping*, *42*(5), 1434. https://doi.org/10.1002/hbm.25304

Sojka, P., Diez, I., Bareš, M., & Perez, D. L. (2021). Individual differences in interoceptive accuracy and prediction error in motor functional neurological disorders: A DTI study. *Human Brain Mapping*, *42*, 1434-1445.

Spector, P. E. (2019). Do Not Cross Me : Optimizing the Use of Cross-Sectional Designs. *Journal of Business and Psychology*, *34*(2), 125-137.

Spurk, D., Hirschi, A., Wang, M., Valero, D., & Kauffeld, S. (2020). Latent profile analysis: A review and “how to” guide of its application within vocational behavior research. *Journal of Vocational Behavior*, *120*. https://doi.org/10.1016/j.jvb.2020.103445

Spurrier, G., F., Shulman, K., Dibich, S., Benoit, L., Duckworth, K., & Martin, A. (2023). Physical symptoms as psychiatric manifestations in medical spaces: A qualitative study. In *Frontiers in Psychiatry* (Vol. 13): Frontiers Media S.A.

Staud, R., & Rodriguez, M. E. (2006). Mechanisms of Disease: pain in fibromyalgia syndrome. *2*(2), 90-98.

Sterling, P. (2012). Allostasis: a model of predictive regulation. *Physiology & behavior*, *106*(1), 5-15.

Sterling, P., & Eyer, J. (1988). Allostasis: A new paradigm to explain arousal pathology. In *Handbook of life stress, cognition and health.* (pp. 629-649). John Wiley & Sons.

Strigo, I. A., & Craig, A. D. (2016). Interoception, homeostatic emotions and sympathovagal balance. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1708), 20160010.

Suksasilp, C., & Garfinkel, S. N. (2022). Towards a comprehensive assessment of interoception in a multi-dimensional framework. *Biological Psychology*, *168*, 108262.

Sun, T., Yap, Y., Tung, Y. C., Bei, B., & Wiley, J. F. (2023). Coping strategies predict daily emotional reactivity to stress: An ecological momentary assessment study. *Journal of Affective Disorders*, *332*, 309-317. https://doi.org/10.1016/j.jad.2023.03.090

Svaldi, J., Griepenstroh, J., Tuschen-Caffier, B., & Ehring, T. (2012). Emotion regulation deficits in eating disorders: A marker of eating pathology or general psychopathology? *Psychiatry Research*, *197*(1-2), 103-111. https://doi.org/10.1016/j.psychres.2011.11.009

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6 ed., Vol. 6). Pearson.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2013). *Using multivariate statistics* (Vol. 6). pearson Boston, MA.

Tan, T. Y., Wachsmuth, L., & Tugade, M. M. (2022). Emotional Nuance: Examining Positive Emotional Granularity and Well-Being. In *Frontiers in psychology* (Vol. 13, pp. 715966). Switzerland: Frontiers Research Foundation.

Tan, Y., Wang, X., Blain, S. D., Jia, L., & Qiu, J. (2023). Interoceptive attention facilitates emotion regulation strategy use. *International Journal of Clinical and Health Psychology*, *23*(1), 100336. https://doi.org/https://doi.org/10.1016/j.ijchp.2022.100336

Taris, T. W., Kessler, S. R., & Kelloway, E. K. (2021). Strategies addressing the limitations of cross-sectional designs in occupational health psychology: What they are good for (and what not). *Work and Stress*, *35*(1), 1-5.

Taylor, A. G., Goehler, L. E., Galper, D. I., Innes, K. E., & Bourguignon, C. (2010). Top-Down and Bottom-Up Mechanisms in Mind-Body Medicine: Development of an Integrative Framework for Psychophysiological Research. *Explore: The Journal of Science and Healing*, *6*(1), 29-41. https://doi.org/10.1016/j.explore.2009.10.004

Taylor, G. J., Bagby, R. M., & Parker, J. D. A. (1991). The alexithymia construct: a potential paradigm for psychosomatic medicine. *Psychosomatics*, *32*(2), 153-164.

Taylor, G. J., Bagby, R. M., & Parker, J. D. A. (1997). *Disorders of affect regulation: Alexithymia in medical and psychiatric illness* [doi:10.1017/CBO9780511526831]. Cambridge University Press. https://doi.org/10.1017/CBO9780511526831

Taylor, G. J., Bagby, R. M., & Parker, J. D. A. (1999). *Disorders of affect regulation: Alexithymia in medical and psychiatric illness*. Cambridge University Press.

Taylor, G. J., Ryan, D., & Bagby, M. (1985). Toward the development of a new self-report alexithymia scale. *Psychotherapy and psychosomatics*, *44*(4), 191-199.

Thomas, D., Zairina, E., George, J., Stewart, D. C., & Babar, Z.-U.-D. (2023). Methodological Approaches to Literature Review. In *Encyclopedia of Evidence in*

Pharmaceutical Public Health and Health Services Research in Pharmacy (pp. 948-962). Cham: Springer International Publishing.

Todd, J., Barron, D., Aspell, J. E., Toh, E. K. L., Zahari, H. S., Khatib, N. A. M., & Swami, V. (2020). Translation and validation of a Bahasa Malaysia (Malay) version of the Multidimensional Assessment of Interoceptive Awareness (MAIA). *PLoS ONE*, *15*(4), 1-19. https://doi.org/10.1371/journal.pone.0231048

Todd, J., Swami, V., Aspell, J. E., Furnham, A., Horne, G., & Stieger, S. (2022). Are some interoceptive sensibility components more central than others? Using item pool visualisation to understand the psychometric representation of interoception. *Plos one*, *17*(12), e0277894.

Tomkins, S. (1962). *Affect imagery consciousness: Volume I: The positive affects*. Springer publishing company.

Tomkins, S. (1963). *Affect imagery consciousness: Volume II: The negative affects*. Springer publishing company.

Trevisan, D. A., Altschuler, M. R., Bagdasarov, A., Carlos, C., Duan, S., Hamo, E.,…McPartland, J. C. (2019). A meta-analysis on the relationship between interoceptive awareness and alexithymia: Distinguishing interoceptive accuracy and sensibility. *J Abnorm Psychol*, *128*(8), 765-776. https://doi.org/10.1037/abn0000454

Trevisan, D. A., Mehling, W. E., & McPartland, J. C. (2021). Adaptive and Maladaptive Bodily Awareness: Distinguishing Interoceptive Sensibility and Interoceptive Attention from Anxiety-Induced Somatization in Autism and Alexithymia. *Autism Res*, *14*(2), 240-247. https://doi.org/10.1002/aur.2458

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D.,…Straus, S. E. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. In *Annals of internal medicine* (Vol. 169, pp. 467-473). United States: American College of Physicians--American Society of Internal Medicine.

Tugade, M. M., Fredrickson, B. L., & Barrett, L. F. (2004). Psychological resilience and positive emotional granularity: Examining the benefits of positive emotions on coping and health. *Journal of Personality*, *72*(6), 1161-1190. https://doi.org/10.1111/j.1467-6494.2004.00294.x

Tuttle, M. C., Kim, B. K., Vanwort-Meng, L., Verma, D., Stern, T. A., Yeung, A. S.,…Sakmar, K. A. (2024). The Evaluation and Treatment of Somatic Symptom Disorder in Primary Care Practices. *Primary Care Companion for CNS Disorders*, *26*(1). https://doi.org/10.4088/PCC.23f03549

Tünte, M., R., Petzke T, M., Brand, S., Murphy, J., Witthöft, M., Hoehl, S.,…Ventura-Bort, C. (2024). Differential Effects of Self-Reported Interoceptive Attention and Accuracy on Subclinical Psychopathology. *Journal of Personality Assessment*. https://doi.org/https://doi.org/10.31234/osf.io/6h9p3

Uddin, L. Q. (2021). Cognitive and behavioural flexibility: neural mechanisms and clinical considerations. *Nature Reviews Neuroscience*, *22*(3), 167-179. https://doi.org/10.1038/s41583-021-00428-w

Uddin, L. Q., Nomi, J. S., Hébert-Seropian, B., Ghaziri, J., & Boucher, O. (2017). Structure and function of the human insula. *Journal of Clinical Neurophysiology*, *34*(4), 300-306.

Van den Bergh, O., Witthöft, M., Petersen, S., & Brown, R. J. (2017). Symptoms and the body: taking the inferential leap. *Neuroscience & Biobehavioral Reviews*, *74*, 185-203.

Van den Bergh, O., Zacharioudakis, N., & Petersen, S. (2018). Interoception, categorization, and symptom perception. *The interoceptive mind: From homeostasis to awareness*, *212*.

van der Velde, J., Servaas, M. N., Goerlich, K. S., Bruggeman, R., Horton, P., Costafreda, S. G., & Aleman, A. (2013). Neural correlates of alexithymia: A meta-analysis of emotion processing studies. *Neuroscience and Biobehavioral Reviews*, *37*(8), 1774-1785. https://doi.org/10.1016/j.neubiorev.2013.07.008

Vanderlind, W. M., Millgram, Y., Baskin-Sommers, A. R., Clark, M. S., & Joormann, J. (2020). Understanding positive emotion deficits in depression: From emotion preferences to emotion regulation. *Clinical Psychology Review*, *76*. https://doi.org/10.1016/j.cpr.2020.101826

Ventura-Bort, C., Wendt, J., & Weymar, M. (2021). The role of interoceptive sensibility and emotional conceptualization for the experience of emotions. *Frontiers in psychology*, *12*, 712418.

Vig, L., Köteles, F., & Ferentzi, E. (2022). Questionnaires of interoception do not assess the same construct. *Plos one*, *17*(8), e0273299.

Vlemincx, E., Walentynowicz, M., Zamariola, G., Van Oudenhove, L., & Luminet, O. (2021). A novel self-report scale of interoception: the three-domain interoceptive sensations questionnaire (THISQ). *Psychology & Health*, 1-20.

Vogt, B. A. (2005). Pain and emotion interactions in subregions of the cingulate gyrus. *Nature Reviews Neuroscience*, *6*(7), 533-544. https://doi.org/10.1038/nrn1704

Wade, D. T., & Halligan, P. W. (2017). The biopsychosocial model of illness: A model whose time has come. *Clinical Rehabilitation*, *31*(8), 995-1004. https://doi.org/10.1177/0269215517709890

Walker, I., & Read, J. (2002). The Differential Effectiveness of Psychosocial and Biogenetic Causal Explanations in Reducing Negative Attitudes toward 'Mental Illness'. *65*(4), 313-325.

Wang, X., & Cheng, Z. (2020). Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. *Chest*, *158*(1), S65-S71. https://doi.org/10.1016/j.chest.2020.03.012

Wang, X., Wu, Q., Egan, L., Gu, X., Liu, P., Gu, G.,…Fan, J. (2019). Anterior insular cortex plays a critical role in interoceptive attention. In *eLife* (Vol. 8): eLife Sciences Publications Ltd.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063-1070. https://doi.org/10.1037/0022-3514.54.6.1063

Westwood, H., Kerr-Gaffney, J., Stahl, D., & Tchanturia, K. (2017). Alexithymia in eating disorders: Systematic review and meta-analyses of studies using the Toronto Alexithymia Scale. *Journal of Psychosomatic Research*, *99*, 66-81. https://doi.org/10.1016/j.jpsychores.2017.06.007

Whitehead, W. E., Drescher, V. M., Heiman, P., & Blackwell, B. (1977). Relation of heart rate control to heartbeat perception. *Biofeedback and Self-regulation*, *2*, 371-392.

Willroth, E., Flett, J., & Mauss, I. (2020). Depressive symptoms and deficits in stress-reactive negative, positive, and within-emotion-category differentiation: A daily diary study. In *Journal of Personality* (Vol. 88): eScholarship, University of California.

Wilson, M. (2002). Six views of embodied cognition. *Psychonomic bulletin & review*, *9*, 625-636.

Wilson-Mendenhall, C. D., Barrett, L. F., & Barsalou, L. W. (2013). Neural Evidence That Human Emotions Share Core Affective Properties. *Psychological Science*, *24*(6), 947-956. https://doi.org/10.1177/0956797612464242

Wilson-Mendenhall, C. D., Barrett, L. F., Simmons, W. K., & Barsalou, L. W. (2011). Grounding emotion in situated conceptualization. *Neuropsychologia*, *49*(5), 1105-1127. https://doi.org/https://doi.org/10.1016/j.neuropsychologia.2010.12.032

Wilson-Mendenhall, C. D., & Dunne, J. D. (2021). Cultivating Emotional Granularity. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.703658

Wolgast, M., Lundh, L.-G., & Viborg, G. (2011). Cognitive reappraisal and acceptance: An experimental comparison of two emotion regulation strategies. *Behaviour Research and Therapy*, *49*(12), 858-866. https://doi.org/10.1016/j.brat.2011.09.011

Woods, S. C., & Ramsay, D. S. (2014). Clarifying the roles of homeostasis and allostasis in physiological regulation. *Psychological Review*, *121*(2), 225.

Worthington, R. L., & Whittaker, T. A. (2006). Scale Development Research: A Content Analysis and Recommendations for Best Practices. *Counseling Psychologist*, *34*(6), 806-838.

Yik, M. S. M., Russell, J. A., & Barrett, L. F. (1999). Structure of self-reported current affect: Integration and beyond. *Journal of personality and social psychology*, *77*(3), 600.

Yun-Hsin, H., Yu-Ting, H., & Nai-Shing, Y. (2023). Interoceptive sensibility differentiates the predictive pattern of emotional reactivity on depression. *Frontiers in Psychology*, *14*, 1-9. https://doi.org/10.3389/fpsyg.2023.1011584

Zamariola, G., Maurage, P., Luminet, O., & Corneille, O. (2018). Interoceptive accuracy scores from the heartbeat counting task are problematic: Evidence from simple bivariate correlations. *Biological psychology*, *137*, 12-17.

Zimprich, D., Nusser, L., & Pollatos, O. (2020). Are interoceptive accuracy scores from the heartbeat counting task problematic? A comment on Zamariola et al.(2018). *Biological Psychology*, *152*, 107868.

Appendices

Appendix A. Reduction of Item Pool Pre-Expert Review

Item	Status	Reason for Removal
Interoceptive Identification		
If someone asked me whether I was thirsty, it would be hard for me to respond. (R)	Removed	Captured by ICQ and ISQ
When my muscles are sore or tight, I can identify the precise location of soreness or tightness.	Removed	Captured by ICQ and ISQ
I can clearly discriminate between distinct bodily states, such as when I am hot versus when I am hungry.	Removed	Captured by ISQ
When I feel sick, I can easily identify and describe the symptoms I am experiencing and where these are occurring in my body.	Removed	Captured by ICQ and ISQ
I notice some sensations better than others (e.g., it is easy for me to detect if I am hungry, but not so easy if I am cold). (R)	Removed	Captured by ICQ and ISQ
I easily notice changes in my energy level throughout the day.	Removed	Captured by BAQ
I notice when my energy level is high or low, based on changes in my body (e.g., absence of headache, presence of fatigue).	Removed	Captured by BAQ
I often get to a point where I feel like I might 'die of thirst' or 'starve to death'. (R)	Removed	Captured by ICQ and ISQ
I rely on the feedback of others to become aware of changes in my body state (e.g., when I am fatigued or when I am cold) (R)	Removed	Captured by ICQ and ISQ
At any moment, I can direct my attention toward how a specific part of my body feels.	Retained	
It is easy for me to focus on specific internal sensations if they are suddenly experienced.	Retained	
It is easy for me to focus on specific internal sensations if I purposefully think about them.	Retained	
If I have not focussed on my body for awhile, it is hard for me to think about it again. (R)	Retained	
I typically push my bodily sensations to run in the background when I am busy.	Retained	
I get used to the way that uncomfortable bodily sensations make me feel, often to the point that I forget they are there.	Removed	Captured by ND MAIA scale
I often forget about how changes in my bodily sensations make me feel when they occur. (R)	Removed	Captured by ND MAIA scale
I often ignore how changes in my bodily sensations make me feel when they occur. (R)	Removed	Captured by ND MAIA scale
Emotional Awareness		

I am very conscious of the slightest change in my breathing when I am experiencing a positive emotion (e.g., happiness, joy, surprise, excitement)	Removed	Captured by MAIA EA scale
I am very conscious of the slightest change in my breathing when I am experiencing a negative emotion (e.g., anger, fear, jealousy, sadness, nervousness)	Removed	Captured by MAIA EA scale
I am very conscious of the slightest change in my heartrate when I am experiencing a positive emotion (e.g., happiness, joy, surprise, excitement)	Removed	Captured by MAIA EA scale
I am very conscious of the slightest change in my heartrate when I am experiencing a negative emotion (e.g., anger, fear, jealousy, sadness, nervousness)	Removed	Captured by MAIA EA scale
I don't really care about how bodily sensations make me feel (R)	Retained	
I believe that experiencing an increased heartrate could be due to a range of positive and negative experiences	Removed	Captured by BL MAIA scale
When I sense changes in my body, such as butterflies in my stomach, I am generally not confused about the type of emotion that I might be experiencing (e.g., excitement, nervousness, intrigued)	Removed	Captured by TAS
When I sense changes in my body, such as my heartrate increasing, I am often confused by the type of emotion I might be experiencing (e.g., surprise, excitement, nervousness) (R)	Removed	Captured by TAS
I don't generally experience emotions alongside bodily changes (R)	Retained	
I don't generally experience bodily changes alongside emotions (R)	Retained	
When something positive happens to me, I find it difficult to identify the changes happening in my body (R)	Removed	Captured by MAIA EA scale
When something negative happens to me, I find it difficult to identify the changes happening in my body (R)	Removed	Captured by MAIA EA scale
If I am feeling sensations like overly fatigued or uncomfortably cold, it is hard for me to put into words how I feel (R)	Removed	Captured by ISQ
I tend to focus on things happening in my physical environment rather than what is happening inside of me (R)	Retained	
When I'm feeling good, I can easily identify what bodily and emotional factors contribute to this state.	Removed	Captured by TAS and PAQ
When I'm feeling bad, I can easily identify what bodily and emotional factors contribute to this state.	Removed	Captured by TAS and PAQ
When I'm feeling good, I can easily talk about what bodily and emotional factors contribute to this state.	Removed	Captured by TAS and PAQ
When I'm feeling bad, I can easily talk about what bodily and emotional factors contribute to this state.	Removed	Captured by TAS and PAQ
If I were asked to, I'd find it hard to describe changes in my body associated with positive or negative emotions	Retained	

If I’m very thirsty, I don’t experience any change in how I feel after consuming a drink (R)	Removed	Captured by ISQ
After eating a main meal, I typically experience both a sense of fullness and change in how I’m feeling.	Retained	
I find it hard to identify changes in my body associated with positive or negative emotions.	Retained	Captured by TAS
Beliefs and Behaviours		
I consider myself in touch with my body and mind.	Retained	
Feeling physically well is something I that prioritise in life	Retained	
Feeling mentally well is something I that prioritise in life	Retained	
I value being well balanced in my body and mind.	Retained	
I think it is bizarre that people are able to think about how bodily sensations make them feel and behave (R)	Removed	Captured by ISQ
Where possible, I always attend to what my body is telling me	Retained	
When I am feeling on edge, I often stop and ask myself questions like, “Did I have enough sleep last night?”	Removed	Captured by BAQ
Feeling well-balanced is important to me	Retained	
I am often proactive in addressing the needs of my body.	Retained	
For the most part, I only drink something when it is directly in front of me. (R)	Retained	
I listen to my body to decide when to stop eating or drinking after being very hungry or thirsty.	Retained	
After exercising, I don’t feel the need to be concerned about bodily responses, such as an elevated heartrate or shortness of breath.	Removed	Captured by NW MAIA scale
During most instances, it is easy for me to adapt to several uncomfortable bodily sensations if they co-occur (e.g., feeling hot, fatigue, and shortness of breath).	Removed	Captured by SSAS
I often think about how changes in my bodily sensations make me feel when they occur.	Removed	Captured by SSAS
I often worry about how changes in my bodily sensations make me feel when they occur. (R)	Removed	Captured by NW MAIA scale and SSAS
I am overwhelmed by subtle changes in my regular bodily sensations (R)	Removed	Captured by NW MAIA scale and SSAS
I am overwhelmed by moderate changes in my regular bodily sensations (R)	Removed	Captured by NW MAIA scale and SSAS
I am bothered by subtle changes in my regular bodily sensations (R)	Removed	Captured by NW MAIA scale and SSAS
I am bothered by moderate changes in my regular bodily sensations (R)	Removed	Captured by NW MAIA scale and SSAS
I can distinctly tell when I am tired due to lack of sleep and tired due to feeling hot.	Removed	Captured by BAQ

I feel disconnected from my body (R)	Retained

Appendix B. Items Pre- and Post-Expert Review

Item Before Expert Review	Item Following Expert Review
Interoceptive Attention	
At any moment, I can direct my attention toward how a specific part of my body feels.	I can direct my focus toward how specific parts of my body feel.
It is easy for me to focus on specific internal sensations if they are suddenly experienced.	It is easy for me to focus on specific internal sensations if they are suddenly experienced.
It is easy for me to focus on specific internal sensations if I purposefully think about them.	It is easy for me to focus on specific internal sensations if I purposefully think about them.
If I have not focussed on my body for awhile, it is hard for me to think about it again. (R)	If I have not thought about my bodily sensations for some time, it is challenging for me to become aware of them again.
I typically push my bodily sensations to run in the background when I am busy.	I often push my bodily sensations to run in the background when I am busy.
Emotional Competency	
I don't really care about how bodily sensations make me feel (R)	I'm not really concerned about how bodily sensations make me feel.
I don't generally experience emotions alongside bodily changes (R)	I don't generally experience emotions alongside bodily changes (e.g., changes in heartrate or breathing, sweating).
I don't generally experience bodily changes alongside emotions (R)	I generally experience bodily changes alongside emotions.
I tend to focus on things happening in my physical environment rather than what is happening inside of me (R)	I tend to focus on things happening in my physical environment rather than what is happening inside of me (R)

If I were asked to, I'd find it hard to describe changes in my body associated with positive or negative emotions	If I were asked to, I'd find it hard to describe changes in my body associated with positive or negative emotions
After eating a main meal, I typically experience both a sense of fullness and change in how I'm feeling.	After eating a main meal, I typically experience both a sense of fullness and change in my emotions.
I find it hard to identify changes in my body associated with positive or negative emotions. *	I find it hard to identify changes in my body associated with positive or negative emotions. *
Beliefs and Behaviours	
I consider myself in touch with my body and mind.	I consider myself in touch with my body and mind.
Feeling physically well is something I that prioritise in life	Feeling physically well is something I that prioritise in life
Feeling mentally well is something I that prioritise in life	Feeling mentally well is something I that prioritise in life
I eat at mealtimes, regardless of whether I'm hungry.	I eat at mealtimes, regardless of whether I'm hungry.
Where possible, I always attend to what my body is telling me	Where possible, I always attend to what my body is telling me
Feeling well-balanced is important to me	I value being well-balanced in my body and my mind.
I am often proactive in addressing the needs of my body.	I am usually proactive in addressing the needs of my body.
For the most part, I only drink something when it is directly in front of me. (R)	I often forget to drink unless there is a drink readily at hand.
I listen to my body to decide when to stop eating or drinking after being very hungry or thirsty.	I listen to my body to decide when to stop eating or drinking after being very hungry or thirsty.
I feel disconnected from my body (R)	I feel disconnected from my body (R)

Appendix C. Analysis of BMCQ Items in Pre-Testing Phase (*n*=25)

Item	*M*	*SD*	Skewness	Kurtosis
I consider myself in touch with my body and mind.	5.16	1.31	-0.56	0.15
I can direct my focus toward how specific parts of my body feel.	4.88	1.56	-0.92	0.61
It is easy for me to focus on specific sensations if they are suddenly experienced.	4.84	1.60	-0.71	-0.08
It is easy for me to focus on specific sensations if I purposefully think about them.	4.24	1.79	-0.54	-1.23
I often push my bodily sensations to run in the background when I am busy. *	3.16	1.28	0.32	-1.26
If I have not thought about my bodily sensations for some time, it is challenging for me to become aware of them again. *	4.44	1.56	-0.38	-1.42
Where possible, I always attend to what my body is telling me.	3.92	1.53	-0.47	-0.86
I am usually proactive in addressing the needs of my body.	3.72	1.72	-0.11	-1.28
I don’t generally experience emotions alongside bodily changes (e.g., changes in heartrate or breathing, sweating). *	4.32	1.41	-0.72	-0.22
I generally experience bodily changes alongside emotions.	4.00	1.78	-0.24	-0.77
I’m not really concerned about how bodily sensations make me feel. *	4.28	1.59	-0.23	-0.56
I find it hard to identify changes in my body associated with positive or negative emotions. *	4.00	1.83	0.05	-1.01
If I were asked to, I’d find it hard to describe changes in my body associated with positive or negative emotions. *	3.24	1.56	1.06	-0.06
I tend to focus on things happening in my physical environment rather than what is happening inside of me. *	4.20	1.78	0.06	-1.08
I often forget to drink unless there is a drink readily at hand. *	4.12	1.88	0.14	-1.37
I eat at mealtimes, regardless of whether I’m hungry. *	3.56	1.89	0.18	-1.32
I listen to my body to decide when to stop eating or drinking after being very hungry or thirsty.	5.00	1.78	-0.77	-0.45
After eating a main meal, I typically experience both a sense of fullness and a change in my emotions.	4.40	1.54	-0.23	-0.29
I feel disconnected from my body. *	4.94	1.78	-0.80	-0.11
Feeling physically well is something that I prioritise in life.	4.85	1.44	-0.50	0.94
Feeling mentally well is something that I prioritise in life.	5.16	1.55	-0.48	-1.02
I value being well-balanced in my body and my mind.	5.16	1.40	-0.91	2.03

* Item reverse scored.

Appendix D. Application for Ethics

ResearchMaster

Ethics Application

Application ID :	HRE21-001
Application Title :	The Development and Validation of The Homeostatic Emotion Questionnaire
Date of Submission :	19/01/2021
Primary Investigator :	MRS EMRA SULEYMAN (Chief Investigator)
Other Personnel :	MS KRISTEN VAN BAEL (Student)
	DR JESSICA SCARFO (Associate Investigator)
	DR MICHELLE BALL (Associate Investigator)

Introduction

Important Information

Form Version: V.16-02. Last Updated: 6.7.2016.

IMPORTANT INFORMATION FOR ALL APPLICANTS:

- Applicants are advised to follow the guidelines provided on the **Human Research Ethics website** prior to submitting this application.
- Ensure all questions are appropriately answered in plain language with correct spelling and grammar.
- All applications must be sighted and approved by all members of the research team and any relevant parties. Applications will not be reviewed without appropriate authorisation.
- To avoid unnecessary delays, please ensure application is submitted in full by the submission deadline for the relevant HREC.

You are reminded that your project may not commence without formal written approval from the appropriate Human Research Ethics Committee.

Contact:

Ethics Secretary
For help and further information regarding ethical conduct, refer to the Human Research Ethics website: *http://research.vu.edu.au/hrec.php* or contact the Secretary for the Human Research Ethics Committee, Office for Research.
Phone: 9919 4781 or 9919 4461
Email: researchethics@vu.edu.au

Quest Service Desk
For technical help, please log a Service Request:

1. Go to the VU Support Hub
2. Scroll down and click "Research" tile
3. Click "Submit a new ticket"
4. Click "Quest Application";
5. Enter "Service" and "Details of Request"
6. Click "Review & Submit" button.

External Resources

- NHMRC: National Statement on Ethical Conduct in Human Research
- NHMRC: Australian Code for the Responsible Conduct of Research

Quest Guide

Quick Tips for Using Quest

Need Help? For help and instructions, we strongly recommend that you download the full Quest Online Ethics Guide (.pdf). Your questions may also be answered in the FAQ page on the Quest Website.

- **Answer All Questions**:
  Most questions are mandatory and must be completed before the application can be submitted. These questions are marked with a red asterisk (*)
- **Access Help and Tips**:
  The help icon, found next to questions and at the top of each page, will provide you with detailed advice on ethical content.
- **Remember to Save**:
  Use the floppy disk icon (and the green tick in some sections) regularly to avoid losing any answers. Each page will save automatically when you click *Next* or *Back*.
- **Print or Save a Copy of Your Application**:
  You can use the report icon at any stage to generate a printer friendly version of the form. Select HTML to print to screen. To save as a .pdf file to your computer select PDF then save a copy from the pop up screen. *(Don't forget to save a copy before you submit!)*
- **Submit Application**:
  When you have completed your application, click on the *Action* tab in the left-hand column and click *Submit Application*. The system will then convert the form to read-only and send it to the Ethics Secretary for review.
  You will receive an email confirmation at submission. Double check that your application has been submitted by viewing the application status in the *My Applications* page.

Responding to comments (if your application is returned)

There may be stages throughout the application process in which the Ethics Secretary will instruct you to amend your application form. These amendments will be communicated to you via 'Comments' within the eForm.

1. **Generate a List of All Comments**:
   Click the report icon, select *Comments Report* from the Document drop-down field and click *OK*. This list will show all comments created in your application and which page they are applicable to. Click *Cancel* to return to the application form.
2. **Revise your Answers**:
   Open the page which shows a Red Flag icon red flag; these denote an Action Comment which you are required to respond to. Revise the relevant question(s) in your application form as required. Remember to click save!
3. **Respond to Action Comments**:
   AFTER you have revised your answers, you must provide a response to each Action Comment explaining to the Committee how you have addressed their communication. Open the Page Comments window and click New Comment to enter your response into the textbox. Click the green tick to save your text.
4. **Mark Comments as Responded**:
   Once you have revised your answers AND finished responding to all comments, reopen Page Comments window, use the checkbox to select the *Action Comments* and click *Mark Selected Comments as Responded*. The colour of the flag will change to Yellow Flag icon yellow and the page will become Read Only.
   Important: *DO NOT mark the comments as 'Responded' until you are completely satisfied with your revised answers - you will lose access to edit the page and the comments.*
5. **Submit Revised Application**:
   Once you have addressed all of the Red Flags, open the *Action* tab and click *Submit Revised Application*. The system will then send the form to the Ethics Secretary for review. Remember to save a copy of your application by clicking the Report icon and generating a PDF or printer-friendly version.

[Office Use Only - Administration]

Application ID - *Assign HRE # using "Manage Applications"*

HRE21-001

Clearance Purpose

Research

For Review:

Assigned Ethics Committee

Low Risk Review Panel

Risk Level *(Enter 'High' or 'Low' or 'Neg')*

Low

Students involved in conduct of project? *(Enter 'Yes' or 'No')*

Yes

Date Accepted by Ethics Secretary

21/01/2021

For Finalisation:

Date Approved

21/04/2021

Approved Start Date for Project

21/04/2021

Approved End Date for Project

21/04/2023

Date Rejected

This question is not answered.

Date Withdrawn

This question is not answered.

Application Process Comments

This question is not answered.

