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Autism spectrum disorder and anorexia nervosa: Investigating the behavioural and neurocognitive overlap

M. Kirkovski [a,b,*], G. Papavasiliou [b], B.E. Speranza [a], J. Scarfo [b], N. Albein-Urios [a,c], J. Linardon [a], A. Phillipou [d,e,f,g,h], M. Fuller-Tyszkiewicz [a], P.G. Enticott [a]

[a] School of Psychology, Deakin University, Burwood, Australia
[b] Institute for Health and Sport, Victoria University, Melbourne, VIC, Australia
[c] Discipline of Psychology, Institute of Health and Wellbeing, Federation University, Berwick, Australia
[d] Orygen, Melbourne, VIC, Australia
[e] Centre for Youth Mental Health, The University of Melbourne, City, VIC, Australia
[f] Department of Mental Health, St Vincent's Hosptial, Melbourne, VIC, Australia
[g] Department of Mental Health, Austin Hospital, Melbourne, VIC, Australia
[h] Department of Psychological Sciences, Swinburne University of Technology, Melbourne, VIC, Australia

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ABSTRACT

Autism spectrum disorder (autism) and anorexia nervosa (AN) share many clinical features. Two key neurocognitive correlates of the autistic dyad, specifically, mentalising (social impairment) and set-shifting (restricted and repetitive behaviours/interests [RRBI]) were investigated in a sample of 327 adult participants with autism ($n = 100$; 50 females, 50 male), AN ($n = 82$; 54 females, 28 male), autism and AN ($n = 45$; 36 females, 9 male), and 100 (50 female, 50 male) control participants from the general population. A battery of self-report (Autism Spectrum Quotient, Eating Disorder Examination Questionnaire, Reflective Function Questionnaire, and Repetitive Behaviour Questionnaire 2 – Adult version) and performance-based (Wisconsin Card Sort Task [WCST] and Penn Emotion Recognition Test [ER-40]) measures were administered online. Clinical participants reported greater mentalising difficulty, more repetitive behaviour, and displayed worse mentalising ability compared to controls, with no difference between the clinical groups. Eating disorder psychopathology predicted error (total and perseverative) rates on the WCST, while lower levels of autistic traits were positively associated with ER-40 accuracy. We provide evidence that clinical features of autism and AN might have specific neurocognitive relevance. Improved understanding of the mechanisms underlying the overlapping features of autism and AN can have critical implications for early detection and improved and tailored intervention.

1. Introduction

Autism spectrum disorder (autism) and anorexia nervosa (AN) are two distinct conditions. Autism is a neurodevelopmental condition diagnosed more often in males, and AN is a feeding and eating disorder – which produces substantial physical and psychosocial impairments, more commonly diagnosed in females (American Psychiatric Association, 2022). An overlap between the two conditions, however, has long been observed (Boltri and Sapuppo, 2021; Gillberg, 1985). While there may be some overlap, it is imperative to note that the presence of eating disorder psychopathology in autism, encompassed by intense fears surrounding weight gain as well as disturbances in weight or shape perception, can be distinct from the problematic eating behaviours also commonly observed in autism, which can manifest as picky eating, aversions to certain foods/textures, or insistence on eating the same foods (Baraskewich et al., 2021). Alongside eating disorder psychopathology, people with autism and people with AN show overlapping cognitive and behavioural symptoms surrounding the dyad of characteristics used to define autism (the autism dyad), which includes restricted and repetitive behaviours/interests (RRBI) (Dinkler et al., 2021; Kerr-Gaffney et al., 2021; Zucker and Losh, 2008), and social impairment (Kerr-Gaffney et al., 2021). Indeed, up to 30 % of people with AN have been found to fit the diagnostic criteria for autism, and missed or misdiagnosis is common (Brown and Stokes, 2020). Biological sex, specifically female sex, appears to be central to the overlap between autism and AN (Gillberg, 1985).

* Corresponding author.
E-mail address: Melissa.kirkovski@deakin.edu.au (M. Kirkovski).

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Females are notoriously underrepresented in the autism literature, and awareness and understanding of the female profile of autism is limited in comparison to what is understood of the presentation of autism in males (Kirkovski et al., 2013; Lockwood Estrin et al., 2021). Irrespective of biological sex, psychiatric comorbidity is high in autism (Joshi et al., 2013; Stadnick et al., 2017), and this coupled with a limited understanding of the female profile of autism, increases the risk of mis-, missed, or late diagnosis. For females in particular, symptoms associated with comorbid diagnoses can dominate in presentation, hence, masking the presence of autism (Zener, 2019). One likely contributor to this phenomenon is that females with autism are more likely to "camouflage" their symptoms; for example, by developing coping mechanisms to conform when in social situations (Hull et al., 2017, 2020; Lai et al., 2017). Related to this, some autistic females might fixate on body image or develop RRBI around food and exercise, leading to a diagnosis of an eating disorder (most commonly AN), and often resulting in the autism being missed or diagnosed later (Brown and Stokes, 2020; Green et al., 2019; Kirkovski et al., 2013).

Historically, research into the overlap between autism and AN has focused on RRBI due to the above-described observations of preoccupation with food and exercise in autistic females (Brown and Stokes, 2020; Green et al., 2019; Kirkovski et al., 2013). While RRBI as expressed in autism are not a diagnostic feature of AN (American Psychiatric Association, 2022), individuals with AN do experience cognitive rigidity (Friederich and Herzog, 2011; Sternheim et al., 2022), and display many rigid, repetitive, and obsessive behaviours and thoughts, particularly in the context of diet and exercise (Di Lodovico and Gorwood, 2020). Kerr-Gaffney et al. (2021) report comparable clinical expression of RRBI between females with autism and females with AN. More recently, however, some focus has shifted toward better understanding social or mentalising difficulty in to AN and eating disorder psychopathology more broadly (Fithall et al., 2023; Gray et al., 2024; Konstantakopoulos et al., 2020a; Simonsen et al., 2020). This is pertinent considering the role of mentalising in the development of irrational body image beliefs (Konstantakopoulos et al., 2020b), and in treatment engagement and efficacy (Jewell et al., 2023).

One critical limitation of the literature to date, however, is a bias in reporting the male profile of autism (Brown and Stokes, 2020; Green et al., 2019; Kirkovski et al., 2013; Lockwood Estrin et al., 2021). To build upon the existing literature and account for these biases in clinical measures, improved understanding of neurocognitive features that are related to the autistic dyad, yet rely less on core diagnostic features, can provide insights regarding features that might be missed by traditional clinical measures.

