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A latent profile approach to the study of conspiracy belief: Identifying the role of executive functioning

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A latent profile approach to the study of conspiracy belief: Identifying the role of executive functioning

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A B S T R A C T

The proliferation of conspiracy theories has coincided with advancement in communication technologies. Research has consistently identified the social determinants of conspiracy beliefs, such as social media exposure and peer influence, the impact of cognitive abilities, especially executive function (EF), remains unexplored. This study aimed to explore whether conspiracy beliefs varied with different EF profiles. A sample of 194 participants ($M = 35.56$; $SD = 10.01$) completed a questionnaire covering beliefs in six common conspiracy theories and tasks assessing working memory (N-Back), cognitive flexibility (Modified Card Sorting Task), and affective decision-making (Iowa Gambling Task). Latent profile analysis on the cognitive tests identified three distinct EF profiles: Low Cool EF, Moderate Cool EF, and High EF. Notably, the Low Cool EF cohort displayed significantly stronger beliefs in five of the six conspiracy theories than the High EF profile. The Moderate Cool EF profile also showed significantly stronger beliefs in conspiracies relating to personal wellbeing, and Covid-19 compared to the High EF profile. Executive functioning plays a pivotal role in shaping an individual's inclination towards or resistance against conspiracy beliefs. Enhanced cognitive flexibility and working memory enables individuals to critically assess information rather than rigidly subscribing to a singular viewpoint, likely fostering resistance to conspiratorial thinking.

1. Introduction

Conspiracy theories offer unsubstantiated explanations for events, often implicating malevolent actors (Douglas et al., 2019). Conspiracies have always existed in society, however with the rise of social media in the digital age their spread and influence has been amplified. Brotherton et al. (2013) have broadly characterised conspiracy beliefs into five distinct types of suspicions. Firstly, government malfeasance posits corrupt and unethical governmental actions, exemplified by theories suggesting the U.S Government's involvement in 9/11. Malevolent global theories assert that covert group, like the Illuminati manipulate global events. Personal wellbeing theories revolve around authoritative entities attempting to exert control over our civil liberties, such as the notice that vaccinations contain microchips to control behaviour. The extra-terrestrial cover-up category encompasses beliefs that the public is being actively deceived about alien existence. Lastly, control of information theories suggest that powerful bodies in society manipulate public information, with claims that organisations (e.g., government or universities) fabricate evidence to deceive the population.

Major world events like terrorist attacks or global pandemics can often fuel the emergence and spread of conspiracy beliefs (Imhoff et al., 2022). The recent Covid-19 pandemic serves as a prime example of this trend. In their efforts to curb the spread of Covid-19 many governments worldwide implemented safety measures such as mask mandates, social distancing guidelines, and vaccination campaigns. These actions inadvertently set off a cascade of conspiracy theories surrounding the true severity of the virus, its alleged malicious origins, and the efficacy and intentions behind these preventative strategies (Dębski et al., 2022). Notably, studies indicate that such beliefs can erode commitment to health-positive behaviours and weaken support for public health directives (Bierwiaczonek et al., 2022). Research has shown that strong beliefs in conspiracy theories can increase support for violence (Jolley & Paterson, 2020) and even lead to greater intentions for violent behaviour (Rottweiler & Gill, 2020).

Douglas et al. (2019) identified three primary motives driving individuals towards conspiracy beliefs. First are epistemic motives, where individuals turn to conspiracy theories to understand complex or seemingly random events of phenomena. Supportively, studies have

found that individuals with higher education, potentially due to enhanced critical thinking abilities, are less likely to believe in conspiracy theories (Goreis & Voracek, 2019). Second are existential motives, where individuals resort to conspiracy theories to regain a sense of control when feeling vulnerable or uncertain about particular events or phenomena. Research corroborates this, showing a correlation between heightened anxiety and conspiratorial thinking (Liekefett et al., 2023). Third are social motives, emerging from the need to belong and accepted an individual may be inclined to join online conspiracy communities. Several social factors, such as feeling ostracised from others (Biddlestone et al., 2021), unemployment (Goreis & Voracek, 2019), and extensive social media use (Romer & Jamieson, 2021), have been linked to increased conspiracy beliefs. The architecture of social media platforms, driven by engagement metrics, further fuels this by suggesting more conspiracy content to users already inclined towards such beliefs. Subsequently, researchers have highlighted that believing in one conspiracy theory often predicts belief in others (Imhoff et al., 2022).