[Office Use Only - Risk Assessment]

NEGLIGIBLE RISK INDICATORS
Applicant has responded YES to:

HIGH RISK INDICATORS
Applicant has responded YES to:

6.8. Does the research involve participants who are in dependent or unequal relationships with any member(s) of the research team or recruiting organisation/agency (e.g. counsellor/client, teacher/student, employer/employee)?

POSSIBLE HIGH RISK INDICATORS
Applicant has responded YES to:

3.2.e. Does the research involve participants in other countries?

6.7. Will any dual relationship or conflict of interest exist between any researcher and potential or actual participants? (e.g., a member of the research team is also a colleague or friend of potential participants)

LOW RISK INDICATOR
If no statements appear under the headings above, the applicant has not responded yes to any negligible or high risk indicators.

SECTION 1 - PROJECT OVERVIEW

General Details

1.1. **Ethics Category***

Human

1.2. **Project Title***

The Development and Validation of The Homeostatic Emotion Questionnaire

1.3. **Project Summary** (Include brief details of aims, methods and significance of the project in plain language. Maximum of 2000 characters)*

Renewed interest in the body has augmented explorations of its relation to cognition and behaviour, and it is now well substantiated the body is intimately connected to the mind and is affected by homeostatic processes (e.g., Damasio, 1994). Homeostasis is a dynamic biological process which maintains balance within specific ranges in the human body to facilitate survival and optimum function (Damasio & Carvalho, 2013). Regulatory mechanisms are automatically triggered to avoid error states occurring when deviations from narrow ranges occur. To act on imbalance, the error state - or the physiological condition of the body - must be sensed. This is termed 'interoception'. Upon sensing discomfort or change (e.g., feeling hot, hungry), we are often motivated to take actions that restore bodily balance: the experience of Homeostatic Emotion (HE, Craig, 2003).

Existing knowledge of HE is built upon existing measures of interoception, including heartbeat counting tasks and self-reports. However, these measures lack specific and sensitive consideration of individual differences inherent in the identification and emotional processing of homeostatic feelings (e.g., hunger, thirst, feeling too hot or cold); they focus on evaluating the ability to detect bodily sensations at the cost of evaluating the behavioural outcomes of the sensation. Consequently, no robust measure of HE exists.

Accordingly, this research aims to develop and then validate a new self-report measure: The Homeostatic Emotion Questionnaire (HEQ) to measure and confirm the proposed constituents of HE. These research phases will provide a robust tool to measure HE, as findings should yield distinct but related domains of HE. This would expand existing conceptualisations of this elusive construct, and facilitate more complete explanations of various behavioural outcomes. Moreover, findings should enable holistic approaches in therapy, with a focus on enhancing adaptive mind-body connections.

1.4. **Primary College or Institute for Application***

INSTITUTE FOR HEALTH & SPORT

Timeline and Funding

1.5. **Period for which ethical approval is sought.** *Please refer to the office-use only section at the top of your application to review your application approval dates.*
Project commencement date:*

- ◉ Immediately upon receiving ethical approval
- ○ Other date

1.6. **Date the data collection is expected to be completed:***

01/11/2021

1.7. **How will the research be funded?***

- ☐ External grant
- ☑ VU grant or funding
- ☐ Sponsor
- ☐ Other
- ☐ Unfunded

VU grant or funding source:*

Student researcher's PhD funding (Kristen Van Bael).

1.8. **Is the research a collaborative effort with another organisation?***

- ○ Yes
- ◉ No

SECTION 2 - PROJECT INVESTIGATORS

Investigators

2.1. **Please list all investigators associated with this project.**
The research team is the group of investigators accountable for the conduct of the project. Include details of the Primary Chief Investigator (primary contact for application), as well as all other Chief Investigators and Associate Investigators. *Student details will be requested separately.* Other staff (e.g. technicians) may perform tasks within the project although they are not necessarily investigators. They should be listed as "Other Staff" if appropriate.*

1	ID	E5104919
	Surname	SCARFO
	Given Name	JESSICA
	Full Name	DR JESSICA SCARFO
	College	COHB-CLINICAL SERVICES
	Email	Jessica.Burlak@vu.edu.au
	Role	Associate Investigator
	Phone	99195890
	Mobile	0411575176
	Qualifications	Dr Scarfo is an early career researcher who completed her own PhD in cognitive psychology and is preparing publications from her project. She is an active member of the Cognitive Psychology Assessment Research Team (CogPART).
2	ID	E5015232
	Surname	BALL
	Given Name	MICHELLE
	Full Name	DR MICHELLE BALL
	College	COHB-CLINICAL SERVICES
	Email	michelle.ball@vu.edu.au
	Role	Associate Investigator
	Phone	99192536
	Mobile	0402148919
	Qualifications	A/Prof Ball is an experienced supervisor and mentor of PhD students and is the leader of the Clinical and Community Health and Wellbeing Research Program in the Institute of Health and Sport. She has supervised several PhD projects in cognition to completion, and published in the field. She has trained in clinical neuropsychology.
3	ID	E5028664
	Surname	SULEYMAN
	Given Name	EMRA
	Full Name	MRS EMRA SULEYMAN
	College	COHB-CLINICAL SERVICES
	Email	Emra.Suleyman@vu.edu.au
	Role	Chief Investigator
	Primary CI	Yes
	Phone	99192397
	Mobile	0402140282
	Qualifications	Dr Suleyman is an experienced supervisor of PhD projects in cognition, having supervised several projects through to completion. She is a founding member of the leadership team of the Cognitive Psychology Assessment Research Team (CogPART). She is a registered psychologist with training in clinical neuropsychology.

Note: Please click the Question Help icon above for instructions on how to search for personnel and use this table.
Once an Investigator record has been added, click on the name in the table above to open the record and edit the information required.

If you are unable to find a personnel record in this system which must be added to your application, please create a "Quest Application" service request under Research section via VU Support Hub.

Student Investigators

2.2. **Will any students be involved in the conduct of this project?***

- (●) Yes
- ( ) No

2.2.a. **If YES, is the project:***

- (●) A STUDENT PROJECT for the degree in which the student is enrolled?
- ( ) A STAFF PROJECT that involves a student(s) undertaking some part of the project?
- ( ) Other

2.2.a.i. **If the research is a STUDENT PROJECT, at what level?***

PhD

* Has this project been approved by the Postgraduate Research Committee? (ie. during confirmation of candidature process)*

- (•) Yes
- ( ) No

2.2.b. **Please list all student investigators involved in this project.**
*Ensure the primary supervisor (not the student), has been marked as the Chief Investigator and primary contact for the application in Q.2.1.**

1	ID	S4538575
	Surname	VAN BAEL
	Given Name	KRISTEN
	Full Name	MS KRISTEN VAN BAEL
	College	INSTITUTE FOR SPORT HEALTH & ACTIVE LIVING
	Email	
	Role	Student
	Phone	0408583819
	Mobile	0408583819
	Qualifications	Kristen has attained a Bachelor of Psychological Studies (Honours) from Victoria University, studying knowledge related to cognition, emotion, and biopsychological processes. Through this degree, she also extensively studied quantitative research methods. She now teaches as a sessional in both psychology and quantitative research methods. Kristen has experience conducting cross-sectional research across these areas, inclusive of developing online surveys, subsequent data analysis, and result interpretation.

Note: Please click the Question Help icon above for instructions on how to search for personnel and use this table.
Once a student's record has been added, click on the name in the table above to open the record and edit the information required.

If you are unable to find a personnel record in this system which must be added to your application, please create a "Quest Application" service request under Research section via VU Support Hub.

2.2.c. **What arrangements are in place for the supervision of student(s) when undertaking project activities?***

Weekly/fortnightly 1 hour meetings between supervisors and the student investigator. The student's work is consistently reviewed by the supervisors, and guidance is provided to ensure that the project maintains feasibility.

Involvement of Other Individuals/Organisations

2.3. **Will any individuals who are not members of the research team be involved in the conduct of this project?** (e.g., medical personnel involved in procedures, research contractors, teachers) *

- ( ) Yes
- (•) No

SECTION 3 - NATURE OF THE PROJECT

Type of Project

3.1.a. **Is the project a pilot study?***

- (•) Yes
- ( ) No

3.1.b. **Is the project a part of a larger study?***

- (•) Yes
- ( ) No

3.1.c. **Is the project a quality assurance or evaluation project (e.g., related to teaching, health-care provision)?***

- ( ) Yes
- (•) No

3.1.d. **Does the research involve a clinical trial (of a substance, device, psychological or physical intervention)?***

- ( ) Yes
- (•) No

3.1.e. **Does the research involve the use of therapeutic/intervention techniques or procedures (non-clinical trial)?***

○ Yes
◉ No

Target Population

3.2.a. **Does the research focus on Australian Indigenous (Aboriginal and/or Torres Strait Islander) populations?***

○ Yes
◉ No

3.2.b. **Does the research involve participants under the age of 18 years?***

○ Yes
◉ No

3.2.c. **Does the research involve participants who are highly dependent on medical care?***

○ Yes
◉ No

3.2.d. **Does the research involve participants who have a cognitive impairment, intellectual disability or mental illness? ***

○ Yes
◉ No

3.2.e. **Does the research involve participants in other countries?***

◉ Yes
○ No

"Supplement F - Research participants in overseas countries" must be completed in Section 11 below.

3.2.f. **Does the research involve pregnant women (with a research focus on the pregnancy) and/or the foetus (in utero or ex utero) or foetal tissue?***

○ Yes
◉ No

3.2.g. **Does the research involve participants who are likely to be highly vulnerable due to any other reasons?***

○ Yes
◉ No

Intrusiveness of Project

3.3.a. **Does the research use physically intrusive techniques?***

○ Yes
◉ No

3.3.b. **Does the research cause discomfort in participants beyond normal levels of inconvenience?***

○ Yes
◉ No

3.3.c. **Does the research collect potentially sensitive data? (e.g., related to a sensitive topic or vulnerable group; personal health/medical information; sensitive organisational strategies)***

◉ Yes
○ No

3.3.d. **Does the research involve deception of participants?***

○ Yes
◉ No

3.3.e. **Does the research involve limited disclosure of information to participants?**

○ Yes
◉ No

3.3.f. **Does the research involve covert observation of participants?***

○ Yes
◉ No

3.3.g. **Does the research produce information that, if inadvertently made public, would be harmful to participants?***

○ Yes
◉ No

3.3.h. **Does the research involve accessing student academic records?***

○ Yes
◉ No

3.3.i. **Does the research involve human genetic or stem cell research?**

○ Yes
◉ No

3.3.j. **Does the research involve the use of ionising radiation?***

○ Yes
◉ No

3.3.k. **Does the research involve the collection of human tissue or fluids?***

○ Yes
◉ No

3.3.l. **Does the research involve any uploading, downloading or publishing on the internet?***

○ Yes
◉ No

3.3.m. **Does the research seek disclosure of information relating to illegal activities or is the research likely to lead to disclosure of information relating to illegal activities?***

○ Yes
◉ No

3.3.n. **Does the research involve procedures that may expose participants to civil, criminal or other legal proceedings?***

○ Yes
◉ No

3.3.o. **Does the research involve gaining access to medical/health related personal information from records of a Commonwealth or State department/agency or private health service provider?***

○ Yes
◉ No

3.3.p. **Does the research involve gaining access to personal information (not medical/health) from the records of a Commonwealth or State department/agency or private organisation?***

○ Yes
◉ No

SECTION 4 - PROJECT DESCRIPTION

General Information

Note: All fields have a maximum of 4000 characters (unless otherwise specified) in plain text only.
If supporting documentation needs to be provided for the following questions (images, graphs etc), please upload as referenced appendices in Section 11 - "Required Attachments" below.

4.1. **Aims of the project.** Provide a concise statement of the aims of the project (maximum 2000 characters in plain language).*

This research aims to develop and psychometrically validate a novel questionnaire which assesses Homeostatic Emotion (HE): The Homeostatic Emotion Questionnaire (HEQ), This study will execute 2 phases.

1. Development of the HEQ. First, identification of HE domains and HEQ item generation. Then, employment of an exploratory factor analysis (EFA). Specifically, it is expected that an EFA will yield distinct but associated factors contributing to the HE construct.

2. Validation of the HEQ. The HEQ will be administered alongside other psychometric self-report measures of theoretically associated constructs, so as to demonstrate convergent and discriminant validity. The factor structure identified in Phase 1 will be confirmed through factor analysis.

4.2. **Briefly describe the relevant background and rationale for the project in plain language.***

Homeostatic Emotion (HE) is a construct that characterises the nexus between body and mind, given that the detection of imbalance in the body involves a mental appraisal of how we feel in the moment, conscious emotional experiences, and behavioural expression. HEs can be regarded as "the background emotions that affect our energy level, our mood, and our disposition" (Mayer et al., 2006, p. 1296). This notion implies that emotions made conscious due to homeostatic factors may underpin a wealth of cognitive and behavioural outcomes. As interoception is strongly associated with emotions generated in response to homeostatic factors, it is reasonable to assume that interoceptive processing abilities can explain why some individuals exhibit poorer functioning within the environment (Paulus & Stein, 2010). For instance, low levels of interoceptive awareness are strongly predictive of lower levels of resilience (Haase et al., 2016), whereas interoceptive dysfunction has been increasingly associated with a multitude of psychiatric disorders (Khalsa et al., 2017). By contrast, higher levels of endorsed interoceptive awareness have been associated with better emotion identification and regulation, and adaptive coping strategies (Schuette et al., 2020), suggesting that adaptive attunement to one's body may act as a protective factor in adverse circumstances (Price & Hooven, 2018).

However, existing measures of interoception focus on the ability to detect bodily sensations as the cost of evaluating the behavioural outcomes of the sensation. Scrutiny of such measures has revealed that there is presently no validated or robust measure of HE. Consequently, HE remains under-explored and elusive. It is proposed that HE represents an important psychological construct which could explain how effectively one engages with their external and internal environments, and thus, an array of outcomes in everyday life. It is therefore important to determine which factors constitute HE and to substantiate how HE relates to and interacts with other psychological factors and behaviours. This research will enable a preliminary demonstration that the HEQ is a valid and reliable measure of HE. Further, it will facilitate identification of factors which could modulate cognitive and emotional experiences of and responses to objective bodily changes.

As HE colours our energy and arousal levels, moods, and dispositions at any given moment (Mayer et al., 2006), it would be immensely beneficial for clinicians to easily capture an individual's baseline HE, as measured by the HEQ. The ability to classify an individual's HE levels could provide better insights into identifying and restructuring maladaptive components. In turn, this will enable better self-regulation strategies and decision-making, each of which serve to facilitate important goal-directed behaviours. This could carry immense benefits in augmenting one's internal and external environmental equilibrium, thus contributing to more effective cognitive functioning, and physical and mental health and wellbeing.

Moreover, In clinical settings, there is presently no method to quantify the effects that HE has on cognitive performance. Instead, these are qualitatively described in interpretations of performance, based on the person's presentation and self-report. As HE colours our energy and arousal levels, moods, and dispositions at any given moment, it would be immensely beneficial for clinicians to easily capture an individual's baseline capacities in identifying, tolerating, and regulating them, as measured by the HEQ. Doing so could provide richer explanations of an individual's HE profile and its impact on their affective and cognitive responses during stressful situations.

4.3. **Methodology and procedures**
Include specific details relating to any measures, interventions, techniques, and/or equipment used in the research.
Provide step-by-step details of the procedures with particular reference to what participants will be asked to do.
Provide details separately for different phases or conditions of the research or, where appropriate, different participant groups.*

Convenience and snowball sampling will be used to recruit participants via flyers (see Appendix C) advertising the study, which will be posted on Victoria University campuses and VU Collaborate sites and the Student Researcher's social media accounts (e.g., Facebook, Twitter). Individuals who express interest in participating in either phase of the study will be provided with a link to the survey. Through the online survey, participants will have an opportunity to read through Information for Participants Involved in Research (see Appendix A), detailing the goals and procedures of the study and contact details for the research team, should they have any questions regarding the study. They will then proceed to another form to indicate that they understood all information provided regarding the study. Consent will be implied by the person filling out the questionnaire. It will also be confirmed on the first page of the electronic questionnaire by the participant selecting a button noting their agreement before they can proceed (see Appendix B).

The study will be conducted in two phases. The first phase aims to formulate the final questionnaire. It will involve Factor Analysis to reduce data and identify the factor structure for construct validity. The factor structure will then be confirmed and more rigorous validity checks will be conducted in the second phase.

In Phase 1 (Item and Scale Development), participants will be requested to provide demographic information (e.g., age, gender, health information). Then, they will be requested to provide responses to the HEQ (full item pool). This is an electronic questionnaire that will be developed using Qualtrics (or its replacement), and can anonymously be completed at a time and location that is convenient for them. This is expected to take no longer than 20 minutes of their time.

In Phase 2 (Scale Validation), participants will anonymously provide responses to an assembled questionnaire battery through the Qualtrics (or its replacement) online survey platform, which should take no longer than 60 minutes. This battery will contain the HEQ--refined through Phase 1 Data Analysis--and additional self-report questionnaires of theoretically associated psychological constructs, such as emotion (Multidimensional Emotion Questionnaire; Perth Alexithymia Questionnaire), interoception (Multidimensional Assessment of Interoceptive Awareness, Version 2), sensory processing sensitivity (Highly Sensitive Person Scale), and body awareness (Body Perception Questionnaire—Body Awareness Scale and Body Awareness Questionnaire). These questionnaires are expected to take participants no longer than 60 minutes to complete.

See Appendix D for all questionnaires that will be utilised in this study, including the HEQ in its current form. See Appendix E for details regarding the psychometric properties of established materials.

Use this textbox if additional room is required for Question 4.3.

This question is not answered.

Data Collection

4.4. **Indicate all types of data to be collected.***

- ☑ Questionnaire / survey responses*
- ☐ Individual interview responses*
- ☐ Group interview or focus group responses*
- ☐ Participant observations
- ☐ Blood or tissue samples
- ☐ Physiological measures
- ☐ Biomechanical measures
- ☐ Accessed health / medical records or data
- ☐ Accessed student academic records or data
- ☐ Archival data
- ☐ Other data

* Attach copies of questionnaires to this application in Section 11 - "Required Attachments" below.

4.5. **Does the research only include the collection of anonymous and non-sensitive data (e.g. online survey, observational data) that poses no foreseeable risks or discomfort to participants?** *Any foreseeable risk must be no more than inconvenience.**

- ○ Yes
- ◉ No

4.6. **Does the research only include the use of non-identifiable and non-sensitive data from an existing database? (e.g., data mining).**
*Such data should pose no foreseeable risks or discomfort to individuals whose information is contained in the database, or to individuals/organisations responsible for the database.**

- ○ Yes
- ◉ No

4.7. **Does the research involve photographing or video recording of participants?***

- ○ Yes
- ◉ No

4.8. **Who will be collecting the data?** (give details for all types of data collected and all persons involved)*

The questionnaire will be administered online and he Student Researcher will be collating the anonymous responses.

4.9. **Where will the data be collected?** (give details for all types of data collected and all locations)*

Through an online survey platform. It is planned to use Qualtrics, but it is currently unclear as to whether Victoria University (VU) will renew its licence for 2021, in which case the program provided by VU as the replacement will be used.

4.10. **How will the data be analysed?** (give details for all types of data collected)*

All collected data will be imputed, cleaned, and analysed using IBM® SPSS® Statistics Version 26.

Phase 1. Item and Scale Development
As an underpinning aim of this research is to identify the number and patterns of common factors within the HE construct, in conjunction with insufficient evidence to support a factor structure for HE, Phase 1 will require employment of an exploratory factor analysis (EFA, Hair et al., 2013; Tabachnick & Fidell, 2012). This study seeks to develop a robust measure of HE and clarify how this is conceptualised and classified within psychological research. As such, EFA is an appropriate statistic which enables this to occur and is a necessary preliminary phase in psychometric scale and construct development (Hair et al., 2013). EFA will substantiate theoretical underpinnings of HE, enable identification of the latent dimensions of HE and factorability of the HEQ, facilitate data reduction and estimate communalities amongst HEQ variables (Hair et al., 2013). Internal consistency using Cronbach's Alpha will be assessed to determine HEQ reliability.

Phase 2. Scale Validation
The final validation phase will involve employment of further factor analytic methods to confirm the HEQ factor structure identified in Phase 1.

Internal consistency using Cronbach's Alpha will be assessed to determine reliability.

Correlations will be run to determine whether the HEQ demonstrates adequate convergent and discriminant validity (Boateng et al., 2018). Following HEQ refinement, and prior to dissemination of the questionnaire battery, specific hypotheses pertaining to whether particular HEQ subscales will relate to validation measures will be developed. Where moderate to large correlations in expected directions are observed, this will suitably demonstrate convergent validity. These correlations will demonstrate that the content of the HEQ corresponds to content of constructs that it is designed to measure. Moreover, where items are not expected to significantly correlate due to distinctness, this will demonstrate divergent validity (Boateng et al., 2018).

4.11. **Who will have access to the data collected?** (give details of all persons who will have access to the data)*

All data will be collected by the student investigator Kristen Van Bael. However, the research team consisting of Dr. Emra Suleyman, Dr. Jessica Scarfo, and A/Prof. Michelle Ball will also have access to all data. All electronic data will be stored on the R drive at Victoria University.

4.12. **Will individuals or organisations external to the research team have access to any data collected?***

- ○ Yes
- ◉ No

SECTION 5 - PARTICIPANTS

Participant Group Details

5.1. **Provide details of all distinct participant groups below.**
Please be as precise as possible, if specific details have not been determined you must indicate that they are approximate.

Group 1
Details of specific participant population:*

Healthy adults from Australia, Canada, New Zealand, the United Kingdom, and the United States for Phase 1. Item and Scale Development.

Number of participants: *

500

Age range of participants:*

18-50

Source of participants:*

For Phase 1, participants will be recruited through convenience and snowball sampling. The Prolific Recruitment Service will also be utilised.

*Record details for additional group? (Group 2)**

- (●) Yes
- ( ) No

Group 2
Details of specific participant population:*

Healthy adults from Australia, Canada, New Zealand, the United Kingdom, and the United States for Phase 2. Scale Validation.

Number of participants: *

300

Age range of participants:*

18-50

Source of participants:*

For Phase 2, participants will be recruited through convenience and snowball sampling. The Prolific Recruitment Service will also be utilised.

*Record details for additional group? (Group 3)**

- ( ) Yes
- (●) No

Participant Selection

5.2. **Provide a rationale for the sample size.***

The minimum recommended sample size for scale development and validation is 10 respondents per survey item and/or 200-300 observations (Boateng et al., 2018), however, larger sample sizes are ideal, as they increase the likelihood of observing stable patterns of correlations amongst items and variables, thus facilitating replicability of factor analysis outcomes (Hair et al., 2013). To enhance statistical power necessary for meaningful results and interpretation, 500 participants will be sufficient for Phase 1 (Scale Development) and an additional 300 participants for Phase 2 (Scale Validation).

5.3. **Does the project include any specific participant selection and/or exclusion criteria beyond those described above in Question 5.1?***

- (●) Yes
- ( ) No

If YES, provide details:*

As the HEQ will be a tool to measure an emerging construct, the age range should limit the likelihood of poor physical health impacting upon responses.

Moreover, research has demonstrated that chronic pain conditions influence the subjective processing of homeostatic factors (e.g., fibromyalgia, Staud et al., 2006). People diagnosed with a chronic pain condition causing sustained discomfort that impacts their activities of daily living, such as fibromyalgia or severe arthritis, will be excluded from the current study.

In order to take part in this study people will need to proficient in reading basic English.

5.4. **Will there be a formal screening process for participants in the project?** (e.g. medical/mental/health screening)*

- ( ) Yes
- (●) No

5.5. **Does the research involve participants who have specific cultural needs or sensitivities?** (e.g., in relation to the provision of informed consent, language, procedural details)*

- ( ) Yes
- (●) No

5.6.a. **Does the research involve a participant population whose principal language is not English?***

- ( ) Yes
- (●) No

5.6.b. **Will documentation about the research (e.g., Information to Participants form and Consent form, questionnaires) be translated into a language other than English?***

- ( ) Yes
- (●) No

SECTION 6 - RECRUITMENT OF PARTICIPANTS

Recruitment and Informed Consent

6.1. **Will individuals other than members of the research team be involved in the recruitment of participants?***

- (•) Yes
- ( ) No

If YES, provide details including what their involvement entails.*

> Prolific recruitment service. This service pays participants registered in their database for their completion of research studies. Participants are recruited through Prolific, based on demographic information that they have provided, which is utilised to determine eligibility.

6.2. **How will potential participants be approached and informed about the research and how will they notify the investigators of their interest in participating?**
Attach copies of the "Information to Participants Involved in Research" form and any flyers or other advertising material to be used in the research in Section 11 - "Required Attachments" below.

> Social Media: If potential participants view the flyer advertising the study with an accompanying survey link via social media, they may click the link to access the study.
>
> Flyer: If potential participants view the flyer on University campuses, they may contact the Student Researcher via email to request further information regarding the study. The researcher will reply to this request with the survey link.
>
> Participants recruited via flyers and social media will constitute the sample required for piloting the questionnaire for face validity prior to dissemination for validation (approx. n = 20, per recommendations of Boateng et al., 2018). These participants will not be paid for their participation.
>
> Prolific: Persons employed by Prolific have provided this organisation with personal information relevant to inclusion criteria (e.g., country of origin, primary spoken language, age). As this study will be recruiting healthy adults aged 18-50 with English proficiency, these details will be entered into Prolific. Participants that meet these criteria will be approached and informed about the research through Prolific's dissemination to eligible respondents.
>
> Participants will imply their interest in participating by accessing the survey.
> The first page of the online survey will contain the Information for Participants Involved in Research form. Then, they will be required to click an arrow which takes them through to the Consent form. They will be required to indicate that they have read information form, had the opportunity to ask the researchers questions, understand how their data will be used, and finally, that they consent to participating in the study through an online survey platform (to be determined).

6.3. **Will potential participants be given time to consider and discuss their involvement in the project with others (e.g. family) before being requested to provide consent?***

- (•) Yes
- ( ) No

6.4. **How will informed consent be obtained from participants?***

- [ ] Participants be required to sign an informed consent form
- [x] Consent will be implied e.g. by return of completed questionnaire
- [ ] Verbal consent will be obtained and recorded (audio, visual or electronic)
- [ ] Other

6.5. **Provide procedural details for obtaining informed consent:***

> Participants will be asked to select an option to indicate they have read the Information to Participants Involved In Research form (in the online survey form), had the opportunity to ask the researchers questions, understand how their data will be used, and finally, that they consent to participating in the study through an online survey platform (to be determined).

6.6. **Will you be seeking consent in order to contact participants in the future for related research participation and/or use participants' data for related research purposes?***

- ( ) Yes
- (•) No

Competing Interests

6.7. **Will any dual relationship or conflict of interest exist between any researcher and potential or actual participants?** (e.g., a member of the research team is also a colleague or friend of potential participants)*

- (•) Yes
- ( ) No

What is the nature of the dual relationship or conflict of interest?*

> Given that the study will be advertised on Victoria University campuses and through social media networks, it is likely that some participants will be known to the researchers.

How will ethical issues arising from the dual relationship or conflict of interest be addressed?*

> Participants will be advised that their data are anonymous

6.8. **Does the research involve participants who are in dependent or unequal relationships with any member(s) of the research team or recruiting organisation/agency (e.g. counsellor/client, teacher/student, employer/employee)?***

- (•) Yes
- ( ) No

What is the nature of the dependent or unequal relationship?*

It is possible that some participants may be students of the Researchers.

What measures will be taken to ensure that participants' voluntary consent is not compromised by the relationship?*

No rewards or incentives will be provided for participation

What procedures are in place to ensure that the dependent or unequal relationship does not disadvantage or prejudice any participants?*

It is made clear in the Participant Information Form that Kristen, Emra, Jessica, and Michelle will not know the identity of any person who takes part, and that individuals known to the researchers will receive no particular benefit or reward as a result their participation. They will also be reminded that they can withdraw their consent at any time with no penalty.

6.9. **Will you be offering reimbursement or any form of incentive to participants which are not part of the research procedures? Please note:**

- Cash payments by the university will only be provided as a gift card.
- Physical cash payments or bank transfers are not approved methods of payment.
- Gift cards can only be ordered through Procurement using the Gift Card Request Form located at: https://intranet.vu.edu.au/Procurement/Forms.asp.

*

◉ Yes
○ No

If YES, provide details:

- You must clearly identify the value, quantity and type of gift cards to be purchased in both the Ethics Form and the Gift Card Request Form. Note you do not need to provide Procurement the Ethics form as supporting information.

*

We will pay the Prolific recruitment service and they will pass funds on to participants.

For Phase 1, the rate for payment is $2.22 AU for 20 minutes.

For Phase 2, the rate for payment is $6.66 AU for 45 minutes.

6.10. **Is approval required from an external organisation?** (e.g., for recruitment of participants, data collection, use of premises)*

○ Yes
◉ No

SECTION 7 - RISKS ASSOCIATED WITH THE RESEARCH

Physical Risks

7.1.a. **Are there any PHYSICAL RISKS beyond the normal experience of everyday life, in either the short or long term, from participation in the research?***

○ Yes
◉ No

Psychological Risks

7.1.b. **Are there any PSYCHOLOGICAL RISKS beyond the normal experience of everyday life, in either the short or long term, from participation in the research?***

◉ Yes
○ No

High probability risks:*

None identified

Low probability risks:*

In Phase 2, it is estimated that completing the questionnaire battery will take up to 60 minutes. It is possible participants may become mentally fatigued.

The HEQ does not ask for any sensitive material, and so it is not anticipated that any upset or distress should be caused by this material. This similarly applies to the questionnaires assessing sensory processing sensitivity, interoception, emotion, and bodily awareness.

How will the risk(s) be minimised?*

Participants will be reminded that they can withdraw from the project by closing the browser window at any time with no disadvantage to themselves.

How will these risks be managed if an adverse event were to happen?*

Although we do not anticipate that any upset or distress will be caused by completing the online questionnaires, contact details to support services (e.g., Beyond Blue, Lifeline) will be provided on the last page of the survey. If the participant does decide to withdraw, all of their information will be destroyed.

Social Risks

7.1.c. **Are there any SOCIAL RISKS beyond the normal experience of everyday life, in either the short or long term, from participation in the research.** (e.g., possible inadvertent public disclosure of personal details or sensitive information)*

- ○ Yes
- ◉ No

Other Risks

7.2. **Does the research involve any risks to the researchers?***

- ○ Yes
- ◉ No

7.3. **Does the research involve any risks to individuals who are not part of the research, such as a participant's family member(s) or social community (e.g., effects of biographical or autobiographical research)?***

- ○ Yes
- ◉ No

7.4. **Are there any legal issues or legal risks associated with any aspect of the research that require specific consideration (i.e., are significant or out of the ordinary), including those related to:**

- participation in the research,
- the aims and nature of the research,
- research methodology and procedures, and/or
- the outcomes of the research?