1.1. Overlapping neurocognitive features related to the autism dyad

1.1.1. RRBI: executive (dys)function

Though RRBI are a difficult construct to measure using neurocognitive tasks, executive functions (EFs), which refer broadly to the organisation and management of thoughts and actions and utilise an array of skills for goal-directed behaviours (Royall et al., 2002), are thought to underpin RRBI in autism (Iversen and Lewis, 2021). Furthermore, research indicates that poorer EF skills may be critical to the overlap between neurodevelopmental and eating disorders (Norton, 2024). Difficulty with set-shifting, also referred to as attention-switching, or cognitive (in)flexibility and rigidity, are of great relevance to the overlap between autism and AN. Independently, autistic individuals (Lage et al., 2024) and individuals with AN (Diaz-Marsa et al., 2023; Keegan et al., 2021; McAnarney et al., 2011; Roberts et al., 2010) show impairments in behavioural performance on these set-shifting tasks, implying problems with mental flexibility. Regarding AN, however, it is important to note that there is some inconsistency in the literature, with some studies noting no performance-based difference between clinical participants and non-clinical comparison groups, potentially accounted for by age (Fitzpatrick et al., 2012; Miles et al., 2020) or illness severity (i.e. the state-trait debate; (Miles et al., 2023)). In AN samples, however, those with higher levels of autistic traits display greater cognitive rigidity (Westwood et al., 2017). Interestingly, a large meta-analysis has indicated no differences in cognitive flexibility (set-shifting) between autistic and AN groups, and that both groups perform significantly worse than non-clinical comparison groups (Westwood et al., 2016). This is in contrast with parent report, which suggests that autistic adolescents exhibit poorer EF profiles when compared to parent report of adolescents with AN (Ghiotto et al., 2022; Timko et al., 2021), potentially reflective of the ecological validity of performance-based measures (Timko et al., 2021). High levels of autistic traits in AN samples have, however, been associated with poorer behavioural regulation and metacognition, as assessed by the Behaviour Rating of Executive Functions Parents-Form (BRIEF-P; (Ghiotto et al., 2022)). Additionally, research indicates that high levels of autistic features, namely difficulty with attention switching (implicated in set-shifting), is associated with increased eating disorder psychopathology among the general population (Fithall et al., 2023).

1.1.2. Social impairment: mentalising

Socio-cognitive difficulty, while core to autism (American Psychiatric Association, 2022), are also observed in AN (Gray et al., 2024; Konstantakopoulos et al., 2020a; Simonsen et al., 2020). From a neurocognitive perspective, self-report and performance-based measures indicate that people with AN experience varying degrees of difficulty when completing empathy-related mentalising tasks (Saure et al., 2020, 2022; Tauro et al., 2022). Findings, however, are often inconsistent and might be affected by the variety of and inconsistency between the social domains measured (see; Tauro et al., 2022 for a comprehensive review). Moreover, there is evidence to suggest overlapping neurocognitive profiles in the mentalising domain between individuals with AN and autism (Leppanen et al., 2018; Postorino et al., 2017), albeit those with autism may have greater difficulty (Leppanen et al., 2018), as appears to be the case regarding EF as described above.

1.2. The present study

The present study aimed to elucidate whether the neurocognitive correlates of the autistic dyad can inform overlapping autistic and AN profiles. It was hypothesised that clinical groups (autism and AN) would report greater difficulty and perform worse compared to control participants on self-report and neurocognitive tasks related to the autistic dyad; i.e. assessment of mentalising, repetitive behaviour and set-shifting. It was further hypothesized that higher levels of autistic traits and eating disorder psychopathology would predict poorer performance on self-report and behavioural assessment of features related to the autistic dyad. Given the critical implication of biological sex in both autism and AN, any effects of biological sex were also explored.

2. Methods

This project was approved by the Deakin University and Victoria University Human Research Ethics Committees. The study was conducted following The Code of Ethics of the World Medical Association (Declaration of Helsinki) and the National Statement on Ethical Conduct in Human Research.

2.1. Participants

Data were collected online as part of a larger study investigating overlapping autistic behaviour and eating disorder psychopathology among both clinical and non-clinical samples. Participants were recruited via Prolific, a dedicated survey platform, as well as social media (e.g., Facebook, Twitter) posts, and via hard copy flyers placed around Deakin University Burwood Campus. In order to participate in this study, participants needed to be aged between 18 and 30 years, and

have been diagnosed with either autism or AN by an appropriate clinician, or have no history or psychological or psychiatric illness. Data for a total of 327 (190 female, 137 male) participants are reported here, matched based on the demographics of the clinical samples. Of these, 100 (50 female, 50 male) participants self-reported having received a diagnosis of autism from an appropriate clinical (psychologist, psychiatrist, paediatrician), 82 (54 female, 28 male) self-reported having been diagnosed with AN, and 45 (36 female, 9 male) reported having received a formal diagnosis of both (i.e. co-occurring) autism and AN. Data for 100 (50 female, 50 male) age and sex-matched controls recruited from the general population are also reported. Refer to Table 1 for a summary of demographic information. Groups did not significantly differ on age, however, Kruskal-Wallace H tests revealed significant group differences in body mass index (BMI), which was to be expected. Post hoc tests revealed that participants with AN had significantly lower current BMI compared to the control and autism groups, $p = <0.001$ (Bonferroni corrected), but not the comorbid autism and AN group. Participants with comorbid autism and AN had significantly lower current BMI compared to the control ($p = .001$, Bonferroni corrected) and autism ($p = <0.001$, Bonferroni corrected) groups. Current BMI did not differ between the autism and control groups.

2.2. Materials

2.2.1. Clinical and behavioural measures

Participants completed the following assessment battery to quantify the clinical, behavioural and neurocognitive characteristics of the sample.

2.2.1.1. Clinical characteristics. The Autism Spectrum Quotient (AQ; (Baron-Cohen et al., 2001) is a 50-item self-report questionnaire used to characterise traits and characteristics associated with autism in both clinical and non-clinical populations. The AQ is measured on a 4-point Likert scale, and provides a total AQ score, as well as five subscales pertaining to: social skills, attention switching, communication, imagination, and attention to detail. Higher scores on the total AQ, and for each of the sub-scales, indicate a greater presence of autistic traits. For the purpose of the present study, and given the inclusion of a clinically diagnosed autism sample, the AQ was scored according to the original (binary) protocol (Baron-Cohen et al., 2001).The AQ has sound psychometric properties (Baghdadli et al., 2017; Stevenson and Hart, 2017). Reliability indices obtained from the primary dataset (manuscript currently in preparation) from which the present data are derived indicate moderate to high internal consistency across each of the five sub-scales of the AQ (communication; $\alpha = 0.84$, social skills; $\alpha = 0.85$, imagination; $\alpha = 0.69$, attention to detail; $\alpha = 0.76$, and attention switching; $\alpha = 0.81$), consistent with previous studies (Baghdadli et al., 2017; Stevenson and Hart, 2017).