Research into the factors contributing to conspiracy beliefs is a rapidly emerging field. Despite emerging evidence linking analytical and critical thinking (Prooijen, 2016; Swami et al., 2014), assessed via self-report measures, with conspiracy beliefs, the interplay between cognitive abilities assessed via performance-based measures and conspiracy beliefs remains unexplored. Understanding the cognitive underpinnings that render individuals susceptible to these beliefs could be instrumental in devising effective strategies to counteract the spread of conspiracy theories.

Executive function (EF) is an umbrella term for cognitive abilities (i. e., executive functions; EFs) that facilitate goal directed behaviour (Diamond, 2013). Broadly, EFs are classified into two primary categories: 'hot' and 'cool' EFs. Hot EFs pertain to cognitive control processes that regulate behaviour in emotionally charged situations, such as mitigating anxiety in challenging circumstances (Zelazo & Muller, 2002). Hot EF assessments largely focus on tasks related to affective decision-making (the capacity to make prudent over impulsive choices), exemplified by the Iowa Gambling Task (Zelazo & Carlson, 2012). Conversely, cool EFs guide behaviour in emotionally neutral contexts (Zelazo & Muller, 2002). Several cool EFs have been noted with the literature, although prevailing assessments predominantly gauge working memory (the cognitive system responsible for temporarily storing and manipulating information; (Baddeley & Hitch, 1974) and cognitive flexibility (the ability to shift mental sets or perspectives; Diamond, 2013). Superior executive functioning has been associated with enhanced academic performance (Best et al., 2011), fewer emotional difficulties (Poon, 2018), improved self-regulation (Moffitt et al., 2011), and even enhanced social problem-solving skills (Miller et al., 2020). Given this, it seems plausible that individuals with heightened cognitive flexibility, working memory, and affective decision-making capabilities might also display reduced conspiracy beliefs, due to their increased capacity to effectively evaluate evidence and resist unverified or emotionally charged narratives.

1.1. The present study

To the authors' knowledge no study to-date has explored the association between performance-based measures of executive functioning and conspiracy beliefs. Therefore, this study aimed to investigate whether profiles of varying EF abilities differ in levels of belief across six prevalent conspiracy themes: government malfeasance, malevolent global conspiracies, personal wellbeing, extra-terrestrial cover-ups, control of information, and Covid-19 conspiracy. It was hypothesised that EF profiles with superior working memory, cognitive flexibility, and affective decision-making will exhibit lower levels of conspiracy belief compared to profiles characterised by weaker EF performance.

2. Method

2.1. Participants

A total of 194 participants, ranging in age from 18 to 60 years ($M = 35.56$; $SD = 10.01$), were recruited via Prolific. The sample included 104 males, 89 females, and one non-binary individual. All participants were required to be registered as proficient English speakers on the Prolific website and to be residents of either Australia ($n = 101$) or the United States ($n = 93$). Regarding the highest level of education achieved: 41 participants had completed high school, 31 had completed sub-bachelor tertiary education, 87 had earned a bachelor's degree, and 35 had obtained a postgraduate degree.

2.2. Materials

Questionnaires and EF tests were administered via the online platform Inquisit (Version 6; Millisecond ®). Details regarding the psychometric properties of each measure used can be found in the supplementary material provided.

2.2.1. Generic Conspiracy Belief Scale (GCBS)

The GCBS (Brotherton et al., 2013) is a 15-item self-report questionnaire designed to gauge the intensity of participants' beliefs in various conspiracy theories. It covers five generic categories: government malfeasance, malevolent global conspiracies, personal wellbeing, extra-terrestrial cover-ups, and control of information (with three items dedicated to each category). Items are rated on a 5-point Likert scale, where 1 indicates "definitely not true" and 5 denotes "definitely true." To obtain a score for each conspiracy category, participants' responses to the three items within that category are averaged. A higher score signifies a stronger belief in the respective conspiracy.

2.2.2. Covid-19 Conspiracy Belief Scale (Covid-19 CBS)

The Covid-19 CGS is a self-report questionnaire designed to assess the intensity of participants' beliefs in conspiracy theories related to Covid-19 (Dębski et al., 2022). This 10-item scale evaluates false beliefs concerning the harmful effects of Covid-19 as well as misconceptions about its prevention or treatment. Items are rated on a 5-point Likert scale, where 1 represents "strongly disagree" and 5 indicates "strongly agree." Participants are given a cumulative score ranging from 10 to 50, with higher scores signifying stronger false beliefs about Covid-19.