*

- ○ Yes
- ◉ No

7.5. **Risk-Benefit Statement:**
Please give your assessment of how the potential benefits to the participants or contributions to the general body of knowledge would outweigh the risks.
*Even if the risk is negligible, the research must bring some benefit to be ethical.**

All risks associated with this project are low impact, and most are unlikely to occur. Nevertheless, the welfare of the participant is of utmost importance, and the research has been designed with consideration of procedures to minimise risks or manage any adverse situations, should they occur. The proposed program of research aims to address specific gaps in the literature surrounding the measurement and conceptualisation of Homeostatic Emotion. The development and psychometric validation of the Homeostatic Emotion Questionnaire will enable this to occur. This novel self-report should provide better insights into factors underpinning an individual's connection to their body and mind, which carries immense benefits for clinical practice.

SECTION 8 - DATA PROTECTION AND ACCESS

Data Protection

8.1. **Indicate how the data, materials and records will be kept to protect the confidentiality/privacy of the identities of participants and their data, including all hardcopies, electronic files and forms.** *See help for definitions.**

- ◉ Data and records will be entirely anonymous
- ○ Data and records will be coded and non-identifiable
- ○ Data and records will be coded and re-identifiable
- ○ Some or all of the retained data and records will include personally identifying information
- ○ Other

8.2. **Who will be responsible for the security of and access to confidential data and records, including consent forms, collected in the course of the research?***

As all data is anonymous, no confidential data will be collected. The Chief Investigator, Dr Emra Suleyman will be responsible for the security of the collected data, and all members of the research team will have access to the secure R Drive folder.

8.3. **Where will data, materials and records be stored during and after completion of the project?** Provide full details of the location for all types of data.
Note: The VU Research Storage provides secure digital storage and long term retention for research project data including graduate research projects.

During the project:*

Data will be stored on the secure VU R Drive.

Upon completion:*

Data will be stored on the secure VU R Drive.

8.4. **Indicate the minimum period for which data will be retained.** See help for definitions.*

- ○ Indefinitely
- ◉ 5 years post publication
- ○ 7 years post publication
- ○ 15 years post publication
- ○ 25 years after date of birth of participants
- ○ Other

8.5. **Who will be responsible for re-evaluating the data/materials after the retention period and considering a further retention period for some or all of the data/materials?***

Dr Emra Suleyman.

8.6. **Will you transfer your data or materials to a managed archive or repository during the project, after the project, or after the retention period? Which discipline specific or institutional archives will be considered?**
*Note: Some funding agencies and publishers may require lodgement with an archive or repository. Retain a copy at VU where possible.**

This is not anticipated.

8.7. **When further retention of data and materials is no longer required, responsible disposal methods should be adopted. Disposal software should also be adopted if digital software, computer hardware, disks or storage media are reused or retired. What methods of appropriate disposal or destruction will be employed?**
Note: Personal, sensitive or confidential information, both digital and hardcopy, will require secure destruction or disposal. For other materials you may need to refer to the Hazardous Materials Policy, Animal Ethics Standard Operating Procedures, or the Ethics and Biosafety site found on the VU Office for Research website. *

Data will be permanently deleted using software provided by Victoria University.

SECTION 9 - DISSEMINATION/PUBLICATION OF RESEARCH RESULTS

Publication Details

9.1. **Indicate how the results of this research will be reported or published.***

- ☑ Thesis
- ☑ Journal article(s)
- ☐ Book
- ☐ Research report to collaborating organisations
- ☑ Conference presentation(s)
- ☐ Recorded performance
- ☐ Other

9.2. **Will any contractual agreement exist between the researchers and a third party that will restrict publication of the research findings?***

- ○ Yes
- ◉ No

9.3. **Are there any other restrictions on publications or reports resulting from this project?***

- ○ Yes
- ◉ No

SECTION 10 - OTHER DETAILS

Comments

10.1. **In your opinion, are there any other ethical issues involved in the research?***

- ○ Yes
- ◉ No

10.2. **Additional information and comments to support this application:**

This question is not answered.

SECTION 11 - DOCUMENTS, ATTACHMENTS AND SUPPLEMENTARY FORMS

Supplement F - Research participants in overseas countries

You have indicated in Question 3.2.e. that the research involves participants in other countries.

Applicants are requested to refer to the NHMRC National Statement Chapter 4.8 when completing this section.

1. **List all countries in which the research will be conducted:***

Through Prolific, the foreign countries include Canada, New Zealand, the United Kingdom, and the United States

2. **Provide a brief summary of all research activities (e.g., recruitment, data collection) to be undertaken in the overseas country(s).***

Recruitment will occur in overseas countries through the Prolific recruitment service.

Inclusion criteria for the study are specified in their system, which will ensure that recruited persons are aged between 18 and 50, are fluent in English, and have no diagnosis of a chronic pain condition. Prior to publishing the study, these criteria are entered to pre-screen participants.

Prolific then electronically disseminates the study to participants that meet these nominated criteria. Participants are recruited if they elect to do so after confirming their involvement with Prolific and accessing the study. Their consent is implied by selecting the appropriate option through Qualtrics.

Provide details of investigators' knowledge/experience in conducting research in the country(s) listed above. (In particular, knowledge of culture, values, language, standards for conducting research, ethical and legal aspects)

3.1. Chief Investigator:*

Dr Suleyman is an experienced supervisor of PhD projects in cognition, having supervised several projects through to completion. She is thus knowledgeable regarding standards for conducting research, and of ethical and legal aspects informing this. She is a founding member of the leadership team of the Cognitive Psychology Assessment Research Team (CogPART). She is a registered psychologist with training in clinical neuropsychology and is knowledgeable of a variety of cultures and values as she has regularly worked with culturally and linguistically diverse individuals. CI Suleyman have utilised Prolific recruitment services and have high familiarity with the service functions. Investigators hosting a survey on Prolific are able to engage with participant questions through the messenger service of the application. This enables all questions or issues regarding the survey, payment or otherwise to be handled directly. Risks in the survey are considered low-risk and information for mental health services will be provided.

3.2. Co-investigators:*

Dr Scarfo is an early career researcher who completed her own PhD in cognitive psychology and is preparing publications from her project. She is an active member of the Cognitive Psychology Assessment Research Team (CogPART). She has supervised many projects in cognition and interoception, and was Kristen's CI for her Honours thesis, which involved recruitment of overseas participants and awareness of how differing cultures influenced results on a test of cognition. She has also worked on several projects which involved overseas participants from the countries listed in this application and therefore has experience in this area. CI Scarfo has utilised Prolific recruitment services and has high familiarity with the service functions. Investigators hosting a survey on Prolific are able to engage with participant questions through the messenger service of the application. This enables all questions or issues regarding the survey, payment or otherwise to be handled directly. Risks in the survey are considered low-risk and information for mental health services will be provided.

A/Prof Ball is an experienced supervisor and mentor of PhD students and is the leader of the Clinical and Community Health and Wellbeing Research Program in the Institute of Health and Sport. She has supervised several PhD projects in cognition to completion, and published in the field. She has trained in clinical neuropsychology. She is knowledgeable regarding standards for conducting research, and of ethical and legal aspects informing this, as a prior member of the review committee for the VUHREC. She was Kristen's Associate Investigator for her Honours thesis, which involved recruitment of overseas participants.

3.3. Student researchers: (if none, indicate what training will be provided to the student(s) and when)*

Student researcher, Kristen Van Bael, has knowledge regarding the overseas countries and their cultures. This will ensure that the data submitted by participants are engaged with and interpreted in a way that is mindful of their cultures and values. She is knowledgeable about social, cultural, linguistic, political and legal frameworks within the countries that recruitment will occur in. In addition, the theoretical framework informing this project explicitly acknowledges cultural differences influencing emotional processing and the diversities inherent in this.

Kristen has previously recruited participants from the United Kingdom and United States through Prolific for her Honours thesis. Her result interpretation was informed by her knowledge of these cultures, as some of the visual stimuli in her Honours study were American. This influenced the response times in a psychological test and was identified and acknowledged as such.

She is being provided with ongoing training and support regarding the
standards for conducting research, and ethical and legal aspects from her supervisors. This is supplemented by her undertaking of units of study regarding ethical standards and risk management in research throughout her undergraduate degree, Honours, and PhD prior to being confirmed as a PhD candidate.

4. **Will the student researcher(s) be located in the overseas country(s) during the course of the research?***

○ Yes
◉ No

Describe the role(s) of each investigator in the overseas component of the research project.

5.1. Chief Investigator:*

There are no research investigators working overseas. The use of Prolific is for recruitment purposes only.

5.2. Co-investigators:*

See item 5.1. - N/A.

5.3. Student researchers:*

See item 5.1. - N/A.

6. **Will any of the investigators (not including student researchers) be located in the overseas country(s) during the course of the research?***

○ Yes
◉ No

If NO, provide contact details of a local person in the country who will be available to respond to participant queries related to the research.

Name:*

Kristen Van Bael

Location:*

Australia

Telephone number:*

0408583819

Mobile number:*

0408583819

Email: *

kristen.vanbael@live.vu.edu.au

7. **Will individuals in overseas countries who are not members of the research team be involved in any aspect of the conduct of the research (e.g., recruitment of participants, data collection)?***

- ○ Yes
- ◉ No

8. **Is there an ethical review process (mandatory or voluntary) for research undertaken in the country(s) where the proposed research will take place?***

- ○ Yes
- ◉ No

9. **Are there any risks to participants, beyond the normal experience of everyday life, in either the short or long term, that relate specifically to participating in the research in the overseas country?***

- ○ Yes
- ◉ No

10. **How will the well-being of overseas participants be monitored throughout the duration of the research?***

We will provide contact details for mental health service hotlines for each of the overseas countries that we are using Prolific to recruit from.

This information will be provided on the page where participants are required to provide their informed consent, in the event that they experience distress. These details will also be provided on the completion page of Qualtrics following response submission.

11. **Other comments relevant to this section of the application:**

This question is not answered.

Required Attachments

The following documentation must be attached to your application:

- Scanned copy of the Declaration Form for External Investigators (if applicable)

- Copy of the '**Information to Participants Involved in Research**' form *(Please use the templates provided on the Human Research Ethics website)*

- Copy of Consent Forms to be used in the research *(Please use the templates provided on the Human Research Ethics website)*

- Any flyers or other advertising material to be used in the research

- Copy of questionnaires

11. **Please attach each of the items specifically listed above as well as any other supporting documentation.**
All documentation must be accurately titled and referenced to within the body of your application where appropriate (i.e. "Appendix A - Declaration Form", "Appendix F - Risk Factor Assessment Questionnaire", etc.). Please limit file types to .doc, .docx, .xls, .xlsx, .pdf, or small-medium images (ie, .gif, .jpg).*

1	Document type	Soft copy
	Name	Consent Form
	Reference (Document Title)	Appendix A - Consent Form.docx
	Description	Please see Appendix B.
2	Document type	Soft copy
	Name	Information to Participants Involved in Research
	Reference (Document Title)	Appendix B - Information to Participants and Consent Forms For Participants Involved in Research - Amended September 2021.docx
	Description	Changes to 'Information to Participants' relevant from Page 5 of this document.
3	Document type	Soft copy
	Name	Declaration Form for External Investigators
	Reference (Document Title)	
	Description	
4	Document type	Soft copy
	Name	Reference List
	Reference (Document Title)	Appendix F - References.docx
	Description	
5	Document type	Soft copy
	Name	Advertising Material (flyers etc.)
	Reference (Document Title)	Appendix C - Study Flyer for HEQ.pdf
	Description	
6	Document type	Soft copy
	Name	Appendix D - Questionnaires
	Reference (Document Title)	Appendix D - Questionnaires - Amended September 2021.docx
	Description	
7	Document type	Soft copy
	Name	Appendix E - Psychometric Properties of Questionnaires
	Reference (Document Title)	Appendix E - Materials Reliability and Validity - Amended September 2021.docx
	Description	
8	Document type	Soft copy
	Name	September 2021 Amendment Request
	Reference (Document Title)	Ethics Application (HRE21001) amendment request.pdf
	Description	
9	Document type	Soft copy
	Name	Amendments October 2021
	Reference (Document Title)	RE_ notification of incident, and amendment required to existing application_ HRE21-001.pdf
	Description	

Note: Please click the Question Help icon above for instructions on how to upload documents and use this table.

If you are certain that you do not need to supply a Consent Form or Information to Participants Involved in Research (both of which are mandatory), please tick Hard Copy and type 'N/A' in the Reference field.

SECTION 12 - SUBMISSION DETAILS

Declaration

I / we, the undersigned, declare the following:

- I / we accept responsibility for the conduct of the research project detailed above in accordance with:
  a. the principles outlined in the National Statement on Ethical Conduct in Human Research (2023);
  b. the protocols and procedures as approved by the HREC;
  c. relevant legislation and regulations.
- I / we will ensure that HREC approval is sought using the Changes to the Research Project process outlined on the Human Research Ethics website if:
  a. proposing to implement change to the research project;
  b. changes to the research team are required.
- I / we have read the National Statement on Ethical Conduct in Human Research prior to completing this form.
- I / we certify that all members of the research team involved the research project hold the appropriate qualifications, experience, skills and training necessary to undertake their roles.
- I / we will provide Annual / Final reports to the approving HREC within 12 months of approval or upon completion of the project if earlier than 12 months.
- I / we understand and agree that research documents and/or records and data may be subject to inspection by the VUHREC, Ethics Secretary, or an independent body for audit and monitoring purposes.
- I / we understand that information relating to this research, and about the investigators, will be held by the VU Office for Research. This information will be used for reporting purposes only and managed according to the principles established in the Privacy Act 1988 (Cth) and relevant laws in the States and Territories of Australia.

*

1	ID	S4538575
	Name	MS KRISTEN VAN BAEL
	Role	Student
	Type	Student
	Declaration signed?	Yes
	Signed on	19/01/2021
2	ID	E5028664
	Name	MRS EMRA SULEYMAN
	Role	Chief Investigator
	Type	Internal
	Declaration signed?	Yes
	Signed on	19/01/2021
3	ID	E5104919
	Name	DR JESSICA SCARFO
	Role	Associate Investigator
	Type	Internal
	Declaration signed?	Yes
	Signed on	19/01/2021
4	ID	E5015232
	Name	DR MICHELLE BALL
	Role	Associate Investigator
	Type	Internal
	Declaration signed?	Yes
	Signed on	23/12/2020

Note: Please click on your name in the table above to complete your declaration; or click on the name of an External Investigator to acknowledge that their declaration has been supplied.

Declaration Instructions and Information

- A digital signature must be supplied by each and every member of the research team using the declaration table above.
- The 'Needs Signature' icon shows which records you are responsible for signing.
- Physical signatures are not required for VU staff and students in applications using form version v.13-07.
- External Investigators do not have access to Quest. The Chief Investigator must supply a completed physical declaration on their behalf by following the steps below:
  1. Send the person a copy of the full application form (including any attachments), as well as the **Declaration Form for External Investigators** document.
  2. Once returned, attach the signed *External Investigator Declaration Form* document in 'Section 11 - Required Attachments'.
  3. Enter into the External Investigator's record in the above declaration table and mark the checkbox to indicate these steps have been completed, include the date you have done so.

     The 'sighted by' field will automatically populate with your name. *(Only the Chief Investigator will have permission to complete this step.)*
- The application cannot be submitted until all members of the research team have logged in and completed this declaration.

Finalise Application

Reminders

- All applications must be sighted and approved by all members of the research team and any relevant parties. Please ensure each member of the research team has completed their declaration in *'Section 12 - Declaration'* above, including any declaration forms supplied on behalf of External Investigators. *Applications will not be reviewed without appropriate authorisation.*
- It is strongly recommended that you save a PDF version of your application before submitting as you will lose access to the electronic record while it undergoes formal review.
- **You are reminded that your project may not commence without formal written approval from the appropriate Human Research Ethics Committee.**

Ready to Submit?

- Once the form is complete and all documents are attached, **click on the *'Action'* tab** above the left-hand form navigation, then **click *'Submit Application'*** to forward the application to the Ethics Secretary to be reviewed and assigned to a Committee meeting.
- You will receive an automatic email notification from Quest when your application has been successfully submitted.
- *Note: Only a Chief Investigator is able to submit an application for ethical approval. The Chief Investigator who is marked as the primary contact for this application is:*

MRS EMRA SULEYMAN

Appendix E. Paper 1 Supporting Information

S1 File. PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title page
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 6-7
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 6-7
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 8
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 7-8
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 7-8
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 9
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 9
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 9
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 9
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 11
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 9
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	PROSPERO pre-registration
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 9-10
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	PROSPERO pre-registration

Section and Topic	Item #	Checklist item	Location where item is reported
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 9-10
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 10-11
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 10
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Page 9
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 10
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 11-12
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 12
Study characteristics	17	Cite each included study and present its characteristics.	Supporting Information (S4 File)
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Supporting Information (S3 File)
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Page 25, 28, 31, 34
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 21
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Page 22-34, Data repository
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 24, 27, 30, 33, Data repository
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Data repository
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Data repository; Tables 1-4
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Data repository
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 37-48

Section and Topic	Item #	Checklist item	Location where item is reported
	23b	Discuss any limitations of the evidence included in the review.	Page 48-49
	23c	Discuss any limitations of the review processes used.	Page 49
	23d	Discuss implications of the results for practice, policy, and future research.	Page 46-47
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 7
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 7
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Page 7
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 50
Competing interests	26	Declare any competing interests of review authors.	Page 50
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Page 50

S2 File. Inter-rater reliability

Inter-Rater Reliability

Article Screening

Database searches employing the pre-registered search strategies identified 232 articles. Following the automated removal of duplicate articles through Covidence (n = 97), 135 studies remained and were screened by the three reviewers (KVB, NA, JK) against titles and abstracts. Following title and abstract screening, acceptable agreement amongst reviewers was observed (69 to 74%); however, inter-rater reliability according to Cohen's kappa was slight to fair (κ = 0.10-0.39), necessitating discussions amongst reviewers to reach consensus. Following these discussions, 103 papers were collectively deemed as not meeting inclusion criteria. Thirty-one papers subsequently remained and were assessed for full-text eligibility. Fifteen studies were excluded and a total of 16 studies identified through database searches were included. Google Scholar searches yielded 797 results; of these, 58 studies were retrieved. Eleven studies identified via Google Scholar were deemed eligible and relevant; included studies then totalled 27. Reference lists for these studies were scanned for additional sources, of which five were identified. These were screened against eligibility criteria and included. We identified that one study was ineligible following screening, as results concerned the same sample (Gaggero et al., 2022). To maintain independence of observations, the study was excluded. Overall, full-text screening agreement was fair to acceptable, requiring further discussion to resolve inconsistencies in screening (67 to 89% agreement; Cohen's κ = 0.27 to 0.46). Upon resolution of conflicts between the reviewers through discussions, the number of articles included in final reporting was 32.

Data Extraction

To assess the reliability of the coding process, we calculated the percentage agreement among three independent coders (KVB, NG, and JK). The analysis involved 32 articles, each coded by the three raters. The primary metric for evaluating agreement was the percentage of articles for which all three raters agreed, with a focus on the number of errors made by each coder. Each article was independently reviewed and coded by the three raters. An error was recorded when a coder's extraction differed from the consensus of the other two coders. Out of the 32 articles, the number of articles where each coder made errors (i.e., differed from the consensus) was as follows: KVB: 3 errors, NG: 4 errors, JK: 5 errors. The percentage agreement was calculated based on the number of articles without errors for each coder. Specifically, this involved a calculation of subtracting the number of errors made by each coder from the total number of articles coded. This result was then divided by the total number of articles and multiplied by 100 to obtain a percentage. The percentage agreement among the three coders was relatively high, ranging from 84.4 to 90.6%, indicating a good level of reliability in the coding process. All errors were resolved following further review of the article and discussions.

Risk of Bias

To ensure the reliability of the risk of bias assessment, we assessed the intra-class correlation (ICC) for the overall risk of bias indicated in each article provided by the three reviewers (e.g., overall low risk). A two-way random effects model with consistency type was used to account for variability amongst both the reviewers and the articles. The ICC for single measures was 0.60 (95% CI: 0.41–0.76), indicating good reliability. The ICC for average measures was 0.82 (95% CI: 0.67–0.91), indicating excellent reliability. Together, these values suggested a high level of agreement among the reviewers regarding the risk of bias present amongst the included articles.

S3 File. Risk of bias assessment.

Quality ratings varied across studies. Most studies were of moderate quality, with a high level of agreement among the reviewers (see File S2 of Supporting Information). The main sources of bias in the included studies were lacking sample size determinations, unclear or undisclosed eligibility criteria, poor descriptions of validity and reliability of administered measures, unjustified scoring methods, incomplete reasons for missing data, incomplete or omitted measures of variability for outcome measures, and a lack of reporting on statistical assumptions. The below tables provide risk of bias assessments for each included article, according to the 22 STROBE checklist components.

Table S1. Risk of bias assessment based on STROBE checklist criteria– Introduction and Methods.

	Introduction			Methods								
Study	Title and Abstract	Background and Rationale	Objectives	Study Design	Setting	Participants	Variables	Data/ Measurement	Bias	Study Size	Quantitative Variables	Statistical Methods
Berenguer et al. (2019)	Low	Low	Low	Medium	Medium	Low	Low	Medium	Low	High	Medium	Medium
Betka et al. (2018)	Medium	Low	Low	Low	Medium	Medium	Low	Low	Low	High	Low	Low
Bonete et al. (2023)	Low	Low	Low	Low	Medium	Medium	Low	Low	Low	Low	Low	Low
Brand et al. (2022)	Low	Medium	Medium	Low	Medium	Medium	Low	Low	Low	Medium	Low	Medium
Brewer et al. (2016)	Low	Low	Low	Medium	High	Low	Medium	Medium	Medium	High	Medium	Medium
Campos et al. (2021)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low
Da Costa Silva et al. (2022)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	High	Low	Low
Desdentado et al. (2022)	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	Low	Low
Dunn et al. (2022)	Low	Low	Low	Low	Medium	Medium	Low	Medium	Low	High	Medium	Medium
Edwards and Lowe (2021)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	High	Low	Low
Ernst et al. (2014)	Low	Low	Low	Low	Medium	Medium	Low	Low	Medium	High	Low	Low
Ferraro and Taylor (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Medium	High	Low	Low
Fiene et al. (2018)	Medium	Low	Low	Low	Low	Low	Low	Medium	Low	High	Low	High
Gaggero et al. (2021)	Low	Low	Low	Low	High	Medium	Low	Low	Low	Medium	Low	Low
Hassen et al. (2023)	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	Low	Low
Huang et al. (2022)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	High	Low	Low
Jakobson et al. (2021)	Low	Low	Low	Low	High	Medium	Low	Low	Medium	High	Low	Low
Longarzo et al. (2015)	Low	Low	Low	Low	Medium	Medium	Low	Low	Medium	Low	Medium	Low
Lyvers and Thorberg (2023)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	High	Low	Low
Morales et al. (2022)	Medium	Low	Low	Low	Low	Medium	Low	Low	Medium	High	Low	Low
Mul et al. (2018)	Low	Low	Low	Low	Medium	Medium	Low	Low	Low	High	Low	Medium
Murphy et al. (2020)	Medium	Low	Low	Low	Low	Medium	Low	Medium	Low	High	Medium	Low
Pink et al. (2021)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	High	Low	Low
Riccardi et al. (2021)	Low	Low	Low	Low	Low	Medium	Low	Medium	Low	Low	Low	Low
Schmitz et al. (2021)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low
Sweetnam et al. (2023)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low
Taylor et al. (1996)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low

Tünte et al. (2022)	Low	Low	Low	Low	Low	Medium	Low	Medium	Medium	High	Low	Low
Ventura-Bort et al. (2021)	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low
Vinni et al. (2023)	Low	Low	Low	Low	Medium	Medium	Low	Low	Low	Low	Low	Low
Vlemincx et al. (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	Low	Low
Zahid et al. (2023)	Medium	Low	Low	Low	Low	Medium	Low	Low	Low	High	Low	Low
Zamariola et al. (2018)	Low	Low	Low	Low	Medium	Low	Low	Low	Low	High	Low	Medium

Table S2. Risk of Bias assessment based on STROBE checklist criteria – Results, Discussion, and Funding.

	Results					Discussion				Other
Study	Participants	Descriptive Data	Outcome Data	Main Results	Other Analyses	Key Results	Limitations	Interpretation	Generalisability	Funding
Berenguer et al. (2019)	Medium	High	Low	Low	Low	Low	Medium	Low	Low	Low
Betka et al. (2018)	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low
Bonete et al. (2023)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Brand et al. (2022)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Brewer et al. (2016)	Low	Low	Medium	Medium	Low	Low	Low	Low	Low	Low
Campos et al. (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Da Costa Silva et al. (2022)	Low	Medium	Low	Low	Low	Low	Low	Low	Low	High
Desdentado et al. (2022)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Dunn et al. (2022)	Low	Medium	Medium	Low	Low	Low	Medium	Low	Low	Low
Edwards and Lowe (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Ernst et al. (2014)	Medium	Medium	Low	Medium	Low	Low	Low	Low	Low	Low
Ferraro and Taylor (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Fiene et al. (2018)	Medium	Low	Medium	Low	Medium	Low	Low	Low	Low	Low
Gaggero et al. (2021)	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Medium
Hassen et al. (2023)	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low
Huang et al. (2022)	Low	Low	Low	Low	Low	Low	Medium	Low	Low	Low
Jakobson et al. (2021)	Low	Medium	Low	Low	Low	Low	Medium	Low	Low	Low
Longarzo et al. (2015)	Low	Low	Low	Low	Medium	Low	Medium	Low	Low	Low
Lyvers and Thorberg (2023)	Low	High	Low	Low	Low	Low	Low	Low	Low	Low
Morales et al. (2022)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Mul et al. (2018)	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low
Murphy et al. (2020)	Low	Low	Medium	Low	Low	Low	Low	Low	Low	Low
Pink et al. (2021)	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low
Riccardi et al. (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Low	High
Schmitz et al. (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Sweetnam et al. (2023)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Taylor et al. (1996)	Low	Low	Medium	Low	Low	Low	Low	Low	Low	Low
Tünte et al. (2022)	Low	Low	Low	Low	Low	Low	Low	Low	Low	High
Ventura-Bort et al. (2021)	Low	Low	Medium	Low	Medium	Low	Low	Low	Low	High
Vinni et al. (2023)	Low	Low	Low	Low	Low	Low	Low	Low	Low	High
Vlemincx et al. (2021)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Zahid et al. (2023)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Zamariola et al. (2018)	Low	Low	Low	Low	Medium	Low	Medium	Low	Low	Low

S4 File. Characteristics of included studies

Table S3. Characteristics of included studies.

Study	Country	Study Design	Sample Characteristics	*N*	*M*Age	% Female	Clinical Condition	Eligibility Criteria	Interoceptive Construct	Interoceptive Scale	Analysed Interoceptive Scales	Alexithymia Scale	Analysed Alexithymia Scales	Covariates	Results
Berenguer et al. (2023)	Portugal	Cross-sectional	Non-clinical males and females	340	F: 24.6 M: 26.2	67%	Non-clinical	Exclusion: antidepressant use; health conditions interfering with sexual function; aged ≤17	Interoceptive Awareness	MAIA	MAIA-Total	TAS-20	DIF DDF EOT TAS-Total	None	In total sample, MAIA total and TAS scales significantly negatively correlated; small for EOT, and moderate for TAS-Total, DIF, DDF. In female sample, MAIA total and TAS scales significantly negatively correlated; small for EOT, and moderate for TAS-Total, DIF, DDF. In male sample, small for DIF, DDF, EOT, moderate for TAS-Total.
Ben Hassen et al. (2023)	Spain	Cross-sectional	Adults with technical academic training, non-technical academic training, and adults with ASD	Total: 77 Tech: 30 Non-Tech 20 ASD: 27	Tech: 23.5 Non-Tech: 22.4 ASD: 32.5	Technical: 46.7% Non-Technical: 85% ASD: 50%	ASD	Diagnosis confirmed via interview; family interview; results on 4 standardised psychopathological tests. Technical and Non-Technical: Not reported.	Interoception	BPQ	BPQ-SF-Total	TAS-20	DIF DDF EOT TAS-Total	Age, gender	In ASD group, negative correlations between BPQ-SF and TAS scales, medium (DIF, DDF) and large (TAS-Total) in magnitude. EOT n.s.. No significant correlations between TAS scores and BPQ-SF in technical and non-technical academic training groups.
Betka et al. (2018)	UK	Cross-sectional	Students and staff	590		74%	Non-clinical	Not reported.	Interoceptive Sensibility	BPQ	BPQ-BA	TAS-20	TAS-Total	Age, gender, education	Small positive correlations between DIF, DDF, and TAS-Total and BPQ-BA. EOT ns.
Bonete et al. (2023)	Spain	Cross-sectional	Men diagnosed with ASD aged 21-58; men with neurotypical development, aged 18-58	60 ASD: 33 CG: 35	ASD: 34.3 CG: 33.4	0%	ASD	Inclusion: ASD group: aged 18+, confirmed ASD diagnosis, language proficiency, score above 6 on AQ-10. CG: aged 18+, no ASD or other clinical diagnosis, score below 6 on AQ-10.	Interoceptive Confusion	ISQ	ISQ-Total	TAS-20	TAS-Total	None	Large positive correlations between ISQ Total and TAS-Total for ASD and HC groups; stronger magnitude in HCs.