The Eating Disorder Examination-Questionnaire (EDE-Q(Fairburn and Beglin, 1994) was used to characterise eating disorder psychopathology . This 28-item self-report measure was developed based on the Eating Disorder Examination Semi-structured Interview, and is suitable for use in both clinical and non-clinical populations (Fairburn and Beglin, 1994). The EDE-Q provides a global score and four subscales: restraint, eating concern, shape concern, and weight concern. Higher scores on each of these measures are indicative of increased eating disorder symptomatology. The EDE-Q has sound psychometric properties (Berg et al., 2012; Peterson et al., 2007). Reliability indices obtained from the primary dataset (manuscript currently in preparation) from which the present data are derived indicate moderate to high internal consistency across each of the four sub-scales of the EDE-Q (restraint; $\alpha = 0.87$, eating concern; $\alpha = 0.86$, shape concern; $\alpha = 0.92$, and weight concern; $\alpha = 0.86$).

Given the self-report nature of this study, these measures also serve to characterise the sample. Table 2 presents a summary of these scores.

Table 1
Summary of participant demographics.

		Autism				AN				Autism and AN				Control					
		m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	H (df =3)	*p*
Age	Total	25.09	3.01	25.00	179.63	24.65	3.31	25.50	167.65	24.62	3.17	25.00	164.60	23.95	3.10	23.00	145.11	6.91	0.075
	Female	24.94	3.07	25.00		24.41	3.44	24.00		24.83	3.13	25.00		24.34	2.94	24.50			
	Male	25.24	2.97	25.00		25.11	3.05	26.00		23.78	3.38	22.00		23.56	3.23	23.00			
Current BMI	Total	27.21	9.04	24.06	205.13	20.47	3.49	19.81	115.20	20.69	3.62	20.43	117.99	24.49	6.10	23.43	183.60	55.72	<0.001
	Female	27.31	8.83	24.08		20.37	3.71	19.81		20.22	3.53	19.85		23.28	6.60	23.73			
	Male	27.11	9.33	24.06		20.68	3.07	19.95		22.60	3.53	22.13		23.82	5.54	22.72			

Table 2
Summary of self-reported clinically relevant characteristics.

		Autism				AN				Autism and AN				Control					
		m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	H (df=3)	p
Clinical Features																			
AQ	Total	34.18	7.34	35.00	217.84	27.43	7.77	28.50	149.88	36.20	9.13	37.00	235.67	21.01	7.71	20.00	89.49	122.36	<0.001
	Female	34.20	7.86	35.50	121.57	28.26	7.86	29.50	86.51	37.47	8.43	39.50	139.47	20.56	7.89	20.50	47.48	73.91	<0.001
	Male	34.16	6.87	35.00	97.24	25.82	7.48	25.00	61.48	31.11	10.56	33.00	83.89	21.46	7.59	20.00	42.29	50.33	<0.001
EDE-Q	Total	2.22	1.54	2.00	143.84	3.54	1.26	3.36	223.68	3.57	1.32	3.81	227.13	1.60	1.14	1.44	106.82	93.87	<0.001
	Female	2.24	1.59	1.78	73.41	3.93	1.19	4.04	130.73	3.89	1.16	4.24	129.69	1.69	1.17	1.57	54.92	71.38	<0.001
	Male	2.20	1.50	2.24	71.98	2.77	1.04	2.67	90.27	2.30	1.20	2.38	77.83	1.52	1.11	1.31	52.52	17.39	<0.001

2.2.1.2. Assessment of features related to the RRBI domain of the autistic dyad. The Adult Repetitive Behaviours Questionnaire (RBQ-2A; (Barrett et al., 2015) is a 20-item self-report measure and was administered to assess RRBI such as routines and rituals, repetitive motor behaviours, sensory interests, and repetitive actions with objects. The total score can range between 20 and 60, with higher scores indicative of more RRBI.

A computerised version of the Wisconsin Card Sort Task (WCST; Grant and Berg, 1948; Heaton et al., 1993) was downloaded from the Inquisit/Millisecond test library (MillisecondSoftware, 2022) as a neurocognitive measure of cognitive flexibility, specifically: set-shifting. Without specific instruction, participants are required to sort cards, from, two 64-card decks, into categories based on colour, shape, and number. Following 10 consecutive correct responses, the sorting "rule" changes. For the purpose of the present study, the number of total and perseverative (i.e. responses that do not match the sorting rule) errors are reported, refer to Miles et al. (2021) for a detailed appraisal of WCST scoring and interpretation.

2.2.1.3. Assessment of features related to the social communication and interaction domain of the autistic dyad. Reflective Functioning Questionnaire (RFQ; (Fonagy et al., 2016), an 8 item self-report measure of intra- and inter-personal mental and emotional (i.e. social) processes. Scores reflect levels of hypermentalization, or certainty (RFQc), and hypomentalization, or uncertainty (RFQu).

To assess behavioural/neurocognitive performance in the social cognitive domain, a computerised version (MillisecondSoftware, 2022) of the Penn Emotion Recognition Test (ER-40; Carter et al., 2009; Kohler et al., 2004) was administered. This neurocognitive task requires participants to identify emotions based on static facial expression. The Research Domain Criteria (RDoC) framework recommends the ER-40 as an appropriate measure to inform Social Communication/Processes ((NIMH), 2021).

2.3. Procedure

All data were collected online. Participants provided consent online via a checkbox, after which they completed basic demographic items, and the above-described battery of self-report questionnaires and neurocognitive tasks. Each task was estimated to take less than 10 min to complete, and the total session time took approximately 30–60 mins. Consent, survey and questionnaire-based measures were completed via Qualtrics (qualtrics.com), after which participants were redirected to Inquisit (MillisecondSoftware, 2022) to complete the neurocognitive tasks. There were six attention checks embedded throughout the study. These included instructional manipulation checks whereby participants were instructed to complete the item in a certain way (e.g. respond "strongly agree" for this item) and nonsensical items, whereby only one of the responses can justifiably be correct (e.g. I fly to Mars for work every day [response must be "disagree" or similar]), in line with Prolific's attention check policy (prolific.com). Upon completion of the study, participants were reimbursed £17.30 (equivalent of AUD$30 at the time of data collection) per hour for their participation via the Prolific platform, or emailed an AUD$30 gift voucher, depending on the method of access to the study.