2.2.3. Modified Card Sorting Task (MCST)

Participants undertook the MCST to assess their cognitive flexibility. They were presented with four references and a separate deck containing 48 cards. The task required participants to match each card from the deck to one of the reference cards based on one of three attributes: colour (red, green, blue, or yellow), shape (circle, square, star, or cross), and number (1, 2, 3, or 4). The sorting rule for the initial card, determined by the participant, set the first sorting rule based on colour, shape, or number. After six consecutive correct matches, the sorting rule would shift following a predetermined sequence: colour, shape, number. The task concluded once all 48 cards were sorted or after six sorting categories were completed. The outcome measure used in the current study was total perseverative errors, where participants persisted with an outdated sorting rule despite corrective feedback. More perseverative errors indicate worse cognitive flexibility. This study followed a modified version of Channon's (1996) scoring method that also considered alternating between two incorrect rules (e.g., colour-shape-colour-shape) as perseverative errors.

2.2.4. N-Back task

The N-Back, a measure of working memory, presents participants with a sequency of letters against a black background. In this study, each trial consisted of a sequence of 20 + n yellow letters (c, g, h, k, p, q, t, w)

where "n" denotes the current level of the task (2-, or 3-back). Specifically, for a 2-back trial, participants saw a sequence of 22 letters, and for a 3-back trial, a sequence of 23 letters. Each letter appeared for 500 ms, succeeded by a 2500 ms interstimulus interval. For the 2-back level, participants identified whether the current letter matched the one shown two stimuli ago; for the 3-back, it was three stimuli ago. The entire task comprised six trials, evenly split with three trials for each n-back level. Performance was evaluated by subtracting commission errors (incorrect target identifications) from correct hits, and then dividing by the number of blocks. Higher scores on this measure indicated superior working memory capacity (Jaeggi et al., 2010).

2.2.5. Iowa Gambling (IGT)

The IGT consists of five blocks, each with 20 trials, where participants select cards from one of four decks (Bechara et al., 1994). Two decks offer higher rewards (e.g., $100) but come with the risk of substantial losses (e.g., −$1250). Conversely, the remaining two decks yield smaller rewards (e.g., $50) and carry correspondingly smaller losses (e. g., −$250). Cards within these decks are randomized without replacement to influence outcomes. Continual selection from the high-reward decks leads to a net loss, while choosing from the smaller-reward decks yields a net gain. Participants begin with a hypothetical $2000, aiming to maximise this amount. The total number of selections from the two advantageous decks during the last three blocks (i.e., the final 60 trials) provided a measure of affective decision-making, with higher counts reflecting better affective decision-making.

2.3. Procedure

The study was advertised on Prolific, an online recruitment platform, targeting registered members in Australia and the United States. Interested individuals clicked on an Inquisit link within the advertisement. After providing informed consent, they filled out a demographic questionnaire to confirm their eligibility to take part in the study. Participants then completed the GCBS, Covid-19 GCB, MCST, N-Back, and IGT. The entire study took approximately 45 min, and participants received £9GBP for their participation.

2.4. Statistical design

To construct EF profiles based on participants' performances on the MCST, N-Back, and IGT, a latent profile analysis (LPA) using the TidyLPA package in R-Studio version 4.3.1 was conducted. We evaluated models with two to three profiles. The selection of the optimal model was based on several statistical indicators and is detailed in the supplementary materials.

Following the identification of the best model, a series of one-way ANOVAs were conducted to investigate differences between the EF profiles across six conspiracy beliefs: government malfeasance, malevolent global, personal wellbeing, extra-terrestrial cover-ups, control of information, and Covid-19 conspiracy. When identifying specific profiles with significant differences, Tukey's Honestly Significant Difference (HSD) post-hoc test was used. If homogeneity of variance was not met, we employed Tamhane's T2 post-hoc test, which corrects for unequal variance between groups. Despite conducting multiple comparisons, Bonferroni adjustment was not implemented as analyses align with preplanned hypotheses (Armstrong, 2014).

3. Results

3.1. Latent profile analysis

The results of the LPA supported a model with three distinct profiles. Detailed fit statistics of the LPA are provided in the supplementary materials. Table 1 displays the descriptive statistics of EF task performance and conspiracy belief scores for the three profiles. Profile 1,

Table 1
Descriptive statistics of EF performance and conspiracy belief for model profiles.