Brand et al. (2022)	Austria, Germany	Cross-sectional	German speaking adults drawn from general population; German and Austrian university students	Total: 3462 Sample 1: 484 Sample 2: 1509 Sample 3: 388 Sample 4: 77 Sample 5: 226 Sample 6: 254 Sample 7: 522	Sample 1: Mage=27.8 years, Sample 2: Mage=33.3 years, Sample 3: Mage=31.0 years, Sample 4:, Mage=23.5 years, Sample 5: Mage=22.8 years, Sample 6: Mage=24.5 years , Sample 7: Mage=23.4 years	Sample 1: 71.2% Sample 2: 79.5% Sample 3: 55.7% Sample 4: 42.8% Sample 5: 72.2% Sample 6: 83.2% Sample 7: 81.1%	Unclear	Exclusion: no report of high proficiency German level; underaged; left items unanswered, and/or responded too fast or slow; reported neurological or heart disease.	Self-Reported Interoceptive Accuracy	IAS	IAS-Total	TAS-20	TAS-Total	None	Medium negative correlation between IAS and TAS-Total in Potsdam; small negative for Vienna IAS.
Brewer et al. (2016)	UK	Cross-sectional	Unclear.	653	Not reported.	Not reported	Not reported.	Not reported.	Interoceptive Sensibility	ICQ	ICQ-Total	TAS-20	TAS-Total	None	Strong positive correlation between ICQ and TAS-Total.
Campos et al. (2021)	Portugal	Cross-sectional	Community sample	515	30.7	60%	Non-clinical	Not reported.	Self-Reported Interoceptive Accuracy Self-reported Interoceptive Attention	IAS BPQ	IAS-Total BPQ-BA BPQ-R	TAS-20	TAS-Total	Not reported.	Significant correlations between TAS-Total and interoceptive self-reports, small negative (IAS) and medium positive (BPQ-R) in magnitude. BPQ-BA n.s..
Da Costa Silva et al. (2022)	France	Cross-sectional	French adults	308	35.2	61.40%	Non-clinical	Inclusion: No history of neuropsychiatric disease and chronic pain; aged 18-65; able to read and understand French.	Interoceptive Awareness	MAIA-2	Not., ND, NW, AR, EA, SR, BL, Trust.	TAS-20	DIF DDF EOT TAS-Total	Not reported.	Negative correlations between DIF and MAIA scales, small (Not., ND, NW, EA, SR) and medium (MAIA-Total, AR, BL, Trust.) in magnitude. Negative correlations between DDF and MAIA scales, small (Not., ND, AR, EA, SR, BL, Trust.) and medium (MAIA-Total) in magnitude. NW ns. Negative correlations between EOT and MAIA scales, small (ND, NW, Trust.), medium (Not., AR, EA, SR, BL) and large (MAIA-Total) in magnitude. Negative correlations between TAS-Total and MAIA scales,

															small (ND), medium (Not., AR, EA, SR, BL, Trust.), and large (MAIA-Total) in magnitude. NW ns.
Desdentado et al. (2022)	Spain	Cross-sectional	Healthy native Spanish adults	391	29	61%	Non-clinical	Exclusion: history of neurological disease or psychiatric disorders; taking psychotropic drugs; not native Spanish speaker.	Interoceptive Sensibility	MAIA-2	Not., ND, NW, AR, EA, SR, BL, Trust.	TAS-20	DIF DDF EOT TAS-Total	Not reported.	Negative correlations between DIF and MAIA scales, small (Not., ND, NW, AR, SR, BL, Trust.) in magnitude. EA ns. Negative correlations between DDF and MAIA scales, small (ND, NW, AR, EA, SR, BL, Trust.) in magnitude. Not. ns. Negative correlations between EOT and MAIA scales, small (Not., AR, EA, SR, BL, Trust.) in magnitude. ND and NW ns. Negative correlations between TAS-Total and MAIA scales, small (ND, NW, AR, EA, SR, BL, Trust.) in magnitude. Not. ns. MAIA ND, NW, AR, and Trust. scales significantly negatively predicted alexithymia in structural equation models. Not., EA, SR, BL n.s.
Dunn et al. (2022)	US	Cross-sectional	University students	74	26	90%	Non-clinical	Not reported.	Interoceptive Impact	SPI	Registration, Avoiding, Sensitivity, Seeking	PAQ	PAQ-Total	None	Small positive correlation between PAQ-Total and SPI Registration (lack of awareness of interoceptive input) r=.260. SPI Avoiding, SPI Sensitivity, SPI Seeking n.s.

Edwards and Lowe (2021)	UK	Cross-sectional	Adults with possible alexithymia	242		51%	Non-clinical	Inclusion: Aged 18+; good ability to read English; normal to corrected to normal vision; internet access; reported difficulty in labeling and describing emotions, which they believed was because of alexithymia.	Interoceptive Awareness	MAIA-2	Not., ND, NW, AR, EA, SR, BL, Trust.	TAS-20	DIF DDF EOT TAS-Total	None	Negative correlations between DIF and MAIA scales, small (Not., ND, AR, EA, BL) in magnitude. NW, SR, Trust. ns. Negative correlations between DDF and MAIA scales, small (ND, AR, SRBL) and medium (NW, Trust.) in magnitude. Not., EA ns. Positive correlations between EOT and MAIA scales, small (Not.)and medium (AR, EA, SR, BL, Trust.) in magnitude. ND and NW ns. Negative correlations between TAS-Total and MAIA scales, small (ND, AR) and moderate (Trust.)in magnitude. Not., NW, EA, SR, BL n.s.. Stepwise linear regression models showed TAS-Total negatively predicted by ND, AR, and EA. SR positively predicted TAS-Total. DIF negatively predicted by ND and AR. DDF negatively predicted by ND and AR. EOT negatively predicted by EA.
Ernst et al. (2014)	Switzerland	Cross-sectional	Healthy adults	18	27.1	59%	Non-clinical	Exclusion: Major medical illnesses; histories of seizures; head trauma with loss of consciousness and pregnancy; any psychiatric or neurologic disorder; history of substance dependence.	Interoceptive Awareness	BPQ	BPQ-BA BPQ-SS BPQ-SR BPQ BPQ-AR	TAS-20	TAS-Total	None	Strong positive correlations between BPQ scales and TAS total: BPQ-Total, BPQ-BA, BPQ-SR, BPQ-AR and BPQ-SS.
Ferraro and Taylor (2021)	Australia	Cross-sectional	Australian adults drawn from a community sample and university students	269		22%	Non-clinical	Not reported.	Interoceptive Awareness	MAIA-2	MAIA-Total	TAS-20	TAS-Total	None	Medium positive correlation between MAIA Total and TAS-Total). MAIA Total negatively predicted TAS-20 in serial mediation model.

Fiene et al. (2018)	Australia	Cross-sectional	Adults with and without ASD from universities and the general population	511 Autism: 52 Neurotypical: 459	ASD: 35.5 Typical: 33.5	Autistic: 51.9% Neurotypical: 62.3%	ASD	ASD: Previously diagnosed with autism by a qualified professional (paediatrician, psychiatrist, clinical psychologist). Neurotypical: Not reported.	Interoceptive challenges	ISQ	ISQ-Total	TAS-20	TAS-Total	None	Large positive correlation between ISQ and TAS-Total.
Gaggero et al. (2021)	US, Singapore, Italy	Cross-sectional	IT: adults aged 18-53, primarily University students Sing: undergraduate students aged 18-28 US: adults aged 22-58	Total: 814 Italy: 325 Singapore: 239 US: 250	IT: 23.5 Sing: 21.8 US: 29.5	Italy: 68% Singapore: 62.8% US: 48%	Non-clinical	Italian: Italian native speakers; aged 18-35 years old; university students or educational level at least equivalent to Italian Bachelor's degree. Singapore: Not reported. US: aged 25-30, US bachelor's degree as minimum educational level, US as country of residence.	Subjective Interoception	BPQ IAS ICQ MAIA-2	BPQ-Total, BPQ-R, BPQ-R-Supra, BPQ-R-Sub BPQ-BA IAS-Total ICQ-Total Not., ND, NW, AR, EA, SR, BL, Trust., MAIA-Total	TAS-20, BVAQ	DIF DDF EOT TAS-Total BVAQ-Total, BVAQ-A BVAQ-C	None	Negative correlations between TAS-Total and interoceptive self-reports, small (Not., ND, NW, ND, AR, EA, SR), medium (IAS, MAIA-Total, BL, Trust.) in magnitude. Positive correlations small (BPQ-AR) and medium (ICQ). BPQ-BA n.s.. Negative correlations between DIF and interoceptive self-reports, small (Not., ND, AR, SR, BL), medium (IAS, MAIA-Total, NW, Trust.), and large (ICQ) in magnitude. Positive medium correlation with BPQ-AR. BPQ-BA, EA n.s.. Negative correlations between DDF and interoceptive self-reports, small (IAS, BPQ-AR, Not., ND, AR, EA, SR, BL, Trust.) in magnitude. Positive correlations, small (BPQ-AR) and medium (ICQ) in magnitude. BPQ-BA, ND n.s.. Negative correlations between EOT and interoceptive self-reports, small (BPQ-BA, MAIA-Total, Not., AR, EA, SR, BL, Trust.) in magnitude. Positive small correlation with ICQ. IAS, ND, NW n.s.. Negative correlations between BVAQ-Total and interoceptive self-reports, small (IAS,

															Not., ND, AR, EA, SR, Trust.) and medium (BL) in magnitude. Positive correlations, small (BPQ-BA, BPQ-AR) and medium (ICQ) in magnitude. NW n.s.. Machine Learning models estimated that Alexithymia (TAS-20) was best predicted by ICQ, MAIA-Not-Worrying, MAIA-Attention Regulation, and MAIA-Noticing. BVAQ-Cognitive Alexithymia was best predicted by ICQ, MAIA-Emotional Awareness, MAIA-Trusting, MAIA-Body Listening, and BPQ-Reactivity. BVAQ-Affective Alexithymia was best predicted by MAIA-Body Listening, MAIA-Not-Worrying, MAIA-Not-Distracting, and BPQ-Awareness. Negative correlations between BVAQ-C and interoceptive self-reports, small (BPQ-BA, BPQ-AR, Not., ND, EA, SR) and medium (IAS, MAIA-Total, BL, Trust.) in magnitude. Large positive correlation with ICQ. NW n.s..
Huang et al. (2022)	Taiwan	Cross-sectional	Healthy adults aged 20-64	224	22.1	70.10%	Non-clinical	Aged 20-64; native speakers of traditional Chinese; normal vision (with or without correction); no diagnosis of mental disorders that influence reality testing or cognitive ability (e.g., schizophrenia, dementia)	Interoceptive Sensibility	MAIA	Not., ND, NW, AR, EA, SR, BL, Trust.	TAS-20	TAS-Total	Social desirability	Negative correlations between TAS-Total and MAIA scales, small (NW, AR, SR, BL, Trust.) in magnitude. Not., EA n.s. Cluster analysis produced low, moderate, and high IS groups based on MAIA scale scores. Low IS, Moderate IS > High IS on TAS-Total, DDF, EOT. DIF n.s..

Jakobson et al. (2021)	Canada	Cross-sectional	University students enrolled in psychology	201	19.7	55.70%	Non-clinical	Not reported.	Self-Reported Interoceptive Accuracy	IAS	IAS-Total	TAS-20	TAS-Total	Age	Small negative correlations between IAS and TAS-Total, DIF, DDF, EOT. IAS scores negatively predicted TAS-Total.
Longarzo et al. (2015)	Italy	Cross-sectional	Healthy university students and staff from psychology and political science departments	250	27.9	70%	Non-clinical	No current or past history of alcohol or drug abuse; no current or past history of major psychiatric diseases; no history of brain injury, stroke, or any other major clinical condition; no past or current use of psychoactive medications.	Interoceptive Awareness	SAQ	SAQ-Total	TAS-20	DIF DDF EOT TAS-Total	None	Positive correlations between SAQ and TAS scales, small (DDF) and medium (DIF) in magnitude. EOT n.s.. SAQ positively predicted TAS-20.
Lyvers and Thorberg (2023)	Australia	Cross-sectional	Young adult alcohol users aged 18-30	224	24.8	66%	Non-clinical	Aged 18-30; no current medication for neurological or psychological disorder, or history of traumatic brain injury.	Interoceptive Sensibility	MAIA-2	MAIA-Total	TAS-20	TAS-Total	None	No significant correlation between MAIA-Total and TAS-Total. Correlations between MAIA scales and TAS-Total, small positive (ND) and negative (AR, Trust) TAS-Total significantly negatively predicted MAIA-Total in mediation model predicting alcohol use.
Morales et al. (2022)	US	Randomised experimental	Female undergraduate students aged 18 to 29, normal BMI	128	19.3	100%	Non-clinical	Inclusion: BMI ≥17.5; history or no history of loss of control eating; English proficiency. Exclusion: ED diagnosis or behaviour; active psychotic symptoms; current suicidal ideation.	Interoceptive Awareness	MAIA	MAIA-Total	TAS-20	TAS-Total	None	Small negative correlation between TAS-Total and MAIA-Total following experimental manipulation of positive or negative mood.
Mul et al. (2018)	UK	Cross-sectional	Adults with and without ASD	52 ASD: 26 HC: 26		26.9%	ASD	ASD: Previous ASD diagnosis confirmed via clinical interview. HCs: Not reported.	Interoceptive Awareness	MAIA	AR, Active and Reactive Strategies (ND, NW, SR, BL), Awareness (Not., EA, Trust.)	TAS-20	DIF DDF EOT TAS-Total	BMI	Negative partial correlations between EOT and MAIA factors, medium (AR, active and reactive strategies [ND, NW, SR, BL]) and large (awareness [Not., EA, Trust]) in magnitude. HCs, ASD/Alexithymia, and ASD/No Alexithymia groups significantly differed in MAIA

															factors for awareness, active and reactive strategies, and AR MAIA factors: ASD/Alexithymia group < ASD/No Alexithymia, HCs In pooled sample, TAS-Total negatively predicted by MAIA awareness (b=-2.42), active and reactive strategies (b=-2.88), AR n.s. (b=0.16), R2=.47.
Murphy et al. (2020)	UK	Cross-sectional	Convergent Validity (Study 2): Adults aged 18-91 primarily without psychiatric diagnoses Accuracy and Attention (Study 5) Healthy adults aged 20-56	Study 2: 76 Study 5: 35	Study 2: 39.3 Study 5: 28.5	Study 2: 67.1 Study 5: 74.1	Study 2: Unclear Study 5: Non-clinical	Not reported for Study 2. Study 5: No current psychiatric diagnosis; English as first language.	Self-Reported Interoceptive Accuracy Self-Reported Interoceptive Attention	BPQ IAS ICQ	BPQ-BA IAS-Total ICQ-Total	TAS-20	TAS-Total	Study 2: Self-esteem Study 5: Age, gender, depression, and anxiety	Study 2: Medium negative correlation between IAS and TAS-Total (r=.43), BPQ-A n.s.. After controlling for self-esteem, negative partial correlation between TAS-20 and IAS small in magnitude. BPQ-A n.s. Study 5: Large negative correlations between TAS-Total and IAS, ICQ. BPQ n.s. Multiple linear regressions controlled for age, gender, depression, and anxiety; TAS-Total significantly negatively predicted IAS, positively predicted ICQ. TAS-Total n.s. where BPQ was outcome.
Pink et al. (2021)	UK	Cross-sectional	Healthy females	254	23.8	100%	Non-clinical	Identifying as female; no current or historical diagnosis of depression, anxiety or eating disorders; English language proficiency.	Interoceptive Sensibility	MAIA	Not., ND, NW, AR, EA, SR, BL, Trust.	TAS-20	DIF DDF EOT TAS-Total	None	Recorded at baseline, negative correlations between DIF and MAIA scales, small (NW), medium (Trust), and large (AR) in magnitude. Not., ND, EA, SR, BL ns. Small negative correlations between DDF and MAIA scales (AR, EA, Trust.) in magnitude. Not., ND, NW, SR, BL ns. Small negative correlations between

															EOT and MAIA scales (Not., AR, EA, SR, BL, Trust.). ND and NW ns. Negative correlations between TAS-Total and MAIA scales, small (NW, AR, EA, SR, BL) and medium (Trust) in magnitude. Not.,ND, BL n.s..
Riccardi et al. (2021)	UK	Cross-sectional	Patients with a diagnosis of functional motor disorders; HC matched for age and gender	Functional group: N=22 HC: N=23 Total: 55		86.4%	Functional motor disorders	FMD: clinically established and documented FMD. HCs: hospital visitor or staff. Exclusion: language difficulties; learning disability; concurrent neurological, cardiologic or medical conditions,; treatment with medications with direct cardiac effects.	Interoceptive Sensibility	BAQ	BAQ-Total	TAS-20	TAS-Total	None	No significant Spearman correlation between BAQ and TAS-Total in Functional group only or full sample.
Schmitz et al. (2021)	Germany	Cross-sectional	Patients with fibromyalgia; HC matched for age and gender, aged 21-77	112 FM: 55 HCs: 55	53.8	83.90%	Fibromyalgia	Fibromyalgia: Confirmed diagnosis via physician based on 2 criteria. Exclusion: Severe physical diseases, psychosis, and addictions. HCs: meeting DSM-IV criteria of pain disorder or somatic stress disorder.	Interoceptive Sensibility	MAIA	Not., ND, NW, AR, EA, SR, BL, Trust.	TAS-20	TAS-Total	Depression, anxiety	In fibromyalgia group, negative correlations between TAS-Total and MAIA scales, small (Not., ND, EA, BL, Trust.) and medium (NW, AR, SR) in magnitude. In regression model, no MAIA subscale significantly predicted TAS-Total scores above and beyond anxiety and depression. For healthy controls, negative correlations between TAS-Total and MAIA scales, small (Not., ND, NW, SR), medium (AR, EA, BL), and large (Trust.) in magnitude. In regression model, only MAIA-Not. and MAIA-EA were significant negative predictors of TAS-Total.
Sweetnam and Flack (2023)	Australia	Cross-sectional	Adults aged 18-78	349	43.7	86.40%	Non-clinical	Engaged in weekly exercise; aged 18+	Interoceptive Awareness	MAIA-2	MAIA-Total	TAS-20	TAS-Total	None	Large negative correlation between

															MAIA-Total and TAS-Total.
Taylor et al. (1996)	UK	Cross-sectional	Female patients with AN, matched HCs, university students	Total: 312 AN: 48 HC: 30 Students: 234	AN: 24.7 HCs: 26.8 Students: 21.6	AN: 100% HC: 100% Students: 50.4%	AN	AN: patients meeting DSM-III-R criteria for AN. HC: no history of eating disorder.	Interoceptive Awareness	EDI	EDI-IAw	TAS-20	TAS-Total	None	Medium positive correlations between EDI-IAw and TAS-Total in AN and male students.
Tünte et al. (2022)	Austria, Germany	Cross-sectional	German speaking adults drawn from general population; German and Austrian university students	Total: 857 Sample 1: 135 Sample 2: 388 Sample 3: 77 Sample 4: 254	23.4 - 30.96	Sample 1: 77.7% Sample 2: 55.7% Sample 3: 72.7% Sample 4: 81.1%	Non-clinical	Inclusion: Aged 18-70. Exclusion: no report of high proficiency German level, aged ≤17, left items unanswered, and/or responded too fast or slow; reported neurological or heart disease.	Self-Reported Interoceptive Attention	IATS	IATS-Total	TAS-20	DIF DDF EOT TAS-Total	None	Positive correlations between TAS-Total and interoceptive self-reports, small (IATS, BPQ-R-Sub) and medium (BPQ-R-Supra) in magnitude. Medium negative correlation with IAS. BPQ-BA n.s. Small positive correlations between DDF and interoceptive self-reports (IATS,BPQ-R-Supra, BPQ-R-Sub). Small negative correlation with IAS. BPQ-BA n.s. Positive correlations between DIF and interoceptive self-reports, small (IATS, BPQ-R-Sub) and medium (BPQ-R-Supra) in magnitude. Medium negative correlation with IAS. BPQ-BA n.s. Small negative correlation between EOT and BPQ-BA. IATS, IAS, BPQ-R-Supra, BPQ-R-Sub n.s.
Ventura-Bort et al. (2021)	Germany	Cross-sectional	University students	157	25.9	85.99%	None	Inclusoin: German proficiency. Exclusion: History of neurological disorder; undergoing psychological treatment; suffered psychological disorder in last year; ongoing acute or long-term psychiatric treatment.	Interoceptive Sensibility	ICQ IAS MAIA-2	ICQ-Total IAS-Total Not., AR, EA, BL	TAS-20	DIF DDF EOT	None	Negative correlations between DIF and interoceptive self-reports, small (EA), medium (Not., AR, BL), and large (IAS, Trust.) in magnitude. Positive large correlation with ICQ. Negative correlations between DDF and interoceptive self-reports, small (IAS, EA) and medium (AR, BL, Trust.) in magnitude. Positive

															medium correlation with ICQ. Not. n.s. Negative correlations between EOT and interoceptive self-reports, small (IAS, AR, EA, Trust.) and medium (IAS) in magnitude. ICQ, Not. n.s.. PCA produced sensibility factor, consisting of ICQ, IAS, AR, Trust, DIF, DDF, EOT scales.
Vinni et al. (2023)	Greece	Case control, Cross-sectional	Adult patients with IBD	IBD: 57 (Crohn's: 41, UC: 16)		CD: 36.8% UC: 62.5%	IBD (CD, UC)	Exclusion: illicit drug use or alcohol abuse during past year; stroke, cancer, cerebrovascular disease; mental retardation, dementia, psychotic or bipolar disorder; mindfulness-based therapy; lack of fluency in the Greek language.	Interoceptive Sensibility	MAIA	Not., ND, NW, AR, EA, SR, BL, Trust.	TAS-20	DIF DDF EOT TAS-Total	None	In CD group, medium negative correlations between DIF and MAIA scales (NW, AR, SR, BL, Trust.). Medium negative correlations between DDF and MAIA scales (NW, AR, BL, Trust.). No correlations between EOT and MAIA scales. Medium negative correlations between TAS-Total and MAIA scales (NW, AR, SR, BL, Trust.).In UC group, no significant correlations between TAS scales and MAIA scales.
Vlemincx et al. (2021)	Netherlands	Cross-sectional	Undergraduate psychology students; Dutch speaking adults	Students: 357 Dutch adults: 399	Students: 18.3 Adults: 28.9	Students: 84.3% Dutch adults: 47.3%)	Non-clinical	Aged 18+; proficiency in Dutch	Self-Reported Interoception	THISQ	THISQ-Total, THISQ-CRA,THISQ-CRD, THISQ-GES	TAS-20	DIF DDF EOT	None	Small positive correlation between DIF and THISQ-CRA. Small positive correlations between THISQ scales and DDF (CRA, GES). Small negative correlations between EOT and THISQ scales (THISQ-Total, CRA, CRD, GES).
Zahid et al. (2023)	Canada	Cross-sectional	Adults from English-speaking countries	759		50.60%	Non-clinical	English proficiency; from US, Canada, UK, New Zealand, Australia.	Interoceptive Awareness	MAIA-2	AR, SR, BL	TAS-20, PAQ	TAS-Total PAQ-Total	None	Small negative correlations between TAS-Total and MAIA scales (AR, SR, BL). Small negative correlations between PAQ-Total and MAIA scales (AR, SR, BL). TAS-Total negatively predicted AR, SR and BL. No PAQ

															subscales predicted MAIA scales.
Zamariola et al. (2018)	Belgium	Cross-sectional	French and Dutch university students	899	20.1 to 22.8	Study 2 (BAQ/Alexithymia): 74.7% Study 3 (BAQ/Alexithymia): 75.2% Study 4 (MAIA/Alexithymia): 65% Study 5 (MAIA/Alexithymia): 69% Study 6 (MAIA/Alexithymia): 86%	Non-clinical	Not reported.	Interoceptive Sensibility	BAQ	BAQ-Total	TAS-20	DIF DDF EOT TAS-Total	None	Negative correlations between BAQ and TAS scales, small (DDF) and medium (EOT, TAS-Total) in magnitude. DIF n.s.. Negative correlations between DIF and MAIA scales, small (Not., ND) and medium (NW, AR, Trust.) EA, BL ns. Negative correlations between DDF and MAIA scales, small (NW, AR, SR, BL, Trust.) in magnitude. Not., ND, EA ns. Negative correlations between EOT and MAIA scales, small (Not., AR, EA, SR, BL, Trust.) in magnitude. ND and NW ns. Negative correlations between TAS-Total and MAIA scales, small (Not, SR, BL) and medium (NW, AR, Trust.) ND, EA. ns. Small positive correlation between TAS-Total and IAQ-Aw. Regression models showed that BAQ negatively predicted EOT and TAS-total. IAQ—Aw negatively predicted EOT and TAS-Total.
										MAIA	Not., ND, NW, AR, EA, SR, BL, Trust.				

S5 File. Interoceptive self-report scales employed in included studies

Table S4. Interoceptive Self-Report Scales Employed in Included Studies, Abbreviations, Subscales, and Descriptions.

Measure and Subscales	Abbreviation	Scale Description
Body Awareness Questionnaire	BAQ	Assesses self-reported attentiveness to normal non-emotive body processes, such as sensitivity to body cycles and rhythms, ability to detect small changes in normal functioning, and ability to anticipate bodily reactions.
Body Perception Questionnaire	BPQ	The subjective experiences of the function and reactivity of target organs and structures that are innervated by the autonomic nervous system
Short Form	SF	Abbreviated version of BPQ
Body Awareness Scale	BPQ-BA	Sensitivity for and awareness of internal bodily functions.
Autonomic Reactivity Scale	BPQ-R-Total	A combined measure of both supra- and sub-diaphragmatic symptoms (e.g., shortness of breath cf. digestive problems).
Autonomic Reactivity - Supradiaphragmatic	BPQ-R-Supra	Reactivity of symptoms above the diaphragm
Autonomic Reactivity - Subdiaphragmatic	BPQ-R-Sub	Reactivity of symptoms below the diaphragm
Stress Response	BPQ-SR	Awareness of perceived changes due to stressful situations
Stress Style	BPQ-SS	Typical emotional and physiological responses to stress
Eating Disorder Inventory	EDI	Multidimensional questionnaire assessing eating-related attitudes and behaviours and other psychological traits associated with anorexia nervosa and bulimia nervosa
Interoceptive Awareness Scale	IAw	The ability to discriminate between sensations and feelings, and between the sensations of hunger and satiety
Interoceptive Accuracy Scale	IAS	Self-perceived interoceptive accuracy
Interoceptive Attention Scale	IATS	Evaluates self-reported attention to interoceptive signals, such as hunger or pain
Interoceptive Confusion Questionnaire	ICQ	Self-perceived trait interoceptive accuracy; assesses the degree to which individuals feel that they struggle to interpret their own non-affective interoceptive states
Interoception Sensory Questionnaire	ISQ	Confusion about interoceptive bodily states unless these states are extreme (alexisomia)
Multidimensional Assessment of Interoceptive Awareness*	MAIA	An 8-subscale state-trait self-report questionnaire to measure multiple dimensions of interoception (awareness of bodily sensations)
Noticing		Awareness of uncomfortable, comfortable, and neutral body sensations
Not-Distracting	ND	Tendency not to ignore or distract oneself from sensations of pain or discomfort

Not-Worrying	NW	Tendency not to worry or experience emotional distress with sensations of pain or discomfort
Attention Regulation	AR	Ability to sustain and control attention to body sensations
Emotional Awareness	EA	Awareness of the connection between body sensations and emotional states
Self-Regulation	SR	Ability to regulate distress by attention to body sensations
Body Listening	BL	Active listening to the body for insight
Trusting		Experience of one's body as safe and trustworthy
Self-Awareness Questionnaire	SAQ	A self-report tool assessing interoceptive awareness
Factor 1	F1	Awareness of visceral sensations (e.g., heartbeat)
Factor 2	F2	Awareness of somatosensory sensations (e.g., pins and needles)
Total		Global interoceptive awareness; higher scores indicate higher awareness
Sensory Profile Interoception	SPI	A participation-focused measure of internal body sensations, evaluating how interoception manifests itself in everyday life behaviours
Avoiding		Active behaviours to avoid interoceptive sensations
Registration		Lack of awareness of interoceptive input
Seeking		Active behaviours to increase interoceptive input
Sensitivity		Heightened awareness of interoception
Three-Domain Interoceptive Sensations Questionnaire	THISQ	A three-scale questionnaire that assesses the perception of neutral sensations in respiratory, cardiac, and gastroesophageal domains
Cardio-Respiratory Activation	CRA	Self-perception of neutral cardiac and respiratory activation (e.g., faster heartrate)
Cardio-Respiratory Deactivation	CRD	Self-perception of neutral cardiac and respiratory deactivation (e.g., shallower breathing)
Gastro-esophageal Sensations	GES	Self-perception of neutral gastroesophageal sensations (e.g., bowel movements)
Total		Global perception of neutral respiratory, cardiac, and gastroesophageal sensations

* Abbreviation for Multidimensional Assessment of Interoceptive Awareness, Version 2: MAIA-2

S6 File. Sample characteristics and extracted correlations of each Independent Sample within included studies employing interoceptive self-report scales to examine their relationship with global alexithymia.

Table S5. Sample characteristics and extracted correlations of each Independent Sample within included studies employing interoceptive self-report scales to examine their relationship with global alexithymia.