2.3.1. Data cleaning

Given the limitations of online data collection, a conservative approach was taken towards data-cleaning. First, considering the degree of ambiguity and uncertainty regarding multiple submissions from the same IP address, all such submissions were excluded. Next, when response validity was questionable (i.e. when a clear pattern was present in the responses) data were removed. Responses to attention checks were then reviewed, and any data set containing two or more failed attention checks were excluded. Additionally, neurocognitive data were manually inspected. Data for participants who had low accuracy (e.g. <

10 correct responses) coupled with faster response times (<1 s) were excluded from the final sample due to researchers' concerns regarding attentiveness. Behavioural response time reflects a combination of visual processing and motor response. Thorpe et al. (1996) provide evidence to suggest that the neural mechanisms underlying visual processing peaks after 100 ms, followed by the behavioural response. Moreover, the authors also report evidence of a "speed-accuracy trade-off" for responses occurring under 100 ms (Thorpe et al., 1996). Data from participants who responded to open questions in a language other than English, or responses indicated that they had violated the inclusion criteria (i.e. outside of the approved age criteria) were also excluded. While AN severity is determined based on BMI (i.e. mild severity $\leq$ 17 kg/m^2 (American Psychiatric Association, 2022)), participants who reported having been diagnosed with AN but fitting within the normal weight range based on BMI were included, giving consideration to the presentation of atypical AN (Walsh et al., 2023) and weight/BMI restoration as people enter remission (American Psychiatric Association, 2022). Data from participants reporting having been diagnosed with AN, but whose current BMI exceeded 30 were excluded.

2.3.2. Statistical design

A series of two-way analyses of variance (ANOVAs) were planned to assess whether outcome variables differed based on diagnosis (autism, AN, comorbid autism and AN, and control) and biological sex (female, male). Outliers, defined as values >3SD from the mean, were detected and windzorised via replacement with the next value that was not a statistical outlier. Inspection of outcome variable distribution and residuals noted numerous violations of statistical assumptions. Therefore, non-parametric alternatives were considered best practice and Kruskal-Wallace H tests were used in place.

To assess whether autistic traits and eating disorder psychopathology would be associated with performance on self-report and behavioural assessment of features related to the autistic dyad, a series of multiple linear regression models with predictor variables of EDE-Q total score, AQ total score, BMI, and biological sex (dichotomous using dummy variable) were planned for each of the following outcome variables; *social domain*: ER-40 accuracy (ER-40$_{ACC}$), ER-40 response time (correct responses; ER-40$_{RT}$) RFQ-u, RFQ-c, *RRBI domain:* WCST total errors (WCST$_{ERR}$), WCST perseverative errors (WCST$_{pERR}$), and RBQ-2A total scores. Again, several violations of statistical assumptions were identified. Data were nonlinear and positively skewed for ER-40$_{RT}$, RFQ-u, RFQ-c, WCST$_{ERR}$ and WCST$_{pERR}$ models. Due to these violations, a generalised linear model fitted with a gamma distribution and log link function was used in place of multiple linear regressions. Where distributions were negatively skewed (ER-40$_{ACC}$), data were reverse coded and the same model (generalised linear model fitted with a gamma distribution and log link function) applied. All relevant assumptions of a multiple linear regression were met for the RBQ-2A model.

3. Results

3.1. Group comparisons

3.1.1. Clinically-related measures

Results of self-reported clinically-relevant characteristics related to autism and eating disorder psychopathology are presented in Table 2. Kruskal-Wallace H tests revealed significant overall group differences on scores for both clinical measures (AQ and Global EDE-Q).

Post-hoc tests revealed that the control group had the lowest level of eating disorder psychopathology, significantly less than the autism group and the AN group. Scores on the EDE-Q were not significantly different between the AN and comorbid autism and AN group. These results were replicated among the female subsample, except that females with autism also did not differ from their neurotypical counterparts on the EDE-Q score. For males, only those diagnosed with AN and controls differed.

Similarly, the control group had the lowest level of autistic traits (AQ scores), significantly less than the AN group, with the autism group and the comorbid autism and AN group scoring highest and not significantly different to each other. The same pattern was identified between females, but for males, the AN groups AQ score did not differ from controls, nor from the comorbid autism and AN group.

3.1.2. Behavioural and neurocognitive measures

A summary of scores for self-report (RFQ, and the RBQ-2A), and performance-based (ER-40$_{ACC}$, ER-40$_{RT}$, WCST$_{ERR}$ or WCST$_{pERR}$) measures related to the autistic dyad are presented in Table 3.

3.1.2.1. RRBI domain

3.1.2.1.1. Neurocognitive task. Kruskall Wallace H-tests did not reveal any group differences on the WCST$_{ERR}$ or WCST$_{pERR}$.

3.1.2.1.2. Self-Report. Group differences were identified between scores on the RBQ-2A. This pattern remained when data were stratified by biological sex. All three clinical groups scored significantly higher on the RBQ-2A than the control group, and not different from each other. The same pattern was observed among the female sub-group, but between males, the comorbid autism and AN group also did not differ to controls. Refer to Table 4 for a summary of all post-hoc tests.

3.1.2.2. Social domain

3.1.2.2.1. Neurocognitive task. Kruskall Wallace H-tests revealed that groups differed in their scores on the ER-40$_{ACC}$, but not ER-40$_{RT}$. For ER-40$_{ACC}$, all three clinical groups scored significantly lower than the control group, and not different from each other. Sex-stratified analysis revealed the same pattern of results among the female sub-group, but there were no group differences identified between males, refer to Table 4.

3.1.2.2.2. Self-Report. Kruskall Wallace H-tests revealed that groups differed in their scores on both RFQ outcomes. The same pattern was replicated when data were stratified by biological sex for the RFQ-u, but not the RFQc. Scores on the RFQc did not differ between female participants.

Post-hoc tests, presented in Table 4, revealed that all three clinical groups scored significantly lower on the RFQc than controls, and not different from each other. There were no differences between the female groups, and for males, only the autism group differed from controls.

Participants with autism, and comorbid autism and AN scored significantly higher on the RFQu compared to controls and also compared to the AN group. Among females, participants with autism, and comorbid autism and AN scored higher on the RFQu compared to controls. Comparing the male subgroups, the autism group scored higher on the RFQu compared to the control groups.

3.2. Continuous effects

3.2.1. Behavioural and neurocognitive measures

A series of generalised linear models and regression analyses are presented below assessing whether eating disorder psychopathology, autistic traits, or biological sex predicted outcomes on self-report of performance-based measures related to the autistic dyad.

3.2.1.1. RRBI domain

3.2.1.1.1. Neurocognitive task. A generalised linear model with a gamma distribution and log link function was used to determine if scores on the EDE-Q, AQ, BMI, and biological sex predicted WCST$_{ERR}$. The overall model was significant, $\chi2(4) = 9.78$, $p = .04$. Tests of model effects revealed a positive main effect of EDE-Q score, $\chi2(1) = 7.12$, $p = .01$, $B = 0.07$, and a non-significant main effect of biological (female) sex, $\chi2(1) = 3.25$, $p = .07$, $B = -0.14$.

The model was repeated for WCST$_{pERR}$, and the omnibus test was significant, $\chi2(4) = 10.15$, $p = .04$. Tests of model effects revealed a

Table 3
Summary of scores on self-report and performance-based measures related to the autistic dyad.