EF Task	Profile 1 (Low Cool EF) n = 25 M(SD)	Profile 2 (Moderate Cool EF) n = 128 M(SD)	Profile 3 (High EF) n = 41 M(SD)
MCST	17.56(6.19)	2.93(3.34)	1.61(2.05)
N-Back	0.77(2.09)	2.05(1.38)	3.18(1.02)
IGT	35.36(17.89)	27.53(11.05)	55.12(5.74)
Conspiracy Belief	Profile 1	Profile 2	Profile 3
Government Malfeasance	3.01(1.16)	2.57(1.22)	2.18(1.15)
Malevolent Global	3.16(1.13)	2.46(1.30)	1.98(1.24)
Extra-terrestrial Cover-up	2.87(1.24)	2.41(1.09)	1.89(1.08)
Personal Wellbeing	3.08(1.14)	2.27(1.11)	1.76(0.94)
Control of Information	3.29(1.04)	2.91(1.11)	2.63(1.08)
Covid-19 Conspiracy	24.56(10.01)	19.04(7.91)	15.80(6.89)

Note. M = Mean; SD = standard deviation; IGT = Iowa Gambling Task; MCST = Modified Card Sorting Task.

representing the smallest proportion of the sample, exhibited the weakest performance on both the N-Back and MCST. Thus, it was labelled as Low Cool EF. Interestingly, despite its overall lower performance, this profile outperformed Profile 2 on the IGT. Profile 2 made up the largest portion of the sample, performance on the N-Back and MCST was better than Profile 1 but still behind Profile 3. Consequently, this profile was labelled Moderate Cool EF. Finally, Profile 3 recorded the strongest performance across all three EF tasks, earning the label High EF. It should be noted that these labels are relative to this sample's performance and not indicative of general performance norms.

3.2. Analysis of variance

The one-way ANOVAs highlighted significant differences between EF profiles in various conspiracy beliefs: Government Malfeasance $F(2,191)$ =3.83, p = .023, η2 = 0.039, Malevolent Global $F(2,191)$ =6.67, p = .002, η2 = 0.065, Extra-terrestrial Cover-up $F(2,191)$ =6.48, p = .002, η2 = 0.064, Personal Wellbeing $F(2,191)$ =11.71, p < .001, η2 = 0.109, and Covid-19 conspiracy $F(2,191)$ =9.29, p < .001, η2 = 0.089. Interestingly, there was no significant difference observed between EF profiles when it came to conspiracy beliefs about control of information F $(2,191)$ =2.83, p = .061.

Post-hoc analyses revealed distinct patterns of conspiracy beliefs across EF profiles. Tukey's HSD post-hoc test showed: (1) The Low Cool EF profile held significantly stronger beliefs in government malfeasance conspiracies compared to the High EF profile (p = .018); (2) Malevolent global conspiracies were more prevalent in the Low Cool EF group, which scored significantly higher than both the Moderate Cool EF (p = .033) and High EF profiles (p < .001); (3) the High EF profile scored significantly lower than both Low Cool EF (p = .002) and Moderate Cool EF (p = .026) profiles for extra-terrestrial cover-up; and (4) there were significant differences across all profiles in terms of personal wellbeing conspiracies, High EF group scored lower than Low Cool EF (p < .001) and Moderate Cool EF (p = .023) profiles, and the Low Cool EF profile scored significantly higher than the Moderate Cool EF (p = .002) profile. Due a violated assumption of homogeneity of variance in Covid-19 conspiracies, Tamhane's T2 host hoc test was interpreted. The results showed the Low Cool EF group exhibited the strongest beliefs, scoring significantly higher than both Moderate Cool EF (p = .042) and High EF profiles (p = .001), and the Moderate Cool EF scored significantly higher than High EF (p = .041). All other comparisons did not yield significant differences (p > .05).

4. Discussion

The aim of this study was to identify if there were notable differences in conspiracy beliefs based on EF profiles. Our results partially supported the hypothesis, individuals from the High EF profile displayed

significantly reduced conspiracy beliefs across five of the six examined domains: government malfeasance, malevolent global, personal wellbeing, extra-terrestrial cover-ups, and Covid-19 conspiracies. Moreover, those with Moderate Cool EF profiles also showed lower conspiracy beliefs in the domains of malevolent global, personal wellbeing, and Covid-19 conspiracies. Evidently, superior executive functioning, especially in terms of working memory and cognitive flexibility, resulted in a decreased inclination towards endorsing conspiracy theories.

Few studies have conducted LPA to create executive functioning profiles, most have instead used EFs as a dependent variable to explore differences in profiles established from other factors like paranormal experiences (Drinkwater et al., 2022), language abilities (Yang et al., 2023), or physical activity (Zhu et al., 2022). Utilising LPA in our study enabled the identification of distinct subgroups within our sample based on their composite EF performance. In real-world scenarios EFs