Study	Interoception Scale	Alexithymia Scale	*N* (adj.)*	*Extracted r*	Clinical Status (0 = Non-Clinical, 1 = Clinical)	% Female	Sample Region
Ricciardi (2021) - FMD/HC	BAQ	TAS-20-Total	55	-0.045	1	60	Europe - UK
Zamariola (2018) - Study 2	BAQ	TAS-20-Total	158	-0.19	0	74.7	Europe - Other
Zamariola (2018) - Study 3	BAQ	TAS-20-Total	157	-0.15	0	75.2	Europe - Other
Betka (2018)	BPQ-BA	TAS-20-Total	590	0.20	0	74	Europe - UK
Brand (2022)	BPQ-BA	TAS-20-Total	614	-0.077	0	66	Europe - Other
Campos (2021)	BPQ-BA	TAS-20-Total	515	-0.03	0	60	Europe - Other
Ernst (2014)	BPQ-BA	TAS-20-Total	18	0.55	0	59	Europe - Other
Gaggero (2021) - ITa	BPQ-BA	TAS-20-Total	162.5*	-0.09	0	68	Europe - Other
Gaggero (2021) - ITb	BPQ-BA	BVAQ-C	162.5*	-0.17	0	68	Europe - Other
Gaggero (2021) - USa	BPQ-BA	TAS-20-Total	125*	0.07	0	68	North America
Gaggero (2021) - USb	BPQ-BA	BVAQ-C	125*	0.02	0	68	North America
Gaggero (2021) - SGa	BPQ-BA	TAS-20-Total	119.5*	-0.02	0	62.8	Asia
Gaggero (2021) - SGb	BPQ-BA	BVAQ-C	119.5*	-0.09	0	62.8	Asia
Hassen (2023) - ASD	BPQ-BA	TAS-20-Total	27	-0.51	1	50	Europe - Other
Hassen (2023) - Sample 1	BPQ-BA	TAS-20-Total	30	-0.05	0	46.7	Europe - Other
Hassen (2023) - Sample 2	BPQ-BA	TAS-20-Total	20	-0.112	0	80	Europe - Other
Murphy (2020) - Study 2	BPQ-BA	TAS-20-Total	76	0.08	0	61.7	Europe - UK
Murphy (2020) - Study 5	BPQ-BA	TAS-20-Total	35	0.07	0	74.1	Europe - UK
Brand (2022)	BPQ-R-Sub	TAS-20-Total	614	0.166	0	66	Europe - Other
Gaggero (2021) - ITa	BPQ-R-Sub	TAS-20-Total	162.5*	0.23	0	68	Europe - Other
Gaggero (2021) - ITb	BPQ-R-Sub	BVAQ-C	162.5*	0.19	0	68	Europe - Other
Gaggero (2021) - USa	BPQ-R-Sub	TAS-20-Total	125*	0.32	0	68	North America
Gaggero (2021) - USb	BPQ-R-Sub	BVAQ-C	125*	0.2	0	68	North America
Gaggero (2021) - SGa	BPQ-R-Sub	TAS-20-Total	119.5*	0.28	0	62.8	Asia

Gaggero (2021) - SGb	BPQ-R-Sub	BVAQ-C	119.5*	0.19	0	62.8	Asia
Brand (2022)	BPQ-R-Supra	TAS-20-Total	614	0.309	0	66	Europe - Other
Gaggero (2021) - ITa	BPQ-R-Supra	TAS-20-Total	162.5*	0.25	0	68	Europe - Other
Gaggero (2021) - ITb	BPQ-R-Supra	BVAQ-C	162.5*	0.25	0	68	Europe - Other
Gaggero (2021) - USa	BPQ-R-Supra	TAS-20-Total	125*	0.48	0	68	North America
Gaggero (2021) - USb	BPQ-R-Supra	BVAQ-C	125*	0.4	0	68	North America
Gaggero (2021) - SGa	BPQ-R-Supra	TAS-20-Total	119.5*	0.37	0	62.8	Asia
Gaggero (2021) - SGb	BPQ-R-Supra	BVAQ-C	119.5*	0.33	0	62.8	Asia
Campos (2021)	BPQ-R-Total	TAS-20-Total	515	0.37	0	60	Europe - Other
Ernst (2014)	BPQ-R-Total	TAS-20-Total	18	0.65	0	59	Europe - Other
Gaggero (2021) - ITa	BPQ-R-Total	TAS-20-Total	162.5*	0.28	0	68	Europe - Other
Gaggero (2021) - ITb	BPQ-R-Total	BVAQ-C	162.5*	0.26	0	68	Europe - Other
Gaggero (2021) - USa	BPQ-R-Total	TAS-20-Total	125*	0.46	0	68	North America
Gaggero (2021) - USb	BPQ-R-Total	BVAQ-C	125*	0.37	0	68	North America
Gaggero (2021) - SGa	BPQ-R-Total	TAS-20-Total	119.5*	0.38	0	62.8	Asia
Gaggero (2021) - SGb	BPQ-R-Total	BVAQ-C	119.5*	0.33	0	62.8	Asia
Taylor (1996) - AN	EDI-IAw	TAS-20-Total	48	0.42	1	100	Europe - UK
Taylor (1996) - Sample 1	EDI-IAw	TAS-20-Total	30	0.16	0	100	Europe - UK
Taylor (1996) - Sample 2	EDI-IAw	TAS-20-Total	116	0.33	0	100	Europe - UK
Taylor (1996) - Sample 3	EDI-IAw	TAS-20-Total	118	0.13	0	0	Europe - UK
Brand (2022)	IAS	TAS-20-Total	614	-0.29	0	66	Europe - Other
Campos (2021)	IAS	TAS-20-Total	515	-0.29	0	60	Europe - Other
Gaggero (2021) - ITa	IAS	TAS-20-Total	162.5*	-0.31	0	68	Europe - Other
Gaggero (2021) - ITb	IAS	BVAQ-C	162.5*	-0.34	0	68	Europe - Other
Gaggero (2021) - USa	IAS	TAS-20-Total	125*	-0.34	0	68	North America
Gaggero (2021) - USb	IAS	BVAQ-C	125*	-0.32	0	68	North America
Gaggero (2021) - SGa	IAS	TAS-20-Total	119.5*	-0.22	0	62.8	Asia
Gaggero (2021) - SGb	IAS	BVAQ-C	119.5*	-0.24	0	62.8	Asia
Jakobson (2021)	IAS	TAS-20-Total	209	-0.27	0	55.7	North America
Murphy (2020) - Study 2	IAS	TAS-20-Total	76	-0.255	0	61.7	Europe - UK

Murphy (2020) - Study 5	IAS	TAS-20-Total	35	-0.572	0	74.1	Europe - UK
Tünte (2022) - Sample 2	IATS-Total	TAS-20-Total	447	0.22	0	Unclear	Europe - Other
Tünte (2022) - Sample 1	IATS-Total	TAS-20-Total	134	0.21	0	Unclear	Europe - Other
Brand (2022)	ICQ-Total	TAS-20-Total	614	0.52	0	66	Europe - Other
Brewer (2016)	ICQ-Total	TAS-20-Total	653	0.69	0	51	Europe - UK
Gaggero (2021) - ITa	ICQ-Total	TAS-20-Total	162.5*	0.46	0	68	Europe - Other
Gaggero (2021) - ITb	ICQ-Total	BVAQ-C	162.5*	0.5	0	68	Europe - Other
Gaggero (2021) - USa	ICQ-Total	TAS-20-Total	125*	0.69	0	68	North America
Gaggero (2021) - USb	ICQ-Total	BVAQ-C	125*	0.62	0	68	North America
Gaggero (2021) - SGa	ICQ-Total	TAS-20-Total	119.5*	0.46	0	62.8	Asia
Gaggero (2021) - SGb	ICQ-Total	BVAQ-C	119.5*	0.46	0	62.8	Asia
Murphy (2020) - Study 5	ICQ-Total	TAS-20-Total	35	0.648	0	74.1	Europe - UK
Bonete (2023) - ASD	ISQ-Total	TAS-20-Total	33	0.502	0	0	Europe - Other
Bonete (2023)	ISQ-Total	TAS-20-Total	35	0.563	0	0	Europe - Other
Fiene (2018)	ISQ-Total	TAS-20-Total	511	0.76	0	61.3	Australasia
Brand (2022)	MAIA-AR	TAS-20-Total	614	-0.31	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-AR	TAS-20-Total	308	-0.37	0	61.4	Europe - Other
Desdentado (2022)	MAIA-AR	TAS-20-Total	391	-0.26	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-AR	TAS-20-Total	230	-0.27	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-AR	TAS-20-Total	162.5*	-0.29	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-AR	BVAQ-C	162.5*	-0.34	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-AR	TAS-20-Total	125*	-0.23	0	68	North America
Gaggero (2021) - USb	MAIA-AR	BVAQ-C	125*	-0.32	0	68	North America
Gaggero (2021) - SGa	MAIA-AR	TAS-20-Total	119.5*	-0.18	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-AR	BVAQ-C	119.5*	-0.21	0	62.8	Asia
Huang (2022)	MAIA-AR	TAS-20-Total	224	-0.18	0	70.1	Asia
Lyvers & Thornberg (2023)	MAIA-AR	TAS-20-Total	337	-0.20	0	66	Australasia
Mul (2018)	MAIA-AR	TAS-20-Total	52	-0.34	1	26.9	Europe - UK
Pink (2021)	MAIA-AR	TAS-20-Total	172	-0.25	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-AR	TAS-20-Total	55	-0.34	1	83.9	Europe - Other

Schmitz (2021)	MAIA-AR	TAS-20-Total	55	-0.16	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-AR	TAS-20-Total	41	-0.32	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-AR	TAS-20-Total	16	-0.16	1	62.5	Europe - Other
Zahid (2023)	MAIA-AR	TAS-20-Total	379.5*	-0.25	0	50.6	North America
Zahid (2023)	MAIA-AR	PAQ-Total	379.5*	-0.18	0	50.6	North America
Zamariola (2018) - Studies 4-6	MAIA-AR	TAS-20-Total	263	-0.33	0	77.9	Europe - Other
Brand (2022)	MAIA-BL	TAS-20-Total	614	-0.18	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-BL	TAS-20-Total	308	-0.33	0	61.4	Europe - Other
Desdentado (2022)	MAIA-BL	TAS-20-Total	391	-0.22	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-BL	TAS-20-Total	230	-0.22	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-BL	TAS-20-Total	162.5*	-0.30	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-BL	BVAQ-C	162.5*	-0.39	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-BL	TAS-20-Total	125*	-0.25	0	68	North America
Gaggero (2021) - USb	MAIA-BL	BVAQ-C	125*	-0.34	0	68	North America
Gaggero (2021) - SGa	MAIA-BL	TAS-20-Total	119.5*	-0.1	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-BL	BVAQ-C	119.5*	-0.2	0	62.8	Asia
Huang (2022)	MAIA-BL	TAS-20-Total	224	-0.14	0	70.1	Asia
Pink (2021)	MAIA-BL	TAS-20-Total	172	-0.08	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-BL	TAS-20-Total	55	-0.29	1	83.9	Europe - Other
Schmitz (2021)	MAIA-BL	TAS-20-Total	55	-0.28	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-BL	TAS-20-Total	41	-0.35	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-BL	TAS-20-Total	16	-0.02	1	62.5	Europe - Other
Zahid (2023)	MAIA-BL	TAS-20-Total	379.5*	-.21	0	50.6	North America
Zahid (2023)	MAIA-BL	PAQ-Total	379.5*	-.21	0	50.6	North America
Zamariola (2018) - Studies 4-6	MAIA-BL	TAS-20-Total	263	-0.23	0	77.9	Europe - Other
Brand (2022)	MAIA-EA	TAS-20-Total	614	-0.21	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-EA	TAS-20-Total	308	-0.30	0	61.4	Europe - Other
Desdentado (2022)	MAIA-EA	TAS-20-Total	391	-0.15	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-EA	TAS-20-Total	230	-0.17	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-EA	TAS-20-Total	162.5*	-0.18	0	68	Europe - Other

Gaggero (2021) - ITb	MAIA-EA	BVAQ-C	162.5*	-0.24	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-EA	TAS-20-Total	125*	-0.2	0	68	North America
Gaggero (2021) - USb	MAIA-EA	BVAQ-C	125*	-0.27	0	68	North America
Gaggero (2021) - SGa	MAIA-EA	TAS-20-Total	119.5*	-0.1	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-EA	BVAQ-C	119.5*	-0.17	0	62.8	Asia
Huang (2022)	MAIA-EA	TAS-20-Total	224	-0.13	0	70.1	Asia
Pink (2021)	MAIA-EA	TAS-20-Total	172	-0.18	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-EA	TAS-20-Total	55	-0.10	1	83.9	Europe - Other
Schmitz (2021)	MAIA-EA	TAS-20-Total	55	-0.33	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-EA	TAS-20-Total	41	-0.17	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-EA	TAS-20-Total	16	-0.01	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-EA	TAS-20-Total	263	-0.07	0	77.9	Europe - Other
Brand (2022)	MAIA-ND	TAS-20-Total	614	-0.33	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-ND	TAS-20-Total	308	-0.27	0	61.4	Europe - Other
Desdentado (2022)	MAIA-ND	TAS-20-Total	391	-0.16	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-ND	TAS-20-Total	230	-0.30	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-ND	TAS-20-Total	162.5*	-0.15	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-ND	BVAQ-C	162.5*	-0.21	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-ND	TAS-20-Total	125*	-0.31	0	68	North America
Gaggero (2021) - USb	MAIA-ND	BVAQ-C	125*	-0.25	0	68	North America
Gaggero (2021) - SGa	MAIA-ND	TAS-20-Total	119.5*	-0.30	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-ND	BVAQ-C	119.5*	-0.25	0	62.8	Asia
Huang (2022)	MAIA-ND	TAS-20-Total	224	-0.14	0	70.1	Asia
Lyvers & Thornberg (2023)	MAIA-ND	TAS-20-Total	337	-0.15	0	66	Australasia
Pink (2021)	MAIA-ND	TAS-20-Total	172	-0.07	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-ND	TAS-20-Total	55	-0.20	1	83.9	Europe - Other
Schmitz (2021)	MAIA-ND	TAS-20-Total	55	-0.18	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-ND	TAS-20-Total	41	0.1	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-ND	TAS-20-Total	16	-0.16	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-ND	TAS-20-Total	263	-0.11	0	77.9	Europe - Other

Brand (2022)	MAIA-Noticing	TAS-20-Total	614	-0.13	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-Noticing	TAS-20-Total	308	-0.30	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Noticing	TAS-20-Total	391	-0.08	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Noticing	TAS-20-Total	230	-0.18	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-Noticing	TAS-20-Total	162.5*	-0.22	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-Noticing	BVAQ-C	162.5*	-0.26	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-Noticing	TAS-20-Total	125*	-0.24	0	68	North America
Gaggero (2021) - USb	MAIA-Noticing	BVAQ-C	125*	-0.32	0	68	North America
Gaggero (2021) - SGa	MAIA-Noticing	TAS-20-Total	119.5*	-0.03	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-Noticing	BVAQ-C	119.5*	-0.13	0	62.8	Asia
Huang (2022)	MAIA-Noticing	TAS-20-Total	224	-0.12	0	70.1	Asia
Pink (2021)	MAIA-Noticing	TAS-20-Total	172	-0.13	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-Noticing	TAS-20-Total	55	-0.27	1	83.9	Europe - Other
Schmitz (2021)	MAIA-Noticing	TAS-20-Total	55	-.18	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-Noticing	TAS-20-Total	41	0.01	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Noticing	TAS-20-Total	16	-0.32	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-Noticing	TAS-20-Total	263	-0.23	0	77.9	Europe - Other
Brand (2022)	MAIA-NW	TAS-20-Total	614	-0.22	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-NW	TAS-20-Total	308	0.02	0	61.4	Europe - Other
Desdentado (2022)	MAIA-NW	TAS-20-Total	391	-0.18	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-NW	TAS-20-Total	230	-0.02	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-NW	TAS-20-Total	162.5*	-0.18	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-NW	BVAQ-C	162.5*	-0.07	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-NW	TAS-20-Total	125*	-0.23	0	68	North America
Gaggero (2021) - USb	MAIA-NW	BVAQ-C	125*	-0.1	0	68	North America
Gaggero (2021) - SGa	MAIA-NW	TAS-20-Total	119.5*	-0.25	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-NW	BVAQ-C	119.5*	-0.09	0	62.8	Asia
Huang (2022)	MAIA-NW	TAS-20-Total	224	-0.14	0	70.1	Asia
Pink (2021)	MAIA-NW	TAS-20-Total	172	-0.17	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-NW	TAS-20-Total	55	-0.42	1	83.9	Europe - Other

Schmitz (2021)	MAIA-NW	TAS-20-Total	55	-0.29	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-NW	TAS-20-Total	41	-0.34	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-NW	TAS-20-Total	16	0.04	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-NW	TAS-20-Total	263	-0.33	0	77.9	Europe - Other
Brand (2022)	MAIA-SR	TAS-20-Total	614	-0.34	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-SR	TAS-20-Total	308	-0.37	0	61.4	Europe - Other
Desdentado (2022)	MAIA-SR	TAS-20-Total	391	-0.16	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-SR	TAS-20-Total	230	-0.17	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-SR	TAS-20-Total	162.5*	-0.28	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-SR	BVAQ-C	162.5*	-0.26	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-SR	TAS-20-Total	125*	-0.34	0	68	North America
Gaggero (2021) - USb	MAIA-SR	BVAQ-C	125*	-0.39	0	68	North America
Gaggero (2021) - SGa	MAIA-SR	TAS-20-Total	119.5*	-0.25	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-SR	BVAQ-C	119.5*	-0.32	0	62.8	Asia
Huang (2022)	MAIA-SR	TAS-20-Total	224	-0.22	0	70.1	Asia
Pink (2021)	MAIA-SR	TAS-20-Total	172	-0.21	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-SR	TAS-20-Total	55	-0.38	1	83.9	Europe - Other
Schmitz (2021)	MAIA-SR	TAS-20-Total	55	-0.30	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-SR	TAS-20-Total	41	-0.34	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-SR	TAS-20-Total	16	-0.03	1	62.5	Europe - Other
Zahid (2023)	MAIA-SR	TAS-20-Total	379.5*	-0.29	0	50.6	North America
Zahid (2023)	MAIA-SR	PAQ-Total	379.5*	-0.19	0	50.6	North America
Zamariola (2018) - Studies 4-6	MAIA-SR	TAS-20-Total	263	-0.28	0	77.9	Europe - Other
Berenguer (2023) - F	MAIA-Total	TAS-20-Total	152	-0.36	0	100	Europe - Other
Berenguer (2023) - M	MAIA-Total	TAS-20-Total	86	-0.3	0	0	Europe - Other
Da Costa Silva (2022)	MAIA-Total	TAS-20-Total	308	-0.50	0	61.4	Europe - Other
Ferraro & Taylor (2021)	MAIA-Total	TAS-20-Total	219	0.31	0	22	Australasia
Gaggero (2021) - ITa	MAIA-Total	TAS-20-Total	162.5*	-0.4	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-Total	BVAQ-C	162.5*	-0.44	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-Total	TAS-20-Total	125*	-0.42	0	68	North America

Gaggero (2021) - USb	MAIA-Total	BVAQ-C	125*	-0.46	0	68	North America
Gaggero (2021) - SGa	MAIA-Total	TAS-20-Total	119.5*	-0.36	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-Total	BVAQ-C	119.5*	-0.43	0	62.8	Asia
Morales (2022)	MAIA-Total	TAS-20-Total	128	-0.26	0	100	North America
Sweetnam & Flack (2023)	MAIA-Total	TAS-20-Total	404	-0.55	0	86.4	Australasia
Brand (2022)	MAIA-Trusting	TAS-20-Total	614	-0.4	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-Trusting	TAS-20-Total	308	-0.42	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Trusting	TAS-20-Total	391	-0.28	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Trusting	TAS-20-Total	230	-0.26	0	51	Europe - UK
Gaggero (2021) - ITa	MAIA-Trusting	TAS-20-Total	162.5*	-0.35	0	68	Europe - Other
Gaggero (2021) - ITb	MAIA-Trusting	BVAQ-C	162.5*	-0.39	0	68	Europe - Other
Gaggero (2021) - USa	MAIA-Trusting	TAS-20-Total	125*	-0.39	0	68	North America
Gaggero (2021) - USb	MAIA-Trusting	BVAQ-C	125*	-0.42	0	68	North America
Gaggero (2021) - SGa	MAIA-Trusting	TAS-20-Total	119.5*	-0.36	0	62.8	Asia
Gaggero (2021) - SGb	MAIA-Trusting	BVAQ-C	119.5*	-0.4	0	62.8	Asia
Huang (2022)	MAIA-Trusting	TAS-20-Total	224	-0.27	0	70.1	Asia
Lyvers & Thornberg (2023)	MAIA-Trusting	TAS-20-Total	337	-0.27	0	66	Australasia
Pink (2021)	MAIA-Trusting	TAS-20-Total	172	-0.33	0	100	Europe - UK
Schmitz (2021) - FM	MAIA-Trusting	TAS-20-Total	55	-0.23	1	83.9	Europe - Other
Schmitz (2021)	MAIA-Trusting	TAS-20-Total	55	-0.30	0	83.9	Europe - Other
Vinni (2023) - CD	MAIA-Trusting	TAS-20-Total	41	-0.31	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Trusting	TAS-20-Total	16	-0.1	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-Trusting	TAS-20-Total	263	-0.39	0	77.9	Europe - Other

S7 File. Sample characteristics and extracted correlations of each independent sample within included studies employing interoceptive self-report scales to examine their relationship with DIF.

Table S6. Sample characteristics and extracted correlations of each Independent Sample within included studies employing interoceptive self-report scales to examine their relationship with DIF.

Study	Interoception Scale	n	*Extracted r*	Clinical Status (0 = Non-Clinical, 1 = Clinical)	% Female	Sample Region
Zamariola (2018) - Study 2	BAQ-Total	158	-0.08	0	74.7	Europe - Other
Zamariola (2018) - Study 3	BAQ-Total	157	-0.06	0	75.2	Europe - Other
Betka (2018)	BPQ-BA	590	0.23	0	74	Europe - UK
Brand (2022)	BPQ-BA	614	-0.005	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-BA	325	-0.03	0	68	Europe - Other
Gaggero (2021) - US	BPQ-BA	250	0.1	0	68	North America
Gaggero (2021) - SG	BPQ-BA	239	-0.03	0	62.8	Asia
Hassen (2023) - ASD	BPQ-BA	27	-0.482	0	50	Europe - Other
Hassen (2023) - Sample 1	BPQ-BA	30	-0.01	0	70.1	Europe - Other
Hassen (2023) - Sample 2	BPQ-BA	20	-0.15	0	80	Europe - Other
Brand (2022)	BPQ-R-Sub	614	0.111	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-R-Sub	325	0.37	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Sub	250	0.4	0	68	North America
Gaggero (2021) - SG	BPQ-R-Sub	239	0.34	0	62.8	Asia
Brand (2022)	BPQ-R-Supra	614	0.23	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-R-Supra	325	0.4	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Supra	250	0.55	0	68	North America
Gaggero (2021) - SG	BPQ-R-Supra	239	0.4	0	62.8	Asia
Gaggero (2021) - IT	BPQ-R-Total	325	0.45	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Total	250	0.55	0	68	North America
Gaggero (2021) - SG	BPQ-R-Total	239	0.43	0	62.8	Asia
Brand (2022)	IAS-Total	614	-0.3	0	66	Europe - Other
Gaggero (2021) - IT	IAS-Total	323	-0.33	0	68	Europe - Other
Gaggero (2021) - US	IAS-Total	248	-0.33	0	68	North America
Gaggero (2021) - SG	IAS-Total	239	-0.28	0	62.8	Asia

Jakobson & Rigby (2021)	IAS-Total	209	-0.2	0		North America
Tünte (2022) - Sample 2	IATS-Total	447	0.28	0		Europe - Other
Tünte (2022) - Sample 1	IATS-Total	134	0.24	0		Europe - Other
Brand (2022)	ICQ-Total	614	0.52	0	66	Europe - Other
Gaggero (2021) - IT	ICQ-Total	325	0.5	0	68	Europe - Other
Gaggero (2021) - US	ICQ-Total	250	0.71	0	68	North America
Gaggero (2021) - SG	ICQ-Total	239	0.5	0	62.8	Asia
Brand (2022)	MAIA-AR	614	-0.36	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-AR	308	-0.3	0	61.4	Europe - Other
Desdentado (2022)	MAIA-AR	391	-0.20	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-AR	230	-0.20	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-AR	325	-0.28	0	68	Europe - Other
Gaggero (2021) - US	MAIA-AR	250	-0.14	0	68	North America
Gaggero (2021) - SG	MAIA-AR	239	-0.11	0	62.8	Asia
Pink (2021)	MAIA-AR	172	-0.82	0	100	Europe - UK
Vinni (2023) - CD	MAIA-AR	41	-0.4	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-AR	16	0.11	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-AR	263	-0.32	0	77.9	Europe - Other
Brand (2022)	MAIA-BL	614	-0.12	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-BL	308	-0.12	0	61.4	Europe - Other
Desdentado (2022)	MAIA-BL	391	-0.12	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-BL	230	-0.15	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-BL	325	-0.21	0	68	Europe - Other
Gaggero (2021) - US	MAIA-BL	250	-0.13	0	68	North America
Gaggero (2021) - SG	MAIA-BL	239	-0.06	0	62.8	Asia
Pink (2021)	MAIA-BL	172	-0.05	0	100	Europe - UK
Vinni (2023) - CD	MAIA-BL	41	-0.4	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-BL	16	0.43	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-BL	263	-0.11	0	77.9	Europe - Other
Brand (2022)	MAIA-EA	614	-0.1	0	66	Europe - Other

Da Costa Silva (2022)	MAIA-EA	308	-0.12	0	61.4	Europe - Other
Desdentado (2022)	MAIA-EA	391	0.01	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-EA	230	-0.20	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-EA	325	-0.07	0	68	Europe - Other
Gaggero (2021) - US	MAIA-EA	250	-0.12	0	68	North America
Gaggero (2021) - SG	MAIA-EA	239	-0.05	0	62.8	Asia
Pink (2021)	MAIA-EA	172	-0.01	0	100	Europe - UK
Vinni (2023) - CD	MAIA-EA	41	-0.15	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-EA	16	0.4	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-EA	263	0.02	0	77.9	Europe - Other
Brand (2022)	MAIA-ND	614	-0.24	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-ND	308	-0.17	0	61.4	Europe - Other
Desdentado (2022)	MAIA-ND	391	-0.2	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-ND	230	-0.14	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-ND	325	-0.16	0	68	Europe - Other
Gaggero (2021) - US	MAIA-ND	250	-0.38	0	68	North America
Gaggero (2021) - SG	MAIA-ND	239	-0.26	0	62.8	Asia
Pink (2021)	MAIA-ND	172	-0.05	0	100	Europe - UK
Vinni (2023) - CD	MAIA-ND	41	0.08	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-ND	16	-0.37	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-ND	263	-0.17	0	77.9	Europe - Other
Brand (2022)	MAIA-Noticing	614	-0.17	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-Noticing	308	-0.16	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Noticing	391	-0.02	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Noticing	230	-0.13	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-Noticing	325	-0.09	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Noticing	250	-0.16	0	68	North America
Gaggero (2021) - SG	MAIA-Noticing	239	-0.04	0	62.8	Asia
Pink (2021)	MAIA-Noticing	172	0	0	86.4	Europe - UK
Vinni (2023) - CD	MAIA-Noticing	41	0	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Noticing	16	0.04	1	62.5	Europe - Other

Zamariola (2018) - Studies 4-6	MAIA-Noticing	263	-0.20	0	77.9	Europe - Other
Brand (2022)	MAIA-NW	614	-0.35	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-NW	308	-0.18	0	61.4	Europe - Other
Desdentado (2022)	MAIA-NW	391	-0.23	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-NW	230	-0.02	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-NW	325	-0.3	0	68	Europe - Other
Gaggero (2021) - US	MAIA-NW	250	-0.27	0	68	North America
Gaggero (2021) - SG	MAIA-NW	239	-0.26	0	62.8	Asia
Pink (2021)	MAIA-NW	172	-0.24	0	100	Europe - UK
Vinni (2023) - CD	MAIA-NW	41	-0.35	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-NW	16	-0.14	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-NW	263	-0.45	0	77.9	Europe - Other
Brand (2022)	MAIA-SR	614	-0.33	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-SR	308	-0.27	0	61.4	Europe - Other
Desdentado (2022)	MAIA-SR	391	-0.13	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-SR	230	-0.11	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-SR	325	-0.28	0	68	Europe - Other
Gaggero (2021) - US	MAIA-SR	250	-0.28	0	68	North America
Gaggero (2021) - SG	MAIA-SR	239	-0.29	0	62.8	Asia
Pink (2021)	MAIA-SR	172	-0.12	0	100	Europe - UK
Vinni (2023) - CD	MAIA-SR	41	-0.38	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-SR	16	0.18	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-SR	263	-0.28	0	77.9	Europe - Other
Berenguer (2023) - F	MAIA-Total	152	-0.31	0	100	Europe - Other
Berenguer (2023) - M	MAIA-Total	86	-0.21	0	0	Europe - Other
Da Costa Silva (2022)	MAIA-Total	308	-0.38	0	61.4	Europe - Other
Gaggero (2021) - IT	MAIA-Total	325	-0.37	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Total	250	-0.34	0	68	North America
Gaggero (2021) - SG	MAIA-Total	239	-0.33	0	62.8	Asia
Brand (2022)	MAIA-Trusting	614	-0.45	0	66	Europe - Other

Da Costa Silva (2022)	MAIA-Trusting	308	-0.45	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Trusting	391	-0.23	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Trusting	230	-0.1	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-Trusting	325	-0.4	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Trusting	250	-0.35	0	68	North America
Gaggero (2021) - SG	MAIA-Trusting	239	-0.37	0	62.8	Asia
Pink (2021)	MAIA-Trusting	172	-0.31	0	100	Europe - UK
Vinni (2023) - CD	MAIA-Trusting	41	-0.36	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Trusting	16	0.25	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-Trusting	263	-0.40	0	77.9	Europe - Other

S8 File. Sample characteristics and extracted correlations of each independent sample within included studies employing interoceptive self-report scales to examine their relationship with DDF.

Table S7. Sample characteristics and extracted correlations of each Independent Sample within included studies employing interoceptive self-report scales to examine their relationship with DDF.