		Autism				AN				Autism and AN				Control					
		m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	m	sd	Median	Mean Rank	H (df=3)	p
Behavioural Characteristics																			
RFQc	Total	0.52	0.68	0.33	156.48	0.46	0.55	0.33	153.94	0.50	0.80	0.00	135.69	0.73	0.69	0.50	192.51	15.24	<0.001
	Female	0.54	0.73	0.33	96.16	0.44	0.53	0.33	91.94	0.44	0.73	0.08	80.63	0.63	0.62	0.42	109.40	6.34	0.10
	Male	0.49	0.63	0.17	61.34	0.49	0.61	0.33	62.95	0.72	1.08	0.00	59.06	0.82	0.74	0.50	81.84	8.54	0.04
RFQu	Total	1.23	0.82	1.17	188.31	0.99	0.80	0.83	159.32	1.41	0.86	1.50	207.69	0.68	0.57	0.67	123.88	34.63	<0.001
	Female	1.28	0.86	1.25	106.07	1.10	0.78	1.00	95.33	1.51	0.87	1.50	120.89	0.69	0.48	0.67	66.83	23.23	<0.001
	Male	1.18	0.79	1.08	83.94	0.76	0.80	0.50	60.91	1.02	0.73	1.17	77.11	0.67	0.64	0.58	57.13	13.22	<0.001
RBQ-2A	Total	42.50	7.67	42.50	185.63	43.35	7.74	44.50	197.95	45.29	8.04	46.00	251.18	33.32	7.64	32.00	91.51	87.89	<0.001
	Female	41.02	8.44	40.00	98.38	43.02	8.36	44.00	112.12	46.31	7.47	47.00	129.94	32.14	7.90	30.00	49.87	53.69	<0.001
	Male	43.98	6.57	44.00	86.28	44.00	6.48	45.00	87.95	41.22	9.38	42.00	71.67	34.50	7.26	33.00	40.63	41.52	<0.001
Neurocognitive Assessment																			
ER-40 (acc)	Total	31.56	4.05	32.00	156.63	30.63	5.87	32.00	152.51	30.48	4.22	31.00	130.09	33.08	3.34	34.00	196.05	19.25	<0.001
	Female	31.26	4.05	32.00	84.30	31.35	5.48	33.00	92.99	30.39	3.84	30.00	71.03	33.98	3.24	35.00	127.03	25.96	<0.001
	Male	31.86	4.06	32.00	71.47	29.25	6.44	30.00	55.96	30.88	5.94	32.50	62.61	32.18	3.23	33.00	74.98	4.62	0.20
ER-40 (RT)	Total	2099.52	551.73	1985.34	176.70	1872.12	634.18	1906.16	157.56	2061.67	687.49	1920.70	166.29	2035.51	706.20	1870.40	155.55	3.01	0.39
	Female	2061.92	546.13	1999.65	83.28	2024.85	538.11	1969.14	98.81	2061.98	740.58	1917.64	97.14	1942.29	695.64	1811.82	83.28	3.62	0.31
	Male	2137.12	560.26	1985.34	73.80	1985.65	798.18	1817.38	58.36	2060.26	401.31	2013.27	72.78	2128.74	711.30	1918.95	69.48	2.83	0.42
WCST $_{pERR}$	Total	15.10	10.34	11.00	161.88	17.01	12.30	13.00	175.52	13.00	8.83	10.50	141.78	15.10	11.35	128.84	164.83	3.73	0.29
	Female	13.84	9.97	11.00	90.57	18.35	13.53	13.00	108.94	13.22	9.08	10.50	86.38	14.24	12.26	11.00	92.48	4.78	0.19
	Male	16.36	10.64	11.50	69.77	14.43	9.13	12.50	65.48	12.00	8.07	9.50	53.63	15.96	10.41	11.00	71.30	1.61	0.66
WCST $_{ERR}$	Total	29.52	19.44	22.00	163.13	35.34	23.24	28.00	184.51	26.91	17.83	20.50	143.02	27.53	16.74	22.00	157.50	6.56	0.09
	Female	21.69	18.35	20.00	89.96	35.44	22.56	30.50	112.69	27.58	18.21	22.00	89.97	25.08	16.07	19.00	86.45	7.51	0.06
	Male	32.14	20.32	24.00	71.10	35.14	24.93	25.00	72.66	21.33	17.48	16.00	46.33	29.98	17.21	23.00	63.93	3.32	0.35

Table 4
Results of all post-hoc tests.