Study	Interoception Scale	Adj. n*	*r*	Clinical Status (0 = Non-Clinical 1 = Clinical)	% Female	Sample Region
Zamariola (2018) - Study 2	BAQ-Total	158	-0.11	0	74.7	Europe - Other
Zamariola (2018) - Study 3	BAQ-Total	157	-0.17	0	75.2	Europe - Other
Betka (2018)	BPQ-BA	590	0.16	0	74	Europe - UK
Brand (2022)	BPQ-BA	614	-0.038	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-BA	325	-0.05	0	68	Europe - Other
Gaggero (2021) - US	BPQ-BA	250	0	0	68	North America
Gaggero (2021) - SG	BPQ-BA	239	0.02	0	62.8	Asia
Hassen (2023) - ASD	BPQ-BA	27	-0.459	0	50	Europe - Other
Hassen (2023) - Sample 1	BPQ-BA	30	-0.3	0	46.7	Europe - Other
Hassen (2023) - Sample 2	BPQ-BA	20	0.1	0	80	Europe - Other
Brand (2022)	BPQ-R-Sub	614	0.265	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-R-Sub	325	0.09	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Sub	250	0.19	0	68	North America
Gaggero (2021) - SG	BPQ-R-Sub	239	0.21	0	62.8	Asia
Brand (2022)	BPQ-R-Supra	614	0.395	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-R-Supra	325	0.14	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Supra	250	0.33	0	68	North America
Gaggero (2021) - SG	BPQ-R-Supra	239	0.32	0	62.8	Asia
Gaggero (2021) - IT	BPQ-R-Total	325	0.14	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Total	250	0.31	0	68	North America
Gaggero (2021) - SG	BPQ-R-Total	239	0.31	0	62.8	Asia
Gaggero (2021) - IT	IAS-Total	325	-0.25	0	68	Europe - Other
Gaggero (2021) - US	IAS-Total	250	-0.26	0	68	North America
Gaggero (2021) - SG	IAS-Total	239	-0.1	0	62.8	Asia
Jakobson & Rigby (2021)	IAS-Total	209	-0.17	0	55.7	North America

Brand (2022)	IAS-Total - Vienna	614	-.23	0	66	Europe - Other
Tünte (2022) - Sample 2	IATS-Total	447	0.2	0		Europe - Other
Tünte (2022) - Sample 1	IATS-Total	134	0.15	0		Europe - Other
Brand (2022)	ICQ-Total	614	0.42	0	66	Europe - Other
Gaggero (2021) - IT	ICQ-Total	325	0.36	0	68	Europe - Other
Gaggero (2021) - US	ICQ-Total	250	0.55	0	68	North America
Gaggero (2021) - SG	ICQ-Total	239	0.39	0	62.8	Asia
Brand (2022)	MAIA-AR	614	-0.22	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-AR	308	-0.21	0	61.4	Europe - Other
Desdentado (2022)	MAIA-AR	391	-0.15	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-AR	230	-0.20	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-AR	325	-0.16	0	68	Europe - Other
Gaggero (2021) - US	MAIA-AR	250	-0.28	0	68	North America
Gaggero (2021) - SG	MAIA-AR	239	-0.15	0	62.8	Asia
Pink (2021)	MAIA-AR	172	-0.18	0	100	Europe - UK
Vinni (2023) - CD	MAIA-AR	41	-0.32	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-AR	16	-0.11	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-AR	263	-0.20	0	77.9	Europe - Other
Brand (2022)	MAIA-BL	614	-0.15	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-BL	308	-0.25	0	61.4	Europe - Other
Desdentado (2022)	MAIA-BL	391	-0.16	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-BL	230	-0.11	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-BL	325	-0.24	0	68	Europe - Other
Gaggero (2021) - US	MAIA-BL	250	-0.33	0	68	North America
Gaggero (2021) - SG	MAIA-BL	239	-0.1	0	62.8	Asia
Pink (2021)	MAIA-BL	172	-0.07	0	100	Europe - UK
Vinni (2023) - CD	MAIA-BL	41	-0.34	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-BL	16	-0.31	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-BL	263	-0.21	0	77.9	Europe - Other
Brand (2022)	MAIA-EA	614	-0.15	0	66	Europe - Other

Da Costa Silva (2022)	MAIA-EA	308	-0.21	0	61.4	Europe - Other
Desdentado (2022)	MAIA-EA	391	-0.10	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-EA	230	-0.01	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-EA	325	-0.14	0	68	Europe - Other
Gaggero (2021) - US	MAIA-EA	250	-0.2	0	68	North America
Gaggero (2021) - SG	MAIA-EA	239	-0.05	0	62.8	Asia
Pink (2021)	MAIA-EA	172	-0.18	0	100	Europe - UK
Vinni (2023) - CD	MAIA-EA	41	-0.1	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-EA	16	-0.28	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-EA	263	-0.05	0	77.9	Europe - Other
Brand (2022)	MAIA-ND	614	-0.32	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-ND	308	-0.23	0	61.4	Europe - Other
Desdentado (2022)	MAIA-ND	391	-0.13	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-ND	230	-0.32	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-ND	325	-0.14	0	68	Europe - Other
Gaggero (2021) - US	MAIA-ND	250	-0.19	0	68	North America
Gaggero (2021) - SG	MAIA-ND	239	-0.31	0	62.8	Asia
Pink (2021)	MAIA-ND	172	-0.03	0	100	Europe - UK
Vinni (2023) - CD	MAIA-ND	41	-0.08	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-ND	16	-0.08	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-ND	263	-0.06	0	77.9	Europe - Other
Brand (2022)	MAIA-Noticing	614	-0.1	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-Noticing	308	-0.21	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Noticing	391	0	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Noticing	230	-0.06	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-Noticing	325	-0.18	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Noticing	250	-0.21	0	68	North America
Gaggero (2021) - SG	MAIA-Noticing	239	0.06	0	62.8	Asia
Pink (2021)	MAIA-Noticing	172	-0.11	0	100	Europe - UK
Vinni (2023) - CD	MAIA-Noticing	41	0.13	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Noticing	16	0.43	1	62.5	Europe - Other

Zamariola (2018) - Studies 4-6	MAIA-Noticing	263	-0.10	0	77.9	Europe - Other
Brand (2022)	MAIA-NW	614	-0.14	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-NW	308	0.11	0	61.4	Europe - Other
Desdentado (2022)	MAIA-NW	391	-0.12	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-NW	230	-0.12	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-NW	325	-0.05	0	68	Europe - Other
Gaggero (2021) - US	MAIA-NW	250	-0.22	0	68	North America
Gaggero (2021) - SG	MAIA-NW	239	-0.21	0	62.8	Asia
Pink (2021)	MAIA-NW	172	-0.06	0	100	Europe - UK
Vinni (2023) - CD	MAIA-NW	41	-0.38	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-NW	16	0.29	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-NW	263	-0.15	0	77.9	Europe - Other
Brand (2022)	MAIA-SR	614	-0.27	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-SR	308	-0.23	0	61.4	Europe - Other
Desdentado (2022)	MAIA-SR	391	-0.11	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-SR	230	-0.12	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-SR	325	-0.19	0	68	Europe - Other
Gaggero (2021) - US	MAIA-SR	250	-0.37	0	68	North America
Gaggero (2021) - SG	MAIA-SR	239	-0.18	0	62.8	Asia
Pink (2021)	MAIA-SR	172	-0.11	0	100	Europe - UK
Vinni (2023) - CD	MAIA-SR	41	-0.28	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-SR	16	-0.12	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-SR	263	-0.20	0	77.9	Europe - Other
Berenguer (2023) - F	MAIA-Total	152	-0.32	0	100	Europe - Other
Berenguer (2023) - M	MAIA-Total	86	-0.27	0	0	Europe - Other
Da Costa Silva (2022)	MAIA-Total	308	-0.32	0	61.4	Europe - Other
Gaggero (2021) - IT	MAIA-Total	325	-0.27	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Total	250	-0.42	0	68	North America
Gaggero (2021) - SG	MAIA-Total	239	-0.28	0	62.8	Asia
Brand (2022)	MAIA-Trusting	614	-.31	0	66	Europe - Other

Da Costa Silva (2022)	MAIA-Trusting	308	-0.29	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Trusting	391	-0.19	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Trusting	230	-0.32	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-Trusting	325	-0.25	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Trusting	250	-0.35	0	68	North America
Gaggero (2021) - SG	MAIA-Trusting	239	-0.26	0	62.8	Asia
Pink (2021)	MAIA-Trusting	172	-0.27	0	100	Europe - UK
Vinni (2023) - CD	MAIA-Trusting	41	-0.36	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Trusting	16	-0.26	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-Trusting	263	-0.26	0	77.9	Europe - Other

S9 File. Sample characteristics and extracted correlations of each independent sample within included studies employing interoceptive self-report scales to examine their relationship with EOT.

Table S8. Sample characteristics and extracted correlations of each Independent Sample within included studies employing interoceptive self-report scales to examine their relationship with EOT.

Study	Interoception Scale	Adj. n	*r*	Clinical Status (0 = Non-Clinical 1 = Clinical)	% Female	Sample Region
Zamariola (2018) - Study 2	BAQ-Total	158	-0.23	0	74.7	Europe - Other
Zamariola (2018) - Study 3	BAQ-Total	157	-0.15	0	75.2	Europe - Other
Betka (2018)	BPQ-BA	590	0.04	0	74	Europe - UK
Brand (2022)	BPQ-BA	614	-0.15	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-BA	325	-0.16	0	68	Europe - Other
Gaggero (2021) - US	BPQ-BA	250	0.09	0	68	North America
Gaggero (2021) - SG	BPQ-BA	239	-0.04	0	62.8	Asia
Hassen (2023) - ASD	BPQ-BA	27	0.361	0	50	Europe - Other
Hassen (2023) - Sample 1	BPQ-BA	30	0.09	0	46.7	Europe - Other
Hassen (2023) - Sample 2	BPQ-BA	20	0.367	0	80	Europe - Other
Brand (2022)	BPQ-R-Sub	614	-0.014	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-R-Sub	325	-0.01	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Sub	250	0.17	0	68	North America

Gaggero (2021) - SG	BPQ-R-Sub	239	0.06	0	62.8	Asia
Brand (2022)	BPQ-R-Supra	614	0.071	0	66	Europe - Other
Gaggero (2021) - IT	BPQ-R-Supra	325	-0.03	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Supra	250	0.27	0	68	North America
Gaggero (2021) - SG	BPQ-R-Supra	239	0.09	0	62.8	Asia
Gaggero (2021) - IT	BPQ-R-Total	325	-0.02	0	68	Europe - Other
Gaggero (2021) - US	BPQ-R-Total	250	0.25	0	68	North America
Gaggero (2021) - SG	BPQ-R-Total	239	0.08	0	62.8	Asia
Brand (2022)	IAS-Total	614	-0.15	0	66	Europe - Other
Gaggero (2021) - IT	IAS-Total	325	-0.1	0	68	Europe - Other
Gaggero (2021) - US	IAS-Total	250	-0.22	0	68	North America
Gaggero (2021) - SG	IAS-Total	239	-0.12	0	62.8	Asia
Jakobson & Rigby (2021)	IAS-Total	209	-0.21	0	55.7	North America
Tünte (2022) - Sample 2	IATS-Total	447	0.01	0		Europe - Other
Tünte (2022) - Sample 1	IATS-Total	134	0.08	0		Europe - Other
Brand (2022)	ICQ-Total	614	0.27	0	66	Europe - Other
Gaggero (2021) - IT	ICQ-Total	325	0.18	0	68	Europe - Other
Gaggero (2021) - US	ICQ-Total	250	0.37	0	68	North America
Gaggero (2021) - SG	ICQ-Total	239	0.12	0	62.8	Asia
Brand (2022)	MAIA-AR	614	-0.14	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-AR	308	-0.37	0	61.4	Europe - Other
Desdentado (2022)	MAIA-AR	391	-0.25	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-AR	230	-0.16	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-AR	325	-0.25	0	68	Europe - Other
Gaggero (2021) - US	MAIA-AR	250	-0.17	0	68	North America
Gaggero (2021) - SG	MAIA-AR	239	-0.1	0	62.8	Asia
Pink (2021)	MAIA-AR	172	-0.23	0	100	Europe - UK
Vinni (2023) - CD	MAIA-AR	41	-0.14	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-AR	16	-0.21	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-AR	263	-0.20	0	77.9	Europe - Other
Brand (2022)	MAIA-BL	614	-0.18	0	66	Europe - Other

Da Costa Silva (2022)	MAIA-BL	308	-0.45	0	61.4	Europe - Other
Desdentado (2022)	MAIA-BL	391	-0.23	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-BL	230	-0.15	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-BL	325	-0.27	0	68	Europe - Other
Gaggero (2021) - US	MAIA-BL	250	-0.19	0	68	North America
Gaggero (2021) - SG	MAIA-BL	239	-0.04	0	62.8	Asia
Pink (2021)	MAIA-BL	172	-0.20	0	100	Europe - UK
Vinni (2023) - CD	MAIA-BL	41	-0.11	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-BL	16	-0.24	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-BL	263	-0.24	0	77.9	Europe - Other
Brand (2022)	MAIA-EA	614	-0.26	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-EA	308	-0.41	0	61.4	Europe - Other
Desdentado (2022)	MAIA-EA	391	-0.29	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-EA	230	0.10	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-EA	325	-0.26	0	68	Europe - Other
Gaggero (2021) - US	MAIA-EA	250	-0.17	0	68	North America
Gaggero (2021) - SG	MAIA-EA	239	-0.13	0	62.8	Asia
Pink (2021)	MAIA-EA	172	-0.29	0	100	Europe - UK
Vinni (2023) - CD	MAIA-EA	41	-0.17	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-EA	16	-0.24	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-EA	263	-0.19	0	77.9	Europe - Other
Brand (2022)	MAIA-ND	614	-0.22	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-ND	308	-0.26	0	61.4	Europe - Other
Desdentado (2022)	MAIA-ND	391	-0.03	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-ND	230	-0.22	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-ND	325	-0.05	0	68	Europe - Other
Gaggero (2021) - US	MAIA-ND	250	-0.17	0	68	North America
Gaggero (2021) - SG	MAIA-ND	239	-0.13	0	62.8	Asia
Pink (2021)	MAIA-ND	172	-0.08	0	100	Europe - UK
Vinni (2023) - CD	MAIA-ND	41	0.2	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-ND	16	0.04	1	62.5	Europe - Other

Zamariola (2018) - Studies 4-6	MAIA-ND	263	-0.11	0	77.9	Europe - Other
Brand (2022)	MAIA-Noticing	614	-0.03	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-Noticing	308	-0.37	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Noticing	391	-0.17	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Noticing	230	0.07	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-Noticing	325	-0.27	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Noticing	250	-0.21	0	68	North America
Gaggero (2021) - SG	MAIA-Noticing	239	-0.04	0	62.8	Asia
Pink (2021)	MAIA-Noticing	172	-0.22	0	100	Europe - UK
Vinni (2023) - CD	MAIA-Noticing	41	-0.17	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Noticing	16	-0.22	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-Noticing	263	-0.23	0	77.9	Europe - Other
Brand (2022)	MAIA-NW	614	0.02	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-NW	308	0.13	0	61.4	Europe - Other
Desdentado (2022)	MAIA-NW	391	-0.05	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-NW	230	-0.31	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-NW	325	-0.02	0	68	Europe - Other
Gaggero (2021) - US	MAIA-NW	250	-0.04	0	68	North America
Gaggero (2021) - SG	MAIA-NW	239	-0.1	0	62.8	Asia
Pink (2021)	MAIA-NW	172	-0.06	0	100	Europe - UK
Vinni (2023) - CD	MAIA-NW	41	-0.05	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-NW	16	-0.1	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-NW	263	-0.09	0	77.9	Europe - Other
Brand (2022)	MAIA-SR	614	-0.19	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-SR	308	-0.39	0	61.4	Europe - Other
Desdentado (2022)	MAIA-SR	391	-0.12	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-SR	230	-0.29	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-SR	325	-0.20	0	68	Europe - Other
Gaggero (2021) - US	MAIA-SR	250	-0.19	0	68	North America
Gaggero (2021) - SG	MAIA-SR	239	-0.05	0	62.8	Asia
Pink (2021)	MAIA-SR	172	-0.27	0	100	Europe - UK

Vinni (2023) - CD	MAIA-SR	41	-0.19	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-SR	16	-0.06	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-SR	263	-0.16	0	77.9	Europe - Other
Berenguer (2023)	MAIA-Total	152	-0.21	0	100	Europe - Other
Berenguer (2023)	MAIA-Total	86	-0.27	0	0	Europe - Other
Da Costa Silva (2022)	MAIA-Total	308	-0.51	0	61.4	Europe - Other
Gaggero (2021) - IT	MAIA-Total	325	-0.29	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Total	250	-0.28	0	68	North America
Gaggero (2021) - SG	MAIA-Total	239	-0.16	0	62.8	Asia
Brand (2022)	MAIA-Trusting	614	-0.16	0	66	Europe - Other
Da Costa Silva (2022)	MAIA-Trusting	308	-0.26	0	61.4	Europe - Other
Desdentado (2022)	MAIA-Trusting	391	-0.22	0	61.4	Europe - Other
Edwards & Lowe (2021)	MAIA-Trusting	230	-0.43	0	51	Europe - UK
Gaggero (2021) - IT	MAIA-Trusting	325	-0.15	0	68	Europe - Other
Gaggero (2021) - US	MAIA-Trusting	250	-0.24	0	68	North America
Gaggero (2021) - SG	MAIA-Trusting	239	-0.18	0	62.8	Asia
Pink (2021)	MAIA-Trusting	172	-0.18	0	100	Europe - UK
Vinni (2023) - CD	MAIA-Trusting	41	-0.02	1	36.8	Europe - Other
Vinni (2023) - UC	MAIA-Trusting	16	-0.5	1	62.5	Europe - Other
Zamariola (2018) - Studies 4-6	MAIA-Trusting	263	-0.20	0	77.9	Europe - Other

S10 File. Covidence export of screened articles.

Covidence #	**Title**	**Authors**	**Year**	**Journal**	**DOI**	**Study**	**Notes**	**Extractors**	**Extraction Date**
#1	A cross-modal A cross-modal component of alexithymia and its relationship with performance in a social cognition task batterycomponent of alexithymia and its relationship with performance in a social cognition task battery	R√∂sch, Sarah A.; Puhlmann, Lara M. C.; Preckel, Katrin	2022	Journal of Affective Disorders	10.1016/j.jad.2021.11.012	R√∂sch 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#2	A meta-analysis on the relationship between interoceptive awareness and alexithymia: Distinguishing interoceptive accuracy and sensibility	Trevisan, Dominic A.; Altschuler, Melody R.; Bagdasarov, Armen; Carlos, Carter; Duan, Suqian; Hamo, Ester; Kala, Shashwat; McNair, Morgan L.; Parker, Termara; Stahl, Dylan; Winkelman, Tatiana; Zhou, Melissa; McPartland, James C.	2019	Journal of Abnormal Psychology	10.1037/abn0000454	Trevisan 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#4	A pilot study investigating changes in neural processing after mindfulness training in elite athletes	Haase, Lori; May, April C.; Falahpour, Maryam; Isakovic, Sara; Simmons, Alan N.; Hickman, Steven D.; Liu, Thomas T.; Paulus, Martin P.	2015	Frontiers in Behavioral Neuroscience		Haase 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#5	Adaptive and maladaptive bodily awareness: Distinguishing interoceptive sensibility and interoceptive attention from anxiety,Äêinduced somatization in autism and alexithymia	Trevisan, Dominic A.; Mehling, Wolf E.; McPartland, James C.	2021	Autism Research	10.1002/aur.2458	Trevisan 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#6	Alcohol use and interoception,ÄîA narrative review	Wi≈õniewski, Pawe≈Ç; Maurage, Pierre; Jakubczyk, Andrzej; Trucco, Elisa M.; Suszek, Hubert; Kopera, Maciej	2021	Progress in Neuro-Psychopharmacology & Biological Psychiatry	10.1016/j.pnpbp.2021.110397	Wi≈õniewski 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#7	Alexithymia and empathy predict changes in autonomic arousal during affective stimulation	Bogdanov, Volodymyr B.; Bogdanova, Olena V.; Gorlov, Dmytro S.; Gorgo, Yuriy P.; Dirckx, Joris J. J.; Makarchuk, Mykola Y.; Schoenen, Jean; Critchley, Hugo	2013	Cognitive and Behavioral Neurology	10.1097/WNN.0000000000000002	Bogdanov 2013	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#10	Alteration of interoceptive sensitivity: Expanding the spectrum of behavioural disorders in amyotrophic lateral sclerosis	Moretta, Pasquale; Spisto, Myriam; Ausiello, Francesco Pio; Iodice, Rosa; De Lucia, Natascia; Santangelo, Gabriella; Trojano, Luigi; Salvatore, Elena; Dubbioso, Raffaele	2022	Neurological Sciences	10.1007/s10072-022-06231-4	Moretta 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#11	Altered interoception in patients with borderline personality disorder: A study using heartbeat-evoked potentials	Flasbeck, Vera; Popkirov, Stoyan; Ebert, Andreas; Br√ºne, Martin	2020	Borderline Personality Disorder and Emotion Dysregulation	10.1186/s40479-020-00139-1	Flasbeck 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#12	An analysis of conscious fear and automatic threat response in psychopathy	Lamoureux, Virginia Ann; Glenn, Andrea L.	2021	Personality Disorders: Theory, Research, and Treatment	10.1037/per0000406	Lamoureux 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#14	Clinical application of somatosensory amplification in psychosomatic medicine	Nakao, Mutsuhiro; Barsky, Arthur J.	2007	BioPsychoSocial Medicine	10.1186/1751-0759-1-17	Nakao 2007	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#15	Demystifying alexithymia: An empirical approach and roadmap for remediation	Aaron, Rachel	2017	Dissertation Abstracts International: Section B: The Sciences and Engineering		Aaron 2017	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#19	Do psychosocial factors moderate the relation between testosterone and female sexual desire? The role of interoception, alexithymia, defense mechanisms, and relationship status	Costa, Rui Miguel; Oliveira, Gon√ßalo; Pestana, Jos√©; Costa, David; Oliveira, Rui F.	2019	Adaptive Human Behavior and Physiology	10.1007/s40750-018-0102-7	Costa 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#22	Female sweet-likers have enhanced cross-modal interoceptive abilities	Iatridi, Vasiliki; Quadt, Lisa; Hayes, John E.; Garfinkel, Sarah N.; Yeomans, Martin R.	2021	Appetite	10.1016/j.appet.2021.105290	Iatridi 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#25	Interoception and alexithymia are related to differences between the self-reported and the objectively measured physical activity in patients with chronic musculoskeletal pain	Shizuma, Hisaharu; Abe, Tetsuya; Kanbara, Kenji; Amaya, Yusaku; Mizuno, Yasuyuki; Saka-Kochi, Yukie; Fukunaga, Mikihiko	2021	Journal of Psychosomatic Research	10.1016/j.jpsychores.2020.110324	Shizuma 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#27	Interoceptive awareness in patients with functional neurological symptoms	Ricciardi, Lucia; Demartini, Benedetta; Crucianelli, Laura; Krah√©, Charlotte; Edwards, Mark J.; Fotopoulou, Aikaterini	2016	Biological Psychology	10.1016/j.biopsycho.2015.10.009	Ricciardi 2016	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#28	Links among emotional awareness, somatic awareness and autonomic homeostatic processing	Kanbara, Kenji; Fukunaga, Mikihiko	2016	BioPsychoSocial Medicine	10.1186/s13030-016-0059-3	Kanbara 2016	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#30	More than words can say: A multi-disciplinary consideration of the psychotherapeutic evaluation and treatment of alexithymia	Duquette, Patrice	2020	Frontiers in Psychiatry	10.3389/fpsyt.2020.00433	Duquette 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#31	Paradoxical somatic information processing for interoception and anxiety in alexithymia	Terasawa, Yuri; Oba, Kentaro; Motomura, Yuki; Katsunuma, Ruri; Murakami, Hiroki; Moriguchi, Yoshiya	2021	European Journal of Neuroscience	10.1111/ejn.15528	Terasawa 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#32	Prevalence of autistic traits in functional neurological disorder and relationship to alexithymia and psychiatric comorbidity	Cole, Richard H.; Elmalem, Michael S.; Petrochilos, Panayiota	2023	Journal of the Neurological Sciences	10.1016/j.jns.2023.120585	Cole 2023	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#33	Psychiatric symptomatology and perception of family functioning in an eating disorder day program	Wisotsky, Willo	2004	Dissertation Abstracts International: Section B: The Sciences and Engineering		Wisotsky 2004	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#37	Self-reported interoceptive deficits in eating disorders: A meta-analysis of studies using the eating disorder inventory	Jenkinson, Paul M.; Taylor, Lauren; Laws, Keith R.	2018	Journal of Psychosomatic Research	10.1016/j.jpsychores.2018.04.005	Jenkinson 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#38	Sense of body ownership in patients affected by functional motor symptoms (conversion disorder)	Demartini, Benedetta; Ricciardi, Lucia; Crucianelli, Laura; Fotopoulou, Aikaterini; Edwards, Mark J.	2016	Consciousness and Cognition: An International Journal	10.1016/j.concog.2015.11.005	Demartini 2016	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#39	The ability to understand emotions is associated with interoception‚Äêrelated insular activation and white matter integrity during aging	Dobrushina, Olga R.; Arina, Galina A.; Dobrynina, Larisa A.; Suslina, Anastasia D.; Solodchik, Polina O.; Belopasova, Anastasia V.; Gubanova, Mariia V.; Sergeeva, Anastasia N.; Kremneva, Elena I.; Krotenkova, Marina V.	2020	Psychophysiology	10.1111/psyp.13537	Dobrushina 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#59	Relationship between interoception and emotion regulation: New evidence from mixed methods.	Zamariola G; Frost N; Van Oost A; Corneille O; Luminet O	2019	J Affect Disord	10.1016/j.jad.2018.12.101	Zamariola 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#62	Atypical bodily self-awareness in vicarious pain responders.	Bowling NC; Botan V; Santiesteban I; Ward J; Banissy MJ	2019	Philos Trans R Soc Lond B Biol Sci	10.1098/rstb.2018.0361	Bowling 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#63	Neural and Behavioral Correlates of Impaired Insight and Self-Awareness in Substance Use Disorder.	Maracic CE; Moeller SJ	2021	Curr Behav Neurosci Rep	10.1007/s40473-021-00240-x	Maracic 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#67	The Anticipation and Perception of Affective Touch in Women with and Recovered from Anorexia Nervosa.	Crucianelli L; Demartini B; Goeta D; Nistic√≤ V; Saramandi A; Bertelli S; Todisco P; Gambini O; Fotopoulou A	2021	Neuroscience	10.1016/j.neuroscience.2020.09.013	Crucianelli 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#79	Oxytocin secretion is pulsatile in men and is related to social-emotional functioning.	Baskaran C; Plessow F; Silva L; Asanza E; Marengi D; Eddy KT; Sluss PM; Johnson ML; Misra M; Lawson EA	2017	Psychoneuroendocrinology	10.1016/j.psyneuen.2017.07.486	Baskaran 2017	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#81	Effectiveness of a guided online mindfulness-focused intervention in a student population: Study protocol for a randomised control trial.	Schultchen D; K√ºchler AM; Schillings C; Weineck F; Karabatsiakis A; Ebert DD; Baumeister H; Pollatos O	2020	BMJ Open	10.1136/bmjopen-2019-032775	Schultchen 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#92	Interoceptive functioning in schizophrenia and schizotypy	Torregrossa, L.J.; Amedy, A.; Roig, J.; Prada, A.; Park, S.	2022	Schizophrenia Research	10.1016/j.schres.2021.11.046	Torregrossa 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#93	Interoceptive Abnormalities and Suicidality: A Systematic Review	Hielscher, E.; Zopf, R.	2021	Behavior Therapy	10.1016/j.beth.2021.02.012	Hielscher 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#118	Do interoceptive accuracy and interoceptive sensibility predict emotion regulation?	Schuette, SA; Zucker, NL; Smoski, MJ	2021	PSYCHOLOGICAL RESEARCH-PSYCHOLOGISCHE FORSCHUNG	10.1007/s00426-020-01369-2	Schuette 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#122	Association Between Interoception and Emotion Regulation in Individuals With Alcohol Use Disorder	Jakubczyk, A; Trucco, EM; Klimkiewicz, A; Skrzeszewski, J; Suszek, H; Zaorska, J; Nowakowska, M; Michalska, A; Wojnar, M; Kopera, M	2020	FRONTIERS IN PSYCHIATRY	10.3389/fpsyt.2019.01028	Jakubczyk 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#123	Exploring the role of interoception in autobiographical memory recollection	Messina, A; Basilico, S; Bottini, G; Salvato, G	2022	CONSCIOUSNESS AND COGNITION	10.1016/j.concog.2022.103358	Messina 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#124	Interoceptive accuracy is associated with emotional contagion in a valence- and sex-dependent manner	Lischke, A; Weippert, M; Mau-Moeller, A; Jacksteit, R; Pahnke, R	2020	SOCIAL NEUROSCIENCE	10.1080/17470919.2019.1690573	Lischke 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#125	Normal interoceptive accuracy in women with bulimia nervosa	Pollatos, O; Georgiou, E	2016	PSYCHIATRY RESEARCH	10.1016/j.psychres.2016.04.072	Pollatos 2016	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#127	Sex-Specific Relationships Between Interoceptive Accuracy and Emotion Regulation	Lischke, A; Pahnke, R; Mau-Moeller, A; Jacksteit, R; Weippert, M	2020	FRONTIERS IN BEHAVIORAL NEUROSCIENCE	10.3389/fnbeh.2020.00067	Lischke 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#128	Direct and indirect effects of age on interoceptive accuracy and awareness across the adult lifespan	Murphy, J; Geary, H; Millgate, E; Catmur, C; Bird, G	2018	PSYCHONOMIC BULLETIN & REVIEW	10.3758/s13423-017-1339-z	Murphy 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#129	Interoceptive sensitivity, body image dissatisfaction, and body awareness in healthy individuals	Emanuelsen, L; Drew, R; Koteles, F	2015	SCANDINAVIAN JOURNAL OF PSYCHOLOGY	10.1111/sjop.12183	Emanuelsen 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#131	Autistic Traits Predict Underestimation of Emotional Abilities	Huggins, CF; Cameron, IM; Williams, JHG	2021	JOURNAL OF EXPERIMENTAL PSYCHOLOGY-GENERAL	10.1037/xge0000784	Huggins 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#136	Investigating Multidimensional Interoceptive Awareness in a Japanese Population: Validation of the Japanese MAIA-J	Shoji, M; Mehling, WE; Hautzinger, M; Herbert, BM	2018	FRONTIERS IN PSYCHOLOGY	10.3389/fpsyg.2018.01855	Shoji 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#138	Differential changes in self-reported aspects of interoceptive awareness through 3 months of contemplative training	Bornemann, B; Herbert, BM; Mehling, WE; Singer, T	2015	FRONTIERS IN PSYCHOLOGY	10.3389/fpsyg.2014.01504	Bornemann 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#139	Psychometric Evaluation and Norms for the Multidimensional Assessment of Interoceptive Awareness (MAIA) in a Clinical Eating Disorders Sample	Brown, TA; Berner, LA; Jones, MD; Reilly, EE; Cusack, A; Anderson, LK; Kaye, WH; Wierenga, CE	2017	EUROPEAN EATING DISORDERS REVIEW	10.1002/erv.2532	Brown 2017	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#141	Interoceptive sensitivity deficits in women recovered from bulimia nervosa	Klabunde, M; Acheson, DT; Boutelle, KN; Matthews, SC; Kaye, WH	2013	EATING BEHAVIORS	10.1016/j.eatbeh.2013.08.002	Klabunde 2013	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#150	Body Attention, Ignorance and Awareness Scale: Assessing Relevant Concepts for Physical and Psychological Functioning in Psoriasis	Van Beugen, S; Ograczyk, A; Ferwerda, M; Smit, JV; Zeeuwen-Franssen, MEJ; Kroft, EBM; de Jong, EMGJ; Zalewska-Janowska, A; Donders, ART; van de Kerkhof, PCM; van Middendorp, H; Evers, AWM	2015	ACTA DERMATO-VENEREOLOGICA	10.2340/00015555-1977	VanBeugen 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#151	Interoceptive awareness is associated with acute alcohol-induced changes in subjective effects	Leganes-Fonteneau, M; Cheang, Y; Lam, Y; Garfinkel, S; Duka, T	2019	PHARMACOLOGY BIOCHEMISTRY AND BEHAVIOR	10.1016/j.pbb.2019.03.007	Leganes-Fonteneau 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#156	Hypermobile spectrum disorders symptoms in patients with functional neurological disorders and autism spectrum disorders: A preliminary study	Nistico, V; Iacono, A; Goeta, D; Tedesco, R; Giordano, B; Faggioli, R; Priori, A; Gambini, O; Demartini, B	2022	FRONTIERS IN PSYCHIATRY	10.3389/fpsyt.2022.943098	Nistico 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#157	Alexithymia in Adolescents with Autism Spectrum Disorder: Its Relationship to Internalising Difficulties, Sensory Modulation and Social Cognition	Milosavljevic, B; Leno, VC; Simonoff, E; Baird, G; Pickles, A; Jones, CRG; Erskine, C; Charman, T; Happe, F	2016	JOURNAL OF AUTISM AND DEVELOPMENTAL DISORDERS	10.1007/s10803-015-2670-8	Milosavljevic 2016	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#158	Room to breathe: Using adaptive architecture to examine the relationship between alexithymia and interoception	Abdulhamid, H; Jager, N; Schnadelbach, H; Smith, AD	2022	JOURNAL OF PSYCHOSOMATIC RESEARCH	10.1016/j.jpsychores.2021.110708	Abdulhamid 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#160	Alexithymic traits can explain the association between puberty and symptoms of depression and anxiety in adolescent females	van der Cruijsen, R; Murphy, J; Bird, G	2019	PLOS ONE	10.1371/journal.pone.0210519	vanderCruijsen 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#162	A systematic review of how emotional self-awareness is defined and measured when comparing autistic and non-autistic groups	Huggins, CF; Donnan, G; Cameron, IM; Williams, JHG	2020	RESEARCH IN AUTISM SPECTRUM DISORDERS	10.1016/j.rasd.2020.101612	Huggins 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#165	How Do Fibromyalgia Patients With Alexithymia Experience Their Body? A Qualitative Approach	Calsius, J; Courtois, I; Stiers, J; De Bie, J	2015	SAGE OPEN	10.1177/2158244015574631	Calsius 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#167	Neuroimaging studies of alexithymia: physical, affective, and social perspectives	Moriguchi, Y; Komaki, G	2013	BIOPSYCHOSOCIAL MEDICINE	10.1186/1751-0759-7-8	Moriguchi 2013	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#169	Interoceptive accuracy scores from the heartbeat counting task are problematic: Evidence from simple bivariate correlations	Zamariola, G; Maurage, P; Luminet, O; Corneille, O	2018	BIOLOGICAL PSYCHOLOGY	10.1016/j.biopsycho.2018.06.006	Zamariola 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#170	Interoceptive awareness and emotional eating in college women: the role of appetite and emotional awareness	Bullock, AJ; Goldbacher, EM	2021	JOURNAL OF AMERICAN COLLEGE HEALTH	10.1080/07448481.2021.1970566	Bullock 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#171	Selective Disruption of Sociocognitive Structural Brain Networks in Autism and Alexithymia	Bernhardt, BC; Valk, SL; Silani, G; Bird, G; Frith, U; Singer, T	2014	CEREBRAL CORTEX	10.1093/cercor/bht182	Bernhardt 2014	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#172	Validation of an electronic version of the Self-Awareness Questionnaire in English and Italian healthy samples	Hughes, L; Betka, S; Longarzo, M	2019	INTERNATIONAL JOURNAL OF METHODS IN PSYCHIATRIC RESEARCH	10.1002/mpr.1758	Hughes 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#176	Levels of emotional awareness and autism: An fMRI study	Silani, G; Bird, G; Brindley, R; Singer, T; Frith, C; Frith, U	2008	SOCIAL NEUROSCIENCE	10.1080/17470910701577020	Silani 2008	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#177	Personality and self-concept in subgroups of patients with anorexia nervosa and bulimia nervosa	Ciccolo, EBF; Johnsson, P	2002	SOCIAL BEHAVIOR AND PERSONALITY	10.2224/sbp.2002.30.4.347	Ciccolo 2002	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#178	Extreme sensory processing patterns show a complex association with depression, and impulsivity, alexithymia, and hopelessness	Serafini, G; Gonda, X; Canepa, G; Pompili, M; Rihmer, Z; Amore, M; Engel-Yeger, B	2017	JOURNAL OF AFFECTIVE DISORDERS	10.1016/j.jad.2016.12.019	Serafini 2017	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#179	DISTINCT INFLUENCE OF ANXIETY AND ALEXITHYMIA ON THE OBJECTIVE AND SUBJECTIVE ESTIMATES OF INDIVIDUAL EFFICACY IN HEARTBEAT DETECTION TASK	Dobrushina, O; Arina, G; Dobrynina, L; Belopasova, A; Gubanova, M; Suslina, A; Krotenkova, M	2020	PSYCHOPHYSIOLOGY		Dobrushina 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#181	Relationship of Alexithymia Ratings to Dopamine D2-type Receptors in Anterior Cingulate and Insula of Healthy Control Subjects but Not Methamphetamine-Dependent Individuals	Okita, K; Ghahremani, DG; Payer, DE; Robertson, CL; Mandelkern, MA; London, ED	2016	INTERNATIONAL JOURNAL OF NEUROPSYCHOPHARMACOLOGY	10.1093/ijnp/pyv129	Okita 2016	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#182	Alexithymia as a risk factor for type 2 diabetes mellitus in the metabolic syndrome: a cross-sectional study	Lemche, AV; Chaban, OS; Lemche, E	2014	PSYCHIATRY RESEARCH	10.1016/j.psychres.2013.12.004	Lemche 2014	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#183	Validity of the French form of the somatosensory amplification scale in a non-clinical sample	Bridou, M; Aguerre, C	2013	HEALTH PSYCHOLOGY RESEARCH	10.4082/hpr.2013.e11	Bridou 2013	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#185	Psychometric validation and refinement of the Interoception Sensory Questionnaire (ISQ) in adolescents and adults on the autism spectrum	Suzman, E; Williams, ZJ; Feldman, JI; Failla, M; Cascio, CJ; Wallace, MT; Niarchou, M; Sutcliffe, JS; Wodka, E; Woynaroski, TG	2021	MOLECULAR AUTISM	10.1186/s13229-021-00440-y	Suzman 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#186	The Relevance of Interoception in Chronic Tinnitus: Analyzing Interoceptive Sensibility and Accuracy	Lau, P; Miesen, M; Wunderlich, R; Stein, A; Engell, A; Wollbrink, A; Gerlach, AL; Junghofer, M; Ehring, T; Pantev, C	2015	BIOMED RESEARCH INTERNATIONAL	10.1155/2015/487372	Lau 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#188	Alexithymic traits, independent of depression and anxiety, are associated with reduced sleep quality	Murphy, J; Wulff, K; Catmur, C; Bird, G	2018	PERSONALITY AND INDIVIDUAL DIFFERENCES	10.1016/j.paid.2018.03.023	Murphy 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#190	Different Aspects of Emotional Awareness in Relation to Motor Cognition and Autism Traits	Huggins, CF; Cameron, IM; Williams, JHG	2019	FRONTIERS IN PSYCHOLOGY	10.3389/fpsyg.2019.02439	Huggins 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#191	The Body in the Mind: On the Relationship Between Interoception and Embodiment	Herbert, BM; Pollatos, O	2012	TOPICS IN COGNITIVE SCIENCE	10.1111/j.1756-8765.2012.01189.x	Herbert 2012	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#192	First-Hand Accounts of Interoceptive Difficulties in Autistic Adults	Trevisan, DA; Parker, T; McPartland, JC	2021	JOURNAL OF AUTISM AND DEVELOPMENTAL DISORDERS	10.1007/s10803-020-04811-x	Trevisan 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#193	Interoceptive sensibility predicts the ability to infer others' emotional states	Hubner, AM; Trempler, I; Gietmann, C; Schubotz, RI	2021	PLOS ONE	10.1371/journal.pone.0258089	Hubner 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#196	The Effects of a Standardized Cognitive-Behavioural Therapy and an Additional Mindfulness-Based Training on Interoceptive Abilities in a Depressed Cohort	Karanassios, G; Schultchen, D; Mohrle, M; Berberich, G; Pollatos, O	2021	BRAIN SCIENCES	10.3390/brainsci11101355	Karanassios 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#197	Knowledge of resting heart rate mediates the relationship between intelligence and the heartbeat counting task	Murphy, J; Millgate, E; Geary, H; Ichijo, E; Coll, MP; Brewer, R; Catmur, C; Bird, G	2018	BIOLOGICAL PSYCHOLOGY	10.1016/j.biopsycho.2018.01.012	Murphy 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#198	Multidimensional Interoception and Autistic Traits Across life Stages: Evidence From a Novel Eye-tracking Task	Yang, HX; Zhou, HY; Wei, Z; Wan, GB; Wang, Y; Wang, YY; Yang, TX; Lui, SSY; Chan, RCK	2022	JOURNAL OF AUTISM AND DEVELOPMENTAL DISORDERS	10.1007/s10803-021-05155-w	Yang 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#199	Individual differences in sensory and expectation driven interoceptive processes: a novel paradigm with implications for alexithymia, disordered eating and obesity	Young, HA; Gaylor, CM; de-Kerckhove, D; Benton, D	2021	SCIENTIFIC REPORTS	10.1038/s41598-021-89417-8	Young 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#200	Interoceptive Accuracy as a Function of Hypnotizability	Rosati, A; Belcari, I; Santarcangelo, EL; Sebastiani, L	2021	INTERNATIONAL JOURNAL OF CLINICAL AND EXPERIMENTAL HYPNOSIS	10.1080/00207144.2021.1954859	Rosati 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#202	Neural activity during interoceptive awareness and its associations with alexithymia-An fMRI study in major depressive disorder and non-psychiatric controls	Wiebking, C; Northoff, G	2015	FRONTIERS IN PSYCHOLOGY	10.3389/fpsyg.2015.00589	Wiebking 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#203	Tulsa 1000: a naturalistic study protocol for multilevel assessment and outcome prediction in a large psychiatric sample	Victor, TA; Khalsa, SS; Simmons, WK; Feinstein, JS; Sayitz, J; Aupperle, RL; Yeh, HW; Bodurka, J; Paulusl, MP	2018	BMJ OPEN	10.1136/bmjopen-2017-016620	Victor 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#204	A Bayesian computational model reveals a failure to adapt interoceptive precision estimates across depression, anxiety, eating, and substance use disorders	Tulsa 1000 Investigators; Smith, R; Kuplicki, R; Feinstein, J; Forthman, KL; Stewart, JL; Paulus, MP; Khalsa, SS	2020	PLOS COMPUTATIONAL BIOLOGY	10.1371/journal.pcbi.1008484	Tulsa1000Investigators 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#205	Body Conscious? Interoceptive Awareness, Measured by Heartbeat Perception, Is Negatively Correlated with Self-Objectification	Ainley, V; Tsakiris, M	2013	PLOS ONE	10.1371/journal.pone.0055568	Ainley 2013	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#208	Interoceptive awareness mitigates deficits in emotional prosody recognition in Autism	Mulcahy, JS; Davies, M; Quadt, L; Critchley, HD; Garfinkel, SN	2019	BIOLOGICAL PSYCHOLOGY	10.1016/j.biopsycho.2019.05.011	Mulcahy 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#211	Evidence toward the potential absence of relationship between temporal and spatial heartbeats perception	Sophie, B; Marta, L; Marta, S; Joshua, K; Sarah, G; Hugo, C	2021	SCIENTIFIC REPORTS	10.1038/s41598-021-90334-z	Sophie 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#212	The relationship between heartbeat counting and heartbeat discrimination: A meta-analysis	Hickman, L; Seyedsalehi, A; Cook, JL; Bird, G; Murphy, J	2020	BIOLOGICAL PSYCHOLOGY	10.1016/j.biopsycho.2020.107949	Hickman 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#213	The Role of Interoception in the Pathogenesis and Treatment of Anorexia Nervosa: A Narrative Review	Jacquemot, AMMC; Park, R	2020	FRONTIERS IN PSYCHIATRY	10.3389/fpsyt.2020.00281	Jacquemot 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#214	Alexithymia in Multiple Sclerosis - Narrative Review	Grigorescu, C; Chalah, MA; Ayache, SS; Palm, U	2022	FORTSCHRITTE DER NEUROLOGIE PSYCHIATRIE	10.1055/a-1882-6544	Grigorescu 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#216	How Does Heartbeat Counting Task Performance Relate to Theoretically-Relevant Mental Health Outcomes? A Meta-Analysis	Desmedt, O; Van den Houte, M; Walentynowicz, M; Dekeyser, S; Luminet, O; Corneille, O	2022	COLLABRA-PSYCHOLOGY	10.1525/collabra.33271	Desmedt 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#217	The bodily fundament of empathy: The role of action, nonaction-oriented, and interoceptive body representations	Raimo, S; Boccia, M; Gaita, M; Canino, S; Torchia, V; Vetere, MA; Di Vita, A; Palermo, L	2022	PSYCHONOMIC BULLETIN & REVIEW	10.3758/s13423-022-02231-9	Raimo 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#218	Dissociation between Emotional Remapping of Fear and Disgust in Alexithymia	Scarpazza, C; Ladavas, E; di Pellegrino, G	2015	PLOS ONE	10.1371/journal.pone.0140229	Scarpazza 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#219	Does Long-Term Training in a Water Immersion Environment Change Interoception?	Baba, Y; Sato, D; Otsuru, N; Ikarashi, K; Fujimoto, T; Yamashiro, K	2021	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	10.3390/ijerph181910259	Baba 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#220	Ideal cardiovascular health in adolescents and young adults is associated with alexithymia over two decades later: Findings from the cardiovascular risk in Young Finns Study Department: Research Centre of Applied and Preventive Cardiovascular Medicine, Un	Karukivi, M; Jula, A; Pulkki-Raback, L; Hutri-Kahonen, N; Laitinen, TT; Viikari, J; Juonala, M; Raitakari, O	2020	PSYCHIATRY RESEARCH	10.1016/j.psychres.2020.112976	Karukivi 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#221	It matters what you practice: differential training effects on subjective experience, behavior, brain and body in the ReSource Project	Singer, T; Engert, V	2019	CURRENT OPINION IN PSYCHOLOGY	10.1016/j.copsyc.2018.12.005	Singer 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#222	Heart rate variability and its neural correlates during emotional face processing in social anxiety disorder	Gaebler, M; Daniels, JK; Lamke, JP; Fydrich, T; Walter, H	2013	BIOLOGICAL PSYCHOLOGY	10.1016/j.biopsycho.2013.06.009	Gaebler 2013	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#223	Interoception and Its Interaction with Self, Other, and Emotion Processing: Implications for the Understanding of Psychosocial Deficits in Borderline Personality Disorder	Loffler, A; Foell, J; Bekrater-Bodmann, R	2018	CURRENT PSYCHIATRY REPORTS	10.1007/s11920-018-0890-2	Loffler 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#224	A heartbeat away from a valid tracking task. An empirical comparison of the mental and the motor tracking task	Kormendi, J; Ferentzi, E; Koteles, F	2022	BIOLOGICAL PSYCHOLOGY	10.1016/j.biopsycho.2022.108328	Kormendi 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#225	Reduced differentiation of emotion-associated bodily sensations in autism	Palser, ER; Galvez-Pol, A; Palmer, CE; Hannah, R; Fotopoulou, A; Pellicano, E; Kilner, JM	2021	AUTISM	10.1177/1362361320987950	Palser 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#226	The role of interoception in understanding others' affect. Dissociation between superficial and detailed appraisal of facial expressions	Dirupo, G; Corradi-Dell'Acqua, C; Kashef, M; Debbane, M; Badoud, D	2020	CORTEX	10.1016/j.cortex.2020.05.010	Dirupo 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#227	Know thyself: Exploring interoceptive sensitivity in Parkinson's disease	Ricciardi, L; Ferrazzano, G; Demartini, B; Morgante, F; Erro, R; Ganos, C; Bhatia, KP; Berardelli, A; Edwards, M	2016	JOURNAL OF THE NEUROLOGICAL SCIENCES	10.1016/j.jns.2016.03.019	Ricciardi 2016	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#228	Social Bodies: Preliminary Evidence That Awareness of Embodied Emotions Is Associated With Recognition of Emotions in the Bodily Cues of Others	Blain, SD; Snodgress, MA; Nummenmaa, L; Peterman, JS; Glerean, E; Park, S	2023	PSYCHOLOGY OF CONSCIOUSNESS-THEORY RESEARCH AND PRACTICE	10.1037/cns0000352	Blain 2023	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#230	Theory of Motivated Cue-Integration and COVID-19: Between Interoception, Somatization, and Radicalization	Shalev, I	2021	FRONTIERS IN PSYCHIATRY	10.3389/fpsyt.2021.631758	Shalev 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#231	Relationship between affective state and empathy in medical and psychology students	Bohler, TE; Brown, RF; Dunn, S	2021	AUSTRALIAN PSYCHOLOGIST	10.1080/00050067.2021.1926218	Bohler 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#232	The effect of aerobic exercise on interoception and cognitive function in healthy university students: a non-randomized controlled trial	Amaya, Y; Abe, T; Kanbara, K; Shizuma, H; Akiyama, Y; Fukunaga, M	2021	BMC SPORTS SCIENCE MEDICINE AND REHABILITATION	10.1186/s13102-021-00332-x	Amaya 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#235	Alexithymia, reward sensitivity and excessive exercise in non-binge-eaters versus severe binge eaters: Implications for primary and secondary exercise dependence	Lyvers, Michael; Truncali, Joseph; Stapleton, Peta; Thorberg, Fred Arne	2022	Current Psychology	10.1007/s12144-022-03511-2	Lyvers 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#238	Alexithymia, a compounding factor for eating and social avoidance symptoms in anorexia nervosa	Courty, Annaig; Godart, Nathalie; Lalanne, Christophe; Berthoz, Sylvie	2015	Comprehensive Psychiatry	https://doi.org/10.1016/j.comppsych.2014.09.011	Courty 2015	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#246	Alexithymia, embodiment of emotions and interoceptive abilities	Scarpazza, Cristina; di Pellegrino, Giuseppe	2018	Current developments in alexithymia: A cognitive and affective deficit		Scarpazza 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#247	Individuals with autistic traits exhibit heightened alexithymia but intact interoceptive-exteroceptive sensory integration	Yang, Han-Xue; Zhou, Han-Yu; Zheng, Hong; Wang, Yi; Wang, Yan-Yu; Lui, Simon SY; Chan, Raymond CK	2021	Journal of Autism and Developmental Disorders		Yang 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#249	Interoceptive reliance as a major determinant of emotional eating in adult obesity	Willem, Cl√©mence; Nandrino, Jean-Louis; Doba, Karyn; Roussel, M√©line; Triquet, Claire; Verkindt, H√©l√®ne; Pattou, Fran√ßois; Gandolphe, Marie-Charlotte	2021	Journal of Health Psychology		Willem 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#257	Interoceptive abilities in inflammatory bowel diseases and irritable bowel syndrome	Fournier, Alicia; Mondillon, Laurie; Luminet, Olivier; Canini, Fr√©deric; Mathieu, Nicolas; Gauchez, Anne Sophie; Dantzer, C√©cile; Bonaz, Bruno; Pellissier, Sonia	2020	Frontiers in psychiatry		Fournier 2020	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#258	Do we need to accurately perceive our heartbeats? Cardioceptive accuracy and sensibility are independent from indicators of negative affectivity, body awareness, body image dissatisfaction, and alexithymia	K√∂rmendi, J√°nos; Ferentzi, Eszter; Petzke, Tara; G√°l, Vera; K√∂teles, Ferenc	2023	Plos one		K√∂rmendi 2023	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#260	On the embodiment of social cognition skills: The inner and outer body processing differently contributes to the affective and cognitive theory of mind	Canino, Silvia; Raimo, Simona; Boccia, Maddalena; Di Vita, Antonella; Palermo, Liana	2022	Brain Sciences		Canino 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#261	Multidimensional assessment of interoceptive abilities, emotion processing and the role of early life stress in inflammatory bowel diseases	Atanasova, Konstantina; Lotter, Tobias; Reindl, Wolfgang; Lis, Stefanie	2021	Frontiers in Psychiatry		Atanasova 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#268	Is It a Gut Feeling? Bodily Sensations Associated With the Experience of Valence and Arousal in Patients With Inflammatory Bowel Disease	Atanasova, Konstantina; Lotter, Tobias; Bekrater-Bodmann, Robin; Kleindienst, Nikolaus; Reindl, Wolfgang; Lis, Stefanie	2022	Frontiers in Psychiatry		Atanasova 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#270	Interoceptive attention facilitates emotion regulation strategy use	Tan, Yafei; Wang, Xiaoqin; Blain, Scott D; Jia, Lei; Qiu, Jiang	2023	International Journal of Clinical and Health Psychology		Tan 2023	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#271	Individual differences in the evolution of mental health: Which are the most relevant in chronic pain?	Ribera, C Suso; Jornet-Gibert, M; Guerrero, L Camacho; Canudas, MV Ribera; Gallardo-Pujol, D	2014	Abstracts/Personality and Individual Differences		Ribera 2014	Irrelevant - did not meet inclusion criteria at title and abstract screening		

#272	Dissociations between self-reported interoceptive accuracy and attention: Evidence from the Interoceptive Attention Scale	Gabriele, Eleonora; Spooner, Ria; Brewer, Rebecca; Murphy, Jennifer	2022	Biological psychology		Gabriele 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#273	Losing trust in body sensations: Interoceptive awareness and depression symptom severity among primary care patients	Dunne, Julie; Flores, Michael; Gawande, Richa; Schuman-Olivier, Zev	2021	Journal of affective disorders		Dunne 2021	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#274	Difficulties in emotion regulation and deficits in interoceptive awareness in moderate and severe obesity	Willem, Cl√©mence; Gandolphe, Marie-Charlotte; Roussel, M√©line; Verkindt, H√©l√®ne; Pattou, Fran√ßois; Nandrino, Jean-Louis	2019	Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity		Willem 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#276	Functional (psychogenic non-epileptic/dissociative) seizures: why and how?	Ertan, Deniz; Aybek, Selma; LaFrance Jr, W Curt; Kanemoto, Kousuke; Tarrada, Alexis; Maillard, Louis; El-Hage, Wissam; Hingray, Coraline	2022	Journal of Neurology, Neurosurgery & Psychiatry		Ertan 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#277	A feeling difficult to identify: Alexithymia is inversely associated with positive body image in adults from the United Kingdom	Longhurst, Phaedra; Swami, Viren	2023	Journal of affective disorders		Longhurst 2023	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#278	Battered Body, Battered Self: A Cross-Sectional Study of the Embodiment-Related Impairments of Female Victims of Intimate Partner Violence	Machorrinho, Joana; Veiga, Guida; Santos, Gra√ßa; Marmeleira, Jos√©	2023	Journal of Aggression, Maltreatment & Trauma		Machorrinho 2023	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#279	Emotional and cognitive modulation of cybersickness: The role of pain catastrophizing and body awareness	Mittelst√§dt, Justin Maximilian; Wacker, Jan; Stelling, Dirk	2019	Human Factors		Mittelst√§dt 2019	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#280	Development of a Scale to Examine Responses to Bodily Sensations	Roche-Freedman, Katherine E; Brown, Rhonda F; Monaghan, Conal; Thorsteinsson, Einar; Brown, John	2022	Psychological Reports		Roche-Freedman 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#281	Coping and beliefs as predictors of functioning and psychological adjustment in fibromyalgia subgroups	Rubio Fidel, Laura; Garc√≠a-Palacios, Azucena; Herrero, Roc√≠o; Molinari, Guadalupe; Suso-Ribera, Carlos	2022	Pain Research and Management		RubioFidel 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#282	The differential relationship between self-reported interoceptive accuracy and attention with psychopathology	Brand, Sebastian; Petzke, Tara M; Witth√∂ft, Michael	2022	Zeitschrift f√ºr Klinische Psychologie und Psychotherapie		Brand 2022	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#284	Alexithymia is associated with a multidomain, multidimensional failure of interoception: Evidence from novel tests.	Murphy, Jennifer; Catmur, Caroline; Bird, Geoffrey	2018	Journal of Experimental Psychology: General		Murphy 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#286	Interoceptive accuracy and body awareness,ÄìTemporal and longitudinal associations in a non-clinical sample	Ferentzi, Eszter; Drew, Raechel; Tihanyi, Benedek T; K√∂teles, Ferenc	2018	Physiology & behavior		Ferentzi 2018	Irrelevant - did not meet inclusion criteria at title and abstract screening		
#3	A network analysis of interoception, self-awareness, empathy, alexithymia, and autistic traits	Yang, Han-Xue; Hu, Hui-Xin; Zhang, Yi-Jing; Wang, Yi; Lui, Simon S. Y.; Chan, Raymond C. K.	2022	European Archives of Psychiatry and Clinical Neuroscience	10.1007/s00406-021-01274-8	Yang 2022	Exclusion reason: No reported correlation;		

#16	Disentangling interoceptive abilities in alexithymia	Scarpazza, Cristina; Zangrossi, Andrea; Huang, Yu-Chun; Sartori, Giuseppe; Massaro, Sebastiano	2021	Psychological Research	10.1007/s00426-021-01538-x	Scarpazza 2021	Exclusion reason: Duplicate;		
#20	Exploring the cognitive, emotional and sensory correlates of social anxiety in autistic and neurotypical adolescents	Pickard, Hannah; Hirsch, Colette; Simonoff, Emily; Happ√©, Francesca	2020	Journal of Child Psychology and Psychiatry	10.1111/jcpp.13214	Pickard 2020	Exclusion reason: Paediatric population;		
#26	Interoception in anorexia nervosa: Exploring associations with alexithymia and autistic traits	Kinnaird, Emma; Stewart, Catherine; Tchanturia, Kate	2020	Frontiers in Psychiatry	10.3389/fpsyt.2020.00064	Kinnaird 2020	Exclusion reason: No interoceptive scale;		
#34	Quadratic relationship between alexithymia and interoceptive accuracy, and results from a pilot mindfulness intervention	Aaron, Rachel V.; Blain, Scott D.; Snodgress, Matthew A.; Park, Sohee	2020	Frontiers in Psychiatry	10.3389/fpsyt.2020.00132	Aaron 2020	Exclusion reason: No interoceptive scale;		
#36	Relationship between interoceptive sensibility and somatoform disorders in adults with autism spectrum traits The mediating role of alexithymia and emotional dysregulation	Zdankiewicz-≈öciga≈Ça, El≈ºbieta; ≈öciga≈Ça, Dawid; Sikora, Joanna; Kwaterniak, Wanda; Longobardi, Claudio	2021	PLoS ONE	10.1371/journal.pone.0255460	Zdankiewicz-≈öciga≈Ça 2021	Exclusion reason: Relationship between interoception and alexithymia not investigated;		
#40	The effect of a single yoga class on interoceptive accuracy in patients affected by anorexia nervosa and in healthy controls: A pilot study	Demartini, Benedetta; Goeta, Diana; Marchetti, Mattia; Bertelli, Sara; Anselmetti, Simona; Cocchi, Alessandra; Ischia, Maddalena; Gambini, Orsola	2021	Eating and Weight Disorders	10.1007/s40519-020-00950-3	Demartini 2021	Exclusion reason: No interoceptive scale;		
#41	The psychophysiological mechanisms of alexithymia in autism spectrum disorder	Gaigg, Sebastian B.; Cornell, Anna S. F.; Bird, Geoffrey	2018	Autism	10.1177/1362361316667062	Gaigg 2018	Exclusion reason: No interoceptive scale;		
#50	Relationships between alexithymia, interoception, and emotional empathy in autism spectrum disorder.	Butera CD; Harrison L; Kilroy E; Jayashankar A; Shipkova M; Pruyser A; Aziz-Zadeh L	2023	Autism	10.1177/13623613221111310	Butera 2023	Exclusion reason: Paediatric population;		
#58	Importance of considering interoceptive abilities in alexithymia assessment.	Fournier A; Luminet O; Dambrun M; Dutheil F; Pellissier S; Mondillon L	2019	PeerJ	10.7717/peerj.7615	Fournier 2019	Exclusion reason: No interoceptive scale;		
#70	Discrepancies between dimensions of interoception in autism: Implications for emotion and anxiety.	Garfinkel SN; Tiley C; O'Keeffe S; Harrison NA; Seth AK; Critchley HD	2016	Biol Psychol	10.1016/j.biopsycho.2015.12.003	Garfinkel 2016	Exclusion reason: Relationship between interoception and alexithymia not investigated;		
#78	[Interoceptive difficulties in children and adolescents with severe form of somatic symptom disorder: A pilot study with nineteen participants].	Heniquez A; Lahaye H; Boissel L; Guil√© JM; Benarous X	2022	Encephale	10.1016/j.encep.2022.06.003	Heniquez 2022	Exclusion reason: Paediatric population;		
#242	Individual differences in emotional processing and autobiographical memory: interoceptive awareness and alexithymia in the fading affect bias	Muir, Kate; Madill, Anna; Brown, Charity	2017	Cognition and Emotion	10.1080/02699931.2016.1225005	Muir 2017	Exclusion reason: Relationship between interoception and alexithymia not investigated;		
#255	Bodily self-consciousness in Autism Spectrum Disorder: investigating the relationship between interoception, self-representation and empathy	Mul, Cari-lene	2019			Mul 2019	Exclusion reason: Duplicate;		
#275	No effect of age on emotion recognition after accounting for cognitive factors and depression	Murphy, Jennifer; Millgate, Edward; Geary, Hayley; Catmur, Caroline; Bird, Geoffrey	2019	Quarterly Journal of Experimental Psychology		Murphy 2019	Exclusion reason: Relationship between interoception and alexithymia not investigated;		

#283	INTEROCEPTIVE ATTENTION AND ACCURACY	T√ºnte, Markus R; Petzke, Tara M; Brand, Sebastian; Murphy, Jennifer; Witth√∂ft, Michael; Hoehl, Stefanie; Weymar, Mathias; Ventura-Bort, Carlos					Exclusion reason: Duplicate;		
#8	Alexithymia and sensory processing sensitivity: Areas of overlap and links to sensory processing styles	Jakobson, Lorna S.; Rigby, Sarah N.	2021	Frontiers in Psychology	10.3389/fpsyg.2021.583786	Jakobson 2021	Included	KVB, JK	2/11/2023
#9	Alexithymia mediates the relationship between interoceptive sensibility and anxiety	Palser, Eleanor R.; Palmer, Clare E.; Galvez-Pol, Alejandro; Hannah, Ricci; Fotopoulou, Aikaterini; Kilner, James M.	2018	PLoS ONE	10.1371/journal.pone.0203212	Palser 2018	Excluded - did not report correlations		
#13	Clarifying the relationship between alexithymia and subjective interoception	Gaggero, Giulia; Bizzego, Andrea; Dellantonio, Sara; Pastore, Luigi; Lim, Mengyu; Esposito, Gianluca	2021	PLoS ONE	10.1371/journal.pone.0261126	Gaggero 2021	Included	KVB, JK	2/11/2023
#17	Disentangling the role of interoceptive sensibility in alexithymia, emotion dysregulation, and depression in healthy individuals	Desdentado, Lorena; Miragall, Marta; Llorens, Roberto; Ba√±os, Rosa Mar√≠a	2022	10.1007/s12144-022-03153-4	Desdentado 2022	Included	KVB, JK	2/11/2023	
#18	Do alexithymia and negative affect predict poor sleep quality? The moderating role of interoceptive sensibility	Huang, Yun-Hsin; Yang, Chien-Ming; Huang, Ya-Chuan; Huang, Yu-Ting; Yen, Nai-Shing	2022	PLoS ONE	10.1371/journal.pone.0275359	Huang 2022	Included	KVB, JK	2/11/2023
#21	Exploring three levels of interoception in people with functional motor disorders	Ricciardi, Lucia; Nistic√≤, Veronica; Andrenelli, Elisa; Cunha, Joana Macedo; Demartini, Benedetta; Kirsch, Louise P.; Crucianelli, Laura; Yogarajah, Mahinda; Morgante, Francesca; Fotopoulou, Aikaterini; Edwards, Mark J.	2021	Parkinsonism & Related Disorders	10.1016/j.parkreldis.2021.03.029	Ricciardi 2021	Included	KVB, JK	1/3/2024
#23	How do self‚Äêassessment of alexithymia and sensitivity to bodily sensations relate to alcohol consumption?	Betka, Sophie; Pfeifer, Gaby; Garfinkel, Sarah; Prins, Hielke; Bond, Rod; Sequeira, Henrique; Duka, Theodora; Critchley, Hugo	2018	Alcoholism: Clinical and Experimental Research	10.1111/acer.13542	Betka 2018	Included	KVB, JK	1/3/2024
#29	Manipulating the sensation of feeling fat: The role of alexithymia, interoceptive sensibility and perfectionism	Pink, Aimee E.; Williams, Claire; Lee, Michelle; Young, Hayley A.; Harrison, Sophie; Davies, Amy Eldred; Price, Menna	2021	Physiology & Behavior	10.1016/j.physbeh.2021.113501	Pink 2021	Included	KVB, JK	15/11/2023
#35	Relationship between interoceptive accuracy, interoceptive sensibility, and alexithymia	Zamariola, Giorgia; Vlemincx, Elke; Corneille, Olivier; Luminet, Olivier	2018	Personality and Individual Differences	10.1016/j.paid.2017.12.024	Zamariola 2018	Included	KVB, JK	
#43	Disentangling interoceptive abilities in alexithymia.	Scarpazza C; Zangrossi A; Huang YC; Sartori G; Massaro S	2022	Psychol Res	10.1007/s00426-021-01538-x	Scarpazza 2022	Excluded - did not report correlations		
#47	Interoceptive Sensibility, Alexithymia, and Emotion Regulation in Individuals Suffering from Fibromyalgia.	Schmitz N; Napieralski J; Schroeder D; Loeser J; Gerlach AL; Pohl A	2021	Psychopathology	10.1159/000513774	Schmitz 2021	Included	KVB, JK	
	Self-Reported Body Awareness: Validation of the Postural Awareness Scale and the Multidimensional Assessment of	Da Costa Silva L; Belrose C; Trousselard M; Rea B; Seery E; Verdonk C; Duffaud AM	2022	Front Psychol	10.3389/fpsyg.2022.946271	DaCostaSilva 2022	Included	KVB, JK	