	Group		Total Sample				Female				Male			
			Std. Error	Test Statistic	Std. Test Statistic	Adj. Sig.	Std. Error	Test Statistic	Std. Test Statistic	Adj. Sig.	Std. Error	Test Statistic	Std. Test Statistic	Adj. Sig.
Clinical Features														
AQ	Control	Autism	13.36	−128.35	−9.60	<0.001	10.99	−74.09	−6.74	<0.001	7.93	−54.95	−6.93	<0.001
		AN	14.08	−60.39	−4.29	<0.001	10.79	−39.03	−3.62	<0.001	9.36	−19.19	−2.05	0.24
		Autism and AN	16.96	−146.18	−8.62	<0.001	12.01	−91.99	−7.66	<0.001	14.36	−41.60	−2.90	0.02
	Autism	AN	14.08	67.96	4.83	<0.001	10.79	35.06	3.25	0.01	9.36	35.76	3.82	<0.001
		Autism and AN	16.96	−17.83	−1.05	1.00	12.01	−17.90	−1.49	0.82	14.36	13.35	0.93	1.00
	AN	Autism and AN	17.53	−85.79	−4.89	<0.001	11.83	−52.96	−4.48	<0.001	15.19	−22.41	−1.47	0.84
EDE-Q	Control	Autism	13.37	−37.02	−2.77	0.03	11.00	−18.49	−1.68	0.56	7.94	−19.46	−2.45	0.09
		AN	14.08	−116.86	−8.30	<0.001	10.79	−75.81	−7.02	<0.001	9.37	−37.75	−4.03	<0.001
		Autism and AN	16.97	−120.31	−7.09	<0.001	12.02	−74.77	−6.22	<0.001	14.37	−25.31	−1.76	0.47
	Autism	AN	14.08	−79.84	−5.67	<0.001	10.79	−57.32	−5.31	<0.001	9.37	−18.29	−1.95	0.31
		Autism and AN	16.97	−83.30	−4.91	<0.001	12.02	−56.28	−4.68	<0.001	14.37	−5.85	−0.41	1.00
	AN	Autism and AN	17.54	−3.46	−0.20	1.00	11.83	1.04	0.09	1.00	15.21	12.43	0.82	1.00
Behavioural Characteristics														
RFQc	Control	Autism	13.13	36.03	2.74	0.04	–	–	–	–	7.83	20.50	2.62	0.05
		AN	13.83	38.57	2.79	0.03	–	–	–	–	9.24	18.89	2.04	0.25
		Autism and AN	16.66	56.82	3.41	<0.001	–	–	–	–	14.17	22.78	1.61	0.65
	Autism	AN	13.83	2.54	0.18	1.00	–	–	–	–	9.24	−1.61	−0.17	1.00
		Autism and AN	16.66	20.79	1.25	1.00	–	–	–	–	14.17	2.28	0.16	1.00
	AN	Autism and AN	17.22	18.25	1.06	1.00	–	–	–	–	15.00	3.89	0.26	1.00
RFQu	Control	Autism	13.33	−64.43	−4.83	<0.001	10.97	−39.24	−3.58	<0.001	7.90	−26.81	−3.39	<0.001
		AN	14.04	−35.44	−2.52	0.07	10.77	−28.50	−2.65	0.05	9.33	−3.78	−0.41	1.00
		Autism and AN	16.92	−83.81	−4.95	<0.001	11.99	−54.06	−4.51	<0.001	14.31	−19.98	−1.40	0.98
	Autism	AN	14.04	28.99	2.06	0.23	10.77	10.74	1.00	1.00	9.33	23.03	2.47	0.08
		Autism and AN	16.92	−19.38	−1.15	1.00	11.99	−14.82	−1.24	1.00	14.31	6.83	0.48	1.00
	AN	Autism and AN	17.49	−48.37	−2.77	0.03	11.80	−25.56	−2.17	0.18	15.14	−16.20	−1.07	1.00
RBQ-2A	Control	Autism	13.36	−94.12	−7.04	<0.001	10.99	−48.51	−4.41	<0.001	7.93	−45.65	−5.76	<0.001
		AN	14.08	−106.44	−7.56	<0.001	10.79	−62.25	−5.77	<0.001	9.36	−47.32	−5.06	<0.001
		Autism and AN	16.96	−123.67	−7.29	<0.001	12.01	−80.07	−6.67	<0.001	14.36	−31.04	−2.16	0.18
	Autism	AN	14.08	−12.32	−0.88	1.00	10.79	−13.74	−1.27	1.00	9.36	−1.67	−0.18	1.00
		Autism and AN	16.96	−29.55	−1.74	0.49	12.01	−31.56	−2.63	0.05	14.36	14.61	1.02	1.00
	AN	Autism and AN	17.53	−17.23	−0.98	1.00	11.83	−17.82	−1.51	0.79	15.20	16.28	1.07	1.00
Neurocognitive Assessment														
ER-40 (acc)	Control	Autism	13.32	39.42	2.96	0.02	10.95	42.73	3.90	<0.001	–	–	–	–
		AN	14.03	43.54	3.10	0.01	10.74	34.04	3.17	0.01	–	–	–	–
		Autism and AN	16.91	65.96	3.90	<0.001	11.96	56.00	4.68	<0.001	–	–	–	–
	Autism	AN	14.03	4.12	0.29	1.00	10.74	−8.69	−0.81	1.00	–	–	–	–
		Autism and AN	16.91	26.54	1.57	0.70	11.96	13.27	1.11	1.00	–	–	–	–
	AN	Autism and AN	17.47	22.42	1.28	1.00	11.78	21.96	1.86	0.37	–	–	–	–

positive main effect of EDE-Q score, $\chi2(1) = 6.72$, $p = .01$, $B = 0.07$ and a non-significant trend level main effect of BMI, $\chi2(1) = 3.35$, $p = .07$, $B = 0.01$.

3.2.1.1.2. Self-Report. A multiple linear regression was used to determine whether scores on the EDE-Q, AQ, BMI, and biological sex predicted scores on the RBQ-2A, the overall model was significant, F (4, 322) = 85.12, $p < .001$, $R^2 = 0.51$. Higher levels of autistic traits (AQ total score; $\beta = 0.53$, $t = 12.99$, $p < .001$), eating disorder psychopathology (EDE-Q scores; $\beta = 0.35$, $t = 8.24$, $p < .001$) and female sex (male as reference; $\beta = -0.15$, $t = -3.75$, $p < .001$) were significantly associated RBQ-2a scores.

3.2.1.2. Social domain

3.2.1.2.1. Neurocognitive task. A generalised linear model with a gamma distribution and log link function was used to determine if scores on the EDE-Q, AQ, BMI or biological sex predicted ER-40_{ACC}. The omnibus test was significant, $\chi2(4) = 27.15$, $p < 0.001$. Tests of model effects revealed a main effect of AQ score ($\chi2(1) = 20.62$, $p < 001$, $B = 0.004$) and a trend level main effect of female sex (male as reference; $\chi2(1) = 3.51$, $p = .06$, $B = -0.03$). Interpretation of these findings must

note that the distribution of this measure was negatively skewed, and data were reverse coded. Therefore, lower scores on the AQ were positively associated with ER-40_{ACC}. The model was repeated for ER-40_{RT}. The omnibus test was not significant, $\chi2(4) = 4.51$, $p = .34$.

3.2.1.2.2. Self-report. The generalised linear model was again repeated for RFQ. As some scores on this measure were equal to zero, a constant (one) was added to all data. The omnibus tests for RFC_C was significant, $\chi2(4) = 98.06$, $p = <0.001$. High EDE-Q score ($\chi2(1) = 23.95$, $p = <0.001$, $B = -0.06$), AQ score ($\chi2(1) = 53.72$, $p = <0.001$, $B = -0.01$), and BMI ($\chi2(1) = 5.84$, $p = <0.001$, $B = -0.01$) were predictive of less certainty.

This model was repeated for uncertainty scores on the RFC_U. The omnibus test was significant, $\chi2(4) = 124.58$, $p = <0.001$. Higher EDE-Q score ($\chi2(1) = 24.32$, $p = <0.001$, $B = 0.06$), and AQ score ($\chi2(1) = 69.09$, $p = <0.001$, $B = 0.02$) was predictive of more uncertainty, as was lower BMI ($\chi2(1) = 7.93$, $p = <0.001$, $B = -0.01$).

4. Discussion

The present study sought to investigate neurocognitive factors related to the autistic dyad in four groups of young adults, based on self-report: autistic individuals (i.e. individuals self-reporting having received a diagnosis of autism), individuals self-reporting having received a diagnosis of AN, individuals self-reporting having received both a diagnosis of autism and AN, and a group of age and sex-matched control participants from the general population. The role of biological sex was also investigated. It was hypothesised that clinical participants would report greater difficulty and perform worse compared to control participants on tasks related to the autistic dyad. This hypothesis was partially supported. From a self-report perspective, all three clinical groups reported greater mentalising difficulty and more repetitive behaviour compared to the control group, and were not different from each other. From a neurocognitive perspective, the same pattern was observed regarding performance on a mentalising task (social domain), but not a set-shifting paradigm (RRBI domain). It was further hypothesized that higher levels of autistic traits and eating disorder psychopathology (including BMI) would predict poorer self-reported ability and behavioural performance on assessments of features related to the autistic dyad. This hypothesis was again partially supported. Increased eating disorder psychopathology and autistic traits significantly predicted mentalising difficulty and repetitive behaviours in different combinations across the measures. Biological (female) sex was only a significant predictor of emotion recognition ability.

4.1. Assessment of features related to the RRBI domain of the autistic dyad

Higher levels of autistic traits and eating disorder psychopathology, measured by the AQ and EDE-Q respectively, predicted increased repetitive behaviours. In line with previous research, all three clinical groups reported increased repetitive behaviours than the control group (Albein-Urios et al., 2018; Di Lodovico and Gorwood, 2020; Friederich and Herzog, 2011; Kerr-Gaffney et al., 2021; Sternheim et al., 2022). Levels of self-reported repetitive behaviour did not differ between the clinical groups, also fitting with previous findings (Kerr-Gaffney et al., 2021).

Despite consistency in the reporting of the presence of repetitive behaviours between these groups, we should consider the underlying motivation for these behaviours, and the role of diagnoses and sex/gender in this regard. Indeed, autistic males and females can be differentiated based on their RRBI profiles (Antezana et al., 2019). Antezana et al. (2019) observed that males are more likely to present with stereotypical RRBI (such as motor movements or ritualistic behaviours), while autistic females are more likely to present with self-injurious behaviours, compulsiveness, and insistence on sameness. In terms of special interests, sex/gender differences have also been identified (Caldwell-Harris and Jordan, 2014). While autistic males show preference toward systemizing (Caldwell-Harris and Jordan, 2014), autistic females appear to have more "neurotypical" interests (Bourson and Prevost, 2022). This may also explain why, in the present study, the female sex was associated with less repetitive behaviour, in that their interests and behaviours are not seen as being relevant by the individual when interpreting scale items related to special interests in the context of autism. As a consequence of these seemingly more neurotypical interests, and also potentially due to attempts to "camouflage" or "mask" their symptoms (Hull et al., 2017, 2020; Lai et al., 2017), autistic females may be more likely to develop RRBI associated with eating disorder psychopathology such as body image, food, or exercise (Brown and Stokes, 2020; Green et al., 2019; Kirkovski et al., 2013), similar to the interests and compulsive behaviours of individuals with AN (Di Lodovico and Gorwood, 2020). Indeed, Western beauty standards and ideals of thinness are widespread and, in many regards, socially accepted (Calogero et al., 2007). These standards have been identified as a risk factor for the development of eating disorders (Rikani et al., 2013). Consequently, social acceptance of these standards and ideals increases the likelihood that such behaviours and interests will be dismissed as normal or acceptable for girls and females, allowing the autism-driven restricted interests to be missed (Brown and Stokes, 2020; Green et al., 2019; Kirkovski et al., 2013). This, in turn, potentially results in the development of clinically significant eating disorder psychopathology and thereby raises questions regarding whether eating disorder psychopathology occurs as a result of autism among females (Brede et al., 2020).

The general consensus in the literature is that behaviourally, set-shifting impairments occur in both autism and AN (Diaz-Marsa et al., 2023; Keegan et al., 2021; Lage et al., 2024; McAnarney et al., 2011; Roberts et al., 2010). In the present study, however, groups did not differ in error rates (total or perseverative) on the set-shifting task (WCST). Research from the AN literature indicates that such group-based differences might be (cognitive) domain- (Miles et al., 2020) and age-specific (Fitzpatrick et al., 2012; Shott et al., 2012; Westwood et al., 2016). The latter, however, is inconsistent with the present findings as such deficits appear to be more commonly observed among adult (versus adolescent) samples (Fitzpatrick et al., 2012; Shott et al., 2012; Westwood et al., 2016), such as the sample of the present study.

Despite the lack of group differences, eating disorder psychopathology (EDE-Q score), but not autistic traits, was predictive of the number of total and perseverative errors made. In considering BMI as a potential characteristic related to AN severity (American Psychiatric Association, 2022), our finding of BMI having no predictive qualities towards set-shifting ability is consistent with those of a recent systematic review (Fuglset, 2021). To explain these findings, we consider the adequacy of BMI as a marker of AN severity. A fundamental flaw in the approach of using BMI in this way is that it overlooks those with atypical AN. That is, people who fit the criteria for AN with the exception that their BMI falls within the "normal" range for their height and biological sex (American Psychiatric Association, 2022). Individuals with atypical AN still, however, experience many of the same psychological and physiological complications as those with classic AN (Walsh et al., 2023). Together these findings might be explained by the notion that certain behavioural difficulties, some of which are present prior to illness onset or into recovery (Bentz et al., 2017; Dell'Osso et al., 2018; Miles et al., 2020; Pruccoli et al., 2021), might be exacerbated during the acute phase of AN, and particularly when the body is experiencing nutritional starvation (Dinkler et al., 2021; Kanakam and Treasure, 2013; Vuillier et al., 2020; Westwood et al., 2016), as indicated by behaviours reported in response to the EDE-Q, and not BMI. Beyond severity, AN subtypes might also be considered. Ghiotto et al. (2022) report greater EF differences, by way of higher behaviour regulation indices, when comparing autism to participants with AN-restrictive type, versus binge-purge type. The present study did not collect data regarding AN sub-type diagnoses, and, therefore, cannot address this

question.

4.2. Assessment of features related to the social communication and interaction domain of the autistic dyad

Consistent with previous literature (Enticott et al., 2014; Saure et al., 2020, 2022; Tauro et al., 2022; Yeung, 2022), when tasked with identifying emotion based on static images of facial expression, all three clinical groups performed significantly worse than the control group. Performance did not differ between the clinical groups, however, which is inconsistent with research comparing mentalising ability between autism and AN (Leppanen et al., 2018). The same pattern was observed among the female sub-group, but there were no group differences between males. Also, in line with previous literature, autistic traits were predictive of greater difficulty in correctly identifying emotional states (Donaldson et al., 2018). There was no such effect of eating disorder psychopathology.

The stimuli presented in the mentalising task utilised for the present study (ER-40) are disproportionately negatively valenced, with three out of the four emotive conditions depicting negative emotions. This characteristic of the task might inform the present results, whereby clinical groups did not differ in their response accuracy. Emotion recognition is a critical element of mentalising and socio-cognitive ability (Mier et al., 2010), and deficits in emotion recognition abilities are well documented in both AN and in autism (Leppanen et al., 2018; Yeung, 2022). There is some evidence, however, to indicate that valence plays an integral role in emotion recognition. Autistic individuals present with greater difficulty identifying negatively valanced emotions (Pedreño et al., 2017), particularly anger (Keating et al., 2022). Mirroring what has been observed in autistic samples, emotion recognition impairments have also been found to be skewed towards greater difficulty in recognising negative valanced emotions among AN samples (Blomberg et al., 2021; Tapajõz Pereira De Sampaio et al., 2013).