#57	Interoceptive Awareness (Version 2) in a Non-clinical Adult French-Speaking Sample.								
#97	Alexithymia and Alcohol Use: Evaluating the Role of Interoceptive Sensibility with the Revised Multidimensional Assessment of Interoceptive Awareness	Lyvers, M.; Thorberg, F.A.	2023	Journal of Psychopathology and Behavioral Assessment	10.1007/s10862-023-10034-y	Lyvers 2023	Included	KVB, JK	10/9/2023
#107	Testing the independence of self-reported interoceptive accuracy and attention	Murphy, J; Brewer, R; Plans, D; Khalsa, SS; Catmur, C; Bird, G	2020	QUARTERLY JOURNAL OF EXPERIMENTAL PSYCHOLOGY	10.1177/1747021819879826	Murphy 2020	Included	KVB, JK	1/3/2024
#114	A novel self-report scale of interoception: the three-domain interoceptive sensations questionnaire (THISQ)	Vlemincx, E; Walentynowicz, M; Zamariola, G; Van Oudenhove, L; Luminet, O	2021	PSYCHOLOGY & HEALTH	10.1080/08870446.2021.2009479	Vlemincx 2021	Included	KVB, JK	1/3/2024
#133	The relationships between interoception and alexithymic trait. The Self-Awareness Questionnarie in healthy subjects	Longarzo, M; D'Olimpio, F; Chiavazzo, A; Santangelo, G; Trojano, L; Grossi, D	2015	FRONTIERS IN PSYCHOLOGY	10.3389/fpsyg.2015.01149	Longarzo 2015	Included	KVB, JK	10/9/2023
#135	Exploring the contributions of affective constructs and interoceptive awareness to feeling fat	Morales, C; Dolan, SC; Anderson, DA; Anderson, LM; Reilly, EE	2022	EATING AND WEIGHT DISORDERS-STUDIES ON ANOREXIA BULIMIA AND OBESITY	10.1007/s40519-022-01490-8	Morales 2022	Included	KVB, JK	10/9/2023
#143	Alexithymia: a general deficit of interoception	Brewer, R; Cook, R; Bird, G	2016	ROYAL SOCIETY OPEN SCIENCE	10.1098/rsos.150664	Brewer 2016	Included	KVB, JK	13/9/2023
#164	The Role of Interoceptive Sensibility and Emotional Conceptualization for the Experience of Emotions	Ventura-Bort, C; Wendt, J; Weymar, M	2021	FRONTIERS IN PSYCHOLOGY	10.3389/fpsyg.2021.712418	Ventura-Bort 2021	Included	KVB, JK	13/9/2023
#184	Shared and unique interoceptive deficits in high alexithymia and neuroticism	Gaggero, G; Dellantonio, S; Pastore, L; Sng, KHL; Esposito, G	2022	PLOS ONE	10.1371/journal.pone.0273922	Gaggero 2022	Excluded - sample not independent to Gaggero 2021		
#233	The Feeling of Me Feeling for You: Interoception, Alexithymia and Empathy in Autism	Mul, Cari-l√®ne; Stagg, Steven D.; Herbelin, Bruno; Aspell, Jane E.	2018	Journal of Autism and Developmental Disorders	10.1007/s10803-018-3564-3	Mul 2018	Included	KVB, NG	2/9/2023
#237	Associations Between Mental Health, Interoception, Psychological Flexibility, and Self-as-Context, as Predictors for Alexithymia: A Deep Artificial Neural Network Approach.	Edwards DJ; Lowe R	2021	Front Psychol	10.3389/fpsyg.2021.637802	Edwards 2021	Included	KVB, NG	5/2/2024
#239	Ready, set, ,Ä¶and difficultly slowing down: What role does alexithymia, emotional regulation and interoceptive awareness play in exercise dependence?	Sweetnam, Taylor J.; Flack, Mal	2023	Acta Psychologica	https://doi.org/10.1016/j.actpsy.2023.103958	Sweetnam 2023	Included	KVB, NG	2/11/2023
#240	Relationships between alexithymia and psychological characteristics associated with eating disorders	Taylor, Graeme J.; Parker, James D.A.; Bagby, R.Michael; Bourke, Michael P.	1996	Journal of Psychosomatic Research	https://doi.org/10.1016/S0022-3999(96)00224-3	Taylor 1996	Included	KVB, NG	2/11/2023
	Adult attachment styles and emotional regulation: The role of	Ferraro, Isabella K; Taylor, Amanda M	2021	Personality and Individual	https://doi.org/10.1016/j.paid.2021.110641	Ferraro 2021	Included	KVB, NG	1/3/2024

#241	interoceptive awareness and alexithymia			Differences					
#243	Interoceptive Awareness, Alexithymia, and Sexual Function	Berenguer, Cl√°udia; Reb√¥lo, Catarina; Costa, Rui Miguel	2019	Journal of Sex & Marital Therapy	10.1080/0092623X.2019.1610128	Berenguer 2019	Included	KVB, NG	1/3/2024
#248	Alexithymic characteristics and interoceptive abilities are associated with disease severity and levels of C-reactive protein and cytokines in patients with inflammatory bowel disease	Vinni, Eleni; Karaivazoglou, Katerina; Tourkochristou, Evanthia; Tsounis, Efthymios; Kalogeropoulou, Maria; Konstantopoulou, Georgia; Lourida, Theoni; Kafentzi, Theodora; Lampropoulou, Efi; Rodi, Maria	2023	Annals of Gastroenterology		Vinni 2023	Included	KVB, NG	15/11/2023
#262	Construct validity of the sensory profile interoception scale: Measuring sensory processing in everyday life	Dunn, Winnie; Brown, Catana; Breitmeyer, Angela; Salwei, Ashley	2022	Frontiers in Psychology		Dunn 2022	Included	KVB, NG	15/11/2023
#265	Untangling self-reported interoceptive attention and accuracy: Evidence from the european portuguese validation of the body perception questionnaire and the interoceptive accuracy scale	Campos, Carlos; Rocha, Nuno; Barbosa, Fernando	2021			Campos 2021	Included	KVB, NG	15/11/2023
#266	He Who Seeks Finds (Bodily Signals): Differential Effects of Self-Reported Interoceptive Attention and Accuracy on Subclinical Psychopathology in a German-Speaking Sample	T√ºnte, Markus R; Petzke, Tara; Brand, Sebastian; Murphy, Jennifer; Witth√∂ft, Michael; Hoehl, Stefanie; Weymar, Mathias; Ventura-Bort, Carlos	2022			T√ºnte 2022	Included	KVB, NG	15/11/2023
#285	Emotional Dysfunction and Interoceptive Challenges in Adults with Autism Spectrum Disorders	Bonete, Saray; Molinero, Clara; Ruisanchez, Daniela	2023	Behavioral Sciences		Bonete 2023	Included	KVB, NG	1/12/2023
#288	Examining the Incremental Validity of the Perth Alexithymia Questionnaire (PAQ) Relative to the 20-Item Toronto Alexithymia Scale (TAS-20)	Zahid, Aqsa; Taylor, Graeme J.; Lau, Sharlane C. L.; Stone, Suddene; Bagby, R. Michael	2023	Journal of Personality Assessment	10.1080/00223891.2023.2201831	Zahid 2023	Included	KVB, NG	5/2/2024
#289	Emotional regulation deficits in autism spectrum disorder: The role of alexithymia and interoception	Ben Hassen, Nour; Molins, Francisco; Garrote-Petisco, Dolores; Serrano, Miguel √Ångel	2023	Research in Developmental Disabilities	https://doi.org/10.1016/j.ridd.2022.104378	BenHassen 2023	Included	KVB, NG	1/12/2023

#290	The Interoception Sensory Questionnaire (ISQ): A Scale to Measure Interoceptive Challenges in Adults	Fiene, L.; Ireland, M. J.; Brownlow, C.	2018	Journal of Autism and Developmental Disorders	10.1007/s10803-018-3600-3	Fiene 2018	Included	KVB, NG	
#291	Bridging the Gap between Interoception and Mental Health: The German Validation of the Interoceptive Accuracy Scale (IAS) and its Relation to Psychopathological Symptom Burden	Brand, Sebastian; Meis, Annelie; T√ºnte, Markus; Murphy, Jennifer; Woller, Joshua Pepe; Jungmann, Stefanie; Witth√∂ft, Michael; Hoehl, Stefanie; Weymar, Mathias; Hermann, Christiane; Ventura-Bort, Carlos	2022		10.31234/osf.io/jak6b	Brand 2022	Included	KVB, NG	
#292	The association of interoceptive awareness and alexithymia with neurotransmitter concentrations in insula and anterior cingulate	Ernst, Jutta; B√∂ker, Heinz; H√§ttenschwiler, Joe; Sch√ºpbach, Daniel; Northoff, Georg; Seifritz, Erich; Grimm, Simone	2014	Social Cognitive and Affective Neuroscience	10.1093/scan/nst058	Ernst 2014	Included	KVB, NG	

Appendix F. Paper 2 Online Supplemental Materials

Physical and Psychiatric Diagnoses Self-Reported by Participants

Participants who nominated that they had a current diagnosis of a physical and/or mental condition were prompted to disclose of their diagnoses using a free-text option. These were manually reviewed by the first author. For physical diagnoses, these were categorised according to the bodily system affected where applicable. For psychiatric diagnoses, clinical categorisations were made according to disorder categories included in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5; American Psychiatric Association, 2013), and were not derived from formal clinical diagnoses or interviews. Table S1 contains current conditions that were self-reported by 119 participants.

Table S1.
Self-Disclosed Diagnoses of Physical and Psychiatric Conditions

Diagnosis	*N* (% of cases) [a]
Physical Diagnosis	18 (4.32%)
Autoimmune (e.g., hypo-, hyperthyroidism)	3 (16.7%)
Cardiovascular	1 (5.6%)
Gastrointestinal	1 (5.6%)
Gynaecological	2 (11.1%)
Long COVID	1 (5.6%)
Neurological (e.g., migraine)	2 (11.1%)
Ocular	1 (5.6%)
Respiratory (e.g., asthma)	7 (38.9%)
Psychiatric Diagnosis	101 (24.2%)
Anxiety Disorders	60 (59.4%)
Bipolar and Related Disorders	4 (4.0%)
Depressive Disorders	53 (52.5%)
Feeding and Eating Disorders	2 (2.0%)
Neurodevelopmental Disorders	19 (18.8%)

Obsessive-Compulsive and Related Disorders	10 (9.9%)
Personality Disorders	2 (2.0%)
Sleep-Wake Disorders	1 (1.0%)
Somatic Symptom and Related Disorders	1 (1.0%)
Trauma- and Stressor-Related Disorders	7 (6.9%)
Not Specified	1 (1.0%)
Comorbid Psychiatric Disorders[b]	**47 (46.5%)**
Comorbid Physical and Psychiatric Diagnoses	**8 (1.9%)**

[a] Percentage exceeds 100%, for psychiatric diagnosis, as multiple participants reported two or more diagnoses.
[b] Anxiety comorbid to Depression (*n*=21), Anxiety comorbid to Depression and other disorders (e.g., Obsessive-Compulsive; *n*=10), Anxiety comorbid to another disorder (e.g., OCD, *n*=7), Depression comorbid to another disorder (e.g., ADHD, *n*=2), Bipolar and Related comorbid to another disorder (e.g., Feeding and Eating; *n*=2), Neurodevelopmental disorder comorbid to another disorder (e.g., Personality Disorder; *n*=4).

Body-Mind Connection Questionnaire Administered for Field Testing

Body-Mind Connection Questionnaire

This section asks you to indicate how applicable a series of statements regarding your body and mind are to you generally. By that, we mean how they apply to you most of the time. Some of these will be a series of statements related to bodily sensations (e.g., hunger, thirst, need for air, etc.) and/or emotions. There are no right or wrong answers.

1.	**I consider myself in touch with my body and mind.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
2.	**I can direct my focus toward how specific parts of my body feel.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
3.	**It is easy for me to focus on specific sensations if they are suddenly experienced.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
4.	**It is easy for me to focus on specific sensations if I purposefully think about them.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
5.	**I often push my bodily sensations to run in the background when I am busy. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
6.	**If I have not thought about my bodily sensations for some time, it is challenging for me to become aware of them again. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
7.	**Where possible, I always attend to what my body is telling me.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
8.	**I am usually proactive in addressing the needs of my body.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
9.	**I don't generally experience emotions alongside bodily changes (e.g., changes in heartrate or breathing, sweating). ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
10.	**I generally experience bodily changes alongside emotions.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
11.	**I'm not really concerned about how bodily sensations make me feel. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me

12.	**I find it hard to *identify* changes in my body associated with positive or negative emotions. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
13.	**If I were asked to, I'd find it hard to *describe* changes in my body associated with positive or negative emotions. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
14.	**I tend to focus on things happening in my physical environment rather than what is happening inside of me. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
15.	**I often forget to drink unless there is a drink readily at hand. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
16.	**I eat at mealtimes, regardless of whether I'm hungry. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
17.	**I listen to my body to decide when to stop eating or drinking after being very hungry or thirsty.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
18.	**After eating a main meal, I typically experience both a sense of fullness and a change in my emotions.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
19.	**I feel disconnected from my body. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
20.	**Feeling physically well is something that I prioritise in life.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
21.	**Feeling mentally well is something that I prioritise in life.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
22.	**I value being well-balanced in my body and my mind.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me

Asterisks indicate reverse scoring of item.

Results of Group Differences in BMCQ Scales According to Demographic Variables

Table S2

Means and Standard Deviations for BMCQ Scales According to Age, Education Level, BMI (Self-Reported), Smoking Status, Alcohol Consumption, Psychiatric Diagnosis, Sport and Exercise Engagement, Yoga Practice, and Mindfulness and Meditation Practice (N=316).

		Interoceptive Attention		Sensation-Emotion Articulation		Body-Mind Values	
Characteristic	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age							
18-19	28	5.04	0.66	4.11	1.12	4.82	1.09
20-29	119	5.15	0.99	4.20	1.22	5.08	1.03
30-39	117	5.17	0.95	4.28	1.22	5.17	1.02
40-50	51	5.25	0.69	4.27	1.06	4.90	0.87
Gender							
Male	124	5.15	0.87	3.98	1.08	5.15	0.96
Female	189	5.17	0.93	4.40	1.22	5.01	1.03
Education							
Year 10 or lower	6	5.04	1.02	3.61	1.25	4.81	0.63
Year 12	121	5.04	0.94	4.10	1.19	4.99	1.12
Bachelor’s degree	111	5.22	0.92	4.26	1.23	5.07	0.99
Honours	15	5.20	0.71	4.31	1.17	5.40	0.61
TAFE or vocational training	11	5.30	0.51	4.27	1.08	5.11	0.68
Masters	41	5.21	0.95	4.57	1.07	5.09	1.00
PhD or Doctorate	6	5.58	0.74	4.17	0.81	5.36	0.55
Graduate Certificate	5	5.90	0.45	4.93	1.19	5.33	1.06
BMI (Self-Report)							
Underweight	10	5.43	0.53	4.83	0.89	4.97	0.62
Normal	136	5.31	0.86	4.36	1.14	5.27	1.04
Overweight	76	4.95	1.09	3.98	1.28	4.94	1.05
Obese	74	5.07	0.83	4.23	1.09	4.80	0.91
Smoking Status							
Smoker	33	5.07	1.19	3.94	1.41	4.78	1.27
Non-smoker	283	5.18	0.87	4.27	1.15	5.10	0.97
Alcohol Consumption							
0-1 times per week	224	5.19	0.90	4.27	1.19	5.08	1.01

1-2 times per week	56	5.16	0.88	4.10	1.18	5.14	1.00
2-3 times per week	19	5.17	0.86	4.56	1.08	5.26	0.78
3-4 times per week	7	5.29	0.94	3.81	1.29	4.52	1.05
4 or more times per week	10	4.53	1.26	3.93	1.09	4.25	1.01
Sport and Exercise							
Yes	208	5.27	0.85	4.26	1.18	5.26	0.93
No	108	4.96	0.98	4.19	1.19	4.69	1.06
Yoga							
Yes	52	5.50	0.80	4.67	1.05	5.57	0.82
No	264	5.10	0.91	4.15	1.19	4.96	1.01
Mindfulness and Meditation							
Yes	75	5.55	0.81	4.49	1.24	5.54	0.80
No	241	5.04	0.90	4.16	1.15	4.91	1.02

Table S3

Results of Group Difference Analyses for BMCQ Scales According to Age, Education Level, BMI (Self-Reported), Smoking Status, Alcohol Consumption, Psychiatric Diagnosis, Sport and Exercise Engagement, Yoga Practice, and Mindfulness and Meditation Practice (N=316).

	Interoceptive Attention				Sensation-Emotion Articulation				Body-Mind Values			
Characteristic	*df*	Statistic	*p*	Group Comparisons	*df*	Statistic	*p*	Group Comparisons	*df*	Statistic	*p*	Group Comparisons
Age	3, 108.47	0.60	.616		3, 99.82	0.24	.868		3, 311	1.47	.228	
Gender	311	-0.22	.829		311	-3.07	.002	Females > Males	311	1.18	.239	
Education	7, 308	1.11	.356		7, 308	1.68	.298		7, 308	0.51	.828	
BMI (Self-Report)	3, 292	3.06	.029	Normal > Overweight	3, 292	2.67	.048		3, 292	4.04	.008	Normal > Obese
Smoking Status	36.09	-0.51	.615		314	-1.53	.126		36.47	-1.37	.180	
Alcohol Consumption	4, 311	1.33	.260		4, 311	0.99	.418		4, 311	2.46	.046	
Sport and Exercise	314	2.90	.004	Regular Sport > No Regular Sport	314	0.56	.573		314	4.9	<.001	Regular Sport > No Regular Sport
Yoga	314	2.99	.003	Yoga > No Yoga	314	2.89	.004	Yoga > No Yoga	84.55	4.06	<.001	Yoga > No Yoga
Mindfulness and Meditation	314	4.36	<.001	Mindfulness > No Mindfulness	314	2.13	.035	Mindfulness > No Mindfulness	156.93	5.55	<.001	Mindfulness > No Mindfulness

Adjusted degrees of freedom are reported where homogeneity of variance was not assumed (Levene's $p<.05$). For post-hoc comparisons, Bonferroni correction was interpreted; Games-Howell interpreted for non-parametric F-test (Welch's).

Appendix G. Paper 3 Supplemental Materials

Psychological Disorders Self-Reported by the Sample

As displayed in Table S1, 92 participants self-reported a diagnosis of a current psychological disorder. Most commonly, comorbid depression and anxiety was reported, whether together or alongside an additional co-occurring disorder(s), accounting for 37% of the reported diagnoses. Anxiety was also frequently reported. Depression and neurodevelopmental conditions, such as attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) also represented commonly reported diagnoses.

Table S1.

Psychological Disorders Self-Reported by the Sample (N = 92).

Diagnosis	*N* (%)
ADHD	6 (6.5%)
Anxiety	23 (25.0%)
ASD	3 (3.3%)
Bipolar disorder	2 (2.2%)
Comorbid anxiety and other (e.g., ASD)	6 (6.5%)
Comorbid depression and anxiety	26 (28.3%)
Comorbid depression, anxiety, and other (e.g., eating disorder)	8 (8.7%)
Comorbid depression and other (e.g., ADHD)	3 (3.3%)
Comorbid other (e.g., ASD and ADHD)	1 (1.1%)
Depression	10 (10.9%)
Not specified	2 (2.2%)
Post-traumatic stress disorder	2 (2.2%)

Supplemental File S1. Original 13-Item Body-Mind Connection Questionnaire and Scoring Instructions

Body-Mind Connection Questionnaire

This questionnaire asks you to indicate how applicable a series of statements regarding your body and mind are to you generally. By that, we mean how they apply to you most of the time. Some of these will be a series of statements related to bodily sensations (e.g., hunger, thirst, need for air, etc.) and/or emotions. There are no right or wrong answers.

1.	**I consider myself in touch with my body and mind.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
2.	**I can direct my focus toward how specific parts of my body feel.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
3.	**It is easy for me to focus on specific sensations if they are suddenly experienced.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
4.	**It is easy for me to focus on specific sensations if I purposefully think about them.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
5.	**Where possible, I always attend to what my body is telling me.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
6.	**I am usually proactive in addressing the needs of my body.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
7.	**I find it hard to *identify* changes in my body associated with positive or negative emotions. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
8.	**If I were asked to, I'd find it hard to *describe* changes in my body associated with positive or negative emotions. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
9.	**I tend to focus on things happening in my physical environment rather than what is happening inside of me. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
10.	**I feel disconnected from my body. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
11.	**Feeling physically well is something that I prioritise in life.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
12.	**Feeling mentally well is something that I prioritise in life.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
13.	**I value being well-balanced in my body and my mind.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me

Asterisks indicate reverse scoring of item.

Scoring Instructions

Take the average of summed items on each BMCQ scale.
Note: reverse-score items 7, 8, 9 on Sensation-Emotion Articulation, and item 10 on Body-Mind Values.

Interoceptive Attention: Direction of attentional resources toward interoceptive stimuli. Higher values reflect greater direction of attentional resources toward interoceptive stimuli.

Q1 ____ + Q2 ____ + Q3 ____ + Q4 ____ / 4.

Sensation-Emotion Articulation: Internal focus and capacity for articulating bodily changes associated with emotions. Higher values reflect greater internal focus and capacity for articulating bodily changes associated with emotions.

Q7**(R)** ____ + Q8**(R)** ____ + Q9**(R)** ____ / 3.

Body-Mind Values: Beliefs in mind-body integration and importance of wellbeing. Higher values reflect stronger beliefs in mind-body integration and importance of wellbeing.

Q5 ____ + Q6 ____ + Q10**(R)** ____ + Q11 ____ + Q12 ____ + Q13____ / 6.

Supplemental File S2. Refined 10-Item Body-Mind Connection Questionnaire and Scoring Instructions

Body-Mind Connection Questionnaire

This questionnaire asks you to indicate how applicable a series of statements regarding your body and mind are to you generally. By that, we mean how they apply to you most of the time. Some of these will be a series of statements related to bodily sensations (e.g., hunger, thirst, need for air, etc.) and/or emotions. There are no right or wrong answers.

1.	**I can direct my focus toward how specific parts of my body feel.**	**1 Very untrue of me**	**2 Untrue of me**	**3 Somewhat untrue of me**	**4 Neutral**	**5 Somewhat true of me**	**6 True of me**	**7 Very true of me**
2.	**It is easy for me to focus on specific sensations if they are suddenly experienced.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
3.	**It is easy for me to focus on specific sensations if I purposefully think about them.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
4.	**I am usually proactive in addressing the needs of my body.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
5.	**I find it hard to *identify* changes in my body associated with positive or negative emotions. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
6.	**If I were asked to, I'd find it hard to *describe* changes in my body associated with positive or negative emotions. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
7.	**I tend to focus on things happening in my physical environment rather than what is happening inside of me. ***	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
8.	**Feeling physically well is something that I prioritise in life.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
9.	**Feeling mentally well is something that I prioritise in life.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me
10.	**I value being well-balanced in my body and my mind.**	1 Very untrue of me	2 Untrue of me	3 Somewhat untrue of me	4 Neutral	5 Somewhat true of me	6 True of me	7 Very true of me

Asterisks indicate reverse scoring of item.

Scoring Instructions

Take the average of summed items on each BMCQ scale.
Note: reverse-score items 5, 6, and 7 on Sensation-Emotion Articulation.

Interoceptive Attention: Direction of attentional resources toward interoceptive stimuli. Higher values reflect greater deployment of attentional resources toward interoceptive stimuli.

Q1 ____ + Q2 ____ + Q3 ____ / 3.

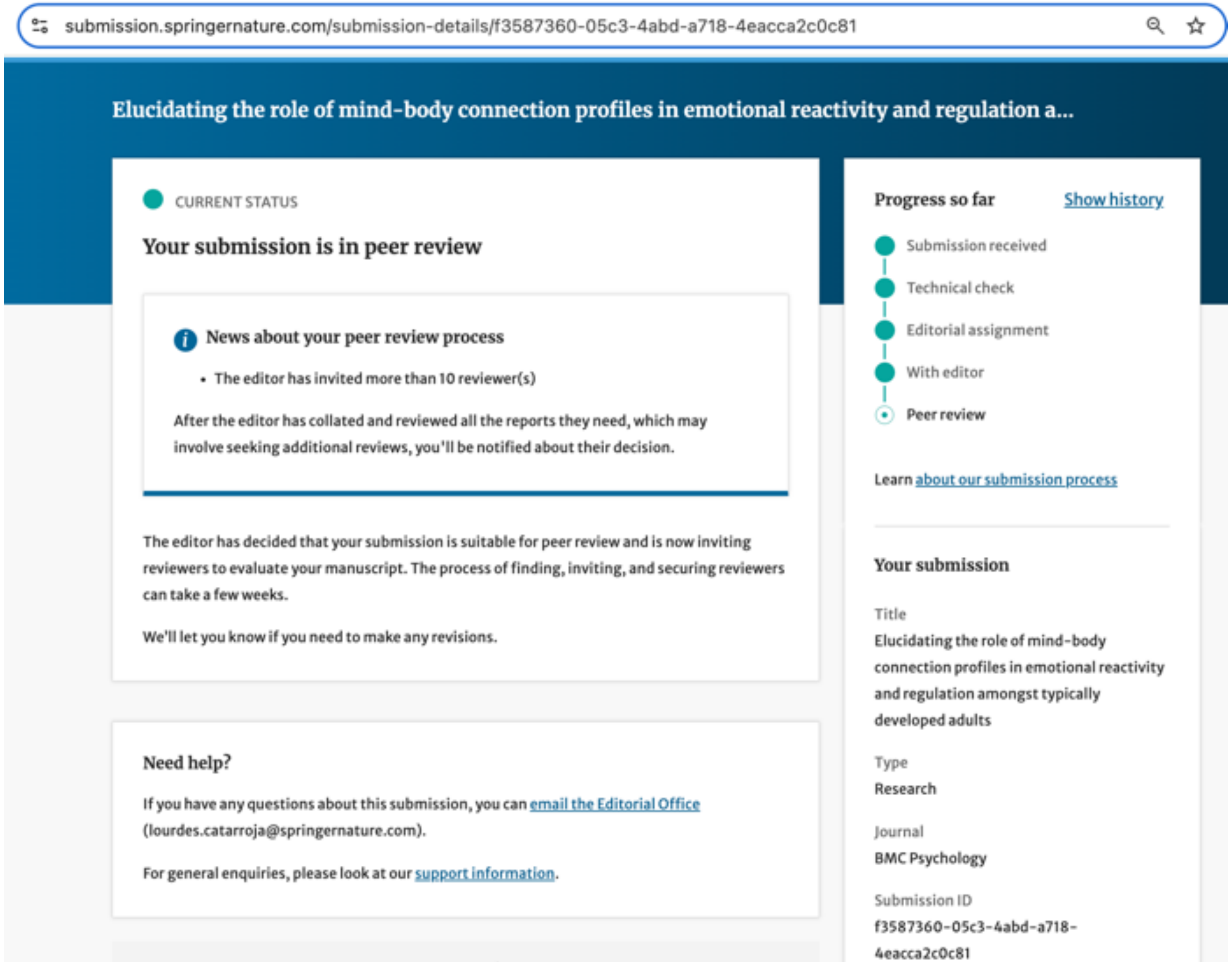
Sensation-Emotion Articulation: Internal focus and capacity for identifying and articulating bodily changes associated with emotions. Higher values reflect greater internal focus and capacity for identifying and articulating bodily changes associated with emotions.

Q5**(R)** ____ + Q6**(R)** ____ + Q7**(R)** ____ / 3.

Body-Mind Values: Beliefs in importance of physical and mental wellbeing. Higher values reflect stronger beliefs in importance of wellbeing.

Q4 ____ + Q8 ____ + Q9 ____ + Q10____ / 4.

Appendix H. Paper 3 Evidence of Submission



submission.springernature.com/submission-details/f3587360-05c3-4abd-a718-4eacca2c0c81

Elucidating the role of mind-body connection profiles in emotional reactivity and regulation a...

CURRENT STATUS

Your submission is in peer review

News about your peer review process

- The editor has invited more than 10 reviewer(s)

After the editor has collated and reviewed all the reports they need, which may involve seeking additional reviews, you'll be notified about their decision.

The editor has decided that your submission is suitable for peer review and is now inviting reviewers to evaluate your manuscript. The process of finding, inviting, and securing reviewers can take a few weeks.

We'll let you know if you need to make any revisions.

Need help?

If you have any questions about this submission, you can email the Editorial Office (lourdes.catarroja@springernature.com).

For general enquiries, please look at our support information.

Progress so far — Show history

- Submission received
- Technical check
- Editorial assignment
- With editor
- Peer review

Learn about our submission process

Your submission

Title
Elucidating the role of mind-body connection profiles in emotional reactivity and regulation amongst typically developed adults

Type
Research

Journal
BMC Psychology

Submission ID
f3587360-05c3-4abd-a718-4eacca2c0c81