The *valence-specific empathy imbalance hypothesis* (Brett et al., 2024) proposes that emotional empathy, or the process of shared emotional experience, might also be valenced (Brett et al., 2023), however in the opposite direction. Specifically, the authors note that among a sample of university students, elevated levels of autistic traits in the social domain were associated with reduced cognitive empathy and also reduced affective empathy for positively valenced emotions, while elevated levels of autistic traits in the RRBI domain predicted increased affective empathy for negatively valenced emotions (Brett et al., 2024). Similarly, individuals with AN appear more expressive (facial expression) in response to observing another individual in a distressing situation (Gaggero et al., 2023), potentially a mirror-system like response (Enticott et al., 2008), and might also have a tendency to be more negative in their interpretations of socially relevant stimuli, especially when higher levels of autistic traits are present (Sedgewick et al., 2019). These nuances with respect to the stimuli presented and specific components of empathy examined might address the highly variable and largely inconclusive (Mason et al., 2021; Tauro et al., 2022) outcomes reported regarding mentalising in AN and when comparing socio-cognitive ability between autistic and AN samples.

In considering that all three clinical groups reported being less certain regarding the interpretation and understanding of mental states compared to controls, we should consider the role of self-insight in aiding the interpretation of these observations, and the production of functional responses. It has been theorised that mentalising ability is related to improved self-control via improved insight (Sodian et al., 2003). Therefore, despite previous research indicating that individuals with AN may be able to respond appropriately with regard to motor empathy, or mimicking of behaviour/facial expression (Gaggero et al., 2023), consistently with previous research the present study indicates that they experience difficulty in accurately identifying emotion (Blomberg et al., 2021; Tapajõz Pereira De Sampaio et al., 2013), which may have implications for social interactions. Furthermore, alongside autistic traits, eating disorder psychopathology and BMI were also predictive of more uncertainty regarding the interpretation of mental states. This is fitting with previous literature which indicates that females with AN experience poorer emotional awareness (Oldershaw et al., 2019), and experience elevated levels of alexithymia (Mason et al., 2021), as do autistic individuals (Ola & Gullon-Scott, 2020), highlighting another critical overlap between these conditions. Alexithymia has been shown to play a role in emotion recognition specifically (Zupan et al., 2021), providing a potential avenue for further investigation.

4.3. Limitations and direction for future research

Despite our best efforts, there are some limitations of the present study to be acknowledged. Firstly, while our sample is comparatively large, and well matched for biological sex, a difficult feat in this context, our group of participants who self-reported having been formally diagnosed with both *autism and AN* is small and disproportionately female. Any interpretations in this regard must, therefore, be made with caution. From a methodological perspective, we must also consider limitations around the use of online data collection. While advantageous in terms of accessibility for participants, we cannot control for environmental factors at the time of testing, and also relied on self-report, including for diagnosis. Finally, with respect to the methodology, our results provide a starting point to improve our understanding of how the neurocognitive features related to the autistic dyad inform the overlap between autism and AN, however, cannot provide an understanding regarding mentalising and EF subtypes.

Beyond addressing the abovementioned issue of sample size for the autism and AN group, we propose that future research integrate a more complex neurocognitive framework, comparing cognitive and affective ToM, while also considering valence. Protocols can also be expanded to consider a broader range of EFs implicated in neurodevelopmental and eating disorders, such as response inhibition (Norton, 2024). Furthermore, future research might consider the interaction between the neurocognitive features of the autistic dyad, as social development is supported by and requires higher-order cognitive processing, which includes EFs (Beauchamp and Anderson, 2010; Moriguchi, 2014). In their seminal conceptualisation of EF Lezak (1982) reports that these mental capacities are necessary for successful, independent, socially useful and purposive behaviour. Finally, investigation of the neurobiological mechanisms related to behavioural performance will also provide valuable insight.

4.4. Implications

It is well established that people with AN may experience worse acute clinical presentation (Nazar et al., 2018; Tchanturia et al., 2019) and long-term outcomes (Leppanen et al., 2022) if high levels of autistic traits are present, highlighting the importance of understanding the overlap and interaction between autism and AN. Individuals with AN and high levels of autistic traits might also have different treatment needs (Kinnaird et al., 2019), and may not respond as well to certain behavioural interventions (Tchanturia et al., 2016). For example, mentalising impairments in AN can reduce the capacity for reciprocity in social interactions (Saure et al., 2022; Tauro et al., 2022) and misinterpretation of the beliefs and intentions of others can consequently lead individuals to interpret neutral or ambiguous social situations negatively, creating a self-perpetuating cycle of withdrawal and inappropriate social reciprocity (Sedgewick et al., 2019). This could in turn have implications for engagement in psycho-social intervention. The interplay between higher-order cognitive functions, including EF and social cognition, must be better understood in order to assist affected individuals to gain better assessment and access to interventions tailored to their specific needs.

5. Conclusion

In summary, we provide evidence that autistic individuals and individuals with AN present with similar difficulty with regard to behaviours considered "classically" autistic. Furthermore, we present evidence of an interplay between autistic traits and eating disorder psychopathology with respect to numerous performance-based assessments of neurocognitive features related to the autistic dyad. Specifically, autistic traits appear more associated with socio-cognitive ability, and eating disorder psychopathology with neurocognitive ability related to RRBI. These findings have important implications for clinical assessment given the increased recognition of the overlap between autism and AN, particularly among females. Additionally, elucidating the nuances of this overlap has implications for reducing the rate of mismissed- and late-diagnosis for individuals presenting with AN and/or autism-related symptoms. Finally, further improving this understanding and particularly from a neurocognitive perspective, will in future, also aid in the improvement of targeted biomedical intervention for these conditions, work on which is already underway (Enticott et al., 2021; Phillipou et al., 2019).

CRediT authorship contribution statement

M. Kirkovski: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **G. Papavasiliou:** Writing – review & editing, Writing – original draft. **B.E. Speranza:** Writing – review & editing, Formal analysis. **J. Scarfo:** Writing – review & editing, Writing – original draft. **N. Albein-Urios:** Writing – review & editing, Methodology, Funding acquisition, Conceptualization. **J. Linardon:** Writing – review & editing, Methodology, Funding acquisition, Conceptualization. **A. Phillipou:** Writing – review & editing, Methodology, Conceptualization. **M. Fuller-Tyszkiewicz:** Writing – review & editing, Methodology, Funding acquisition, Formal analysis, Conceptualization. **P.G. Enticott:** Writing – review & editing, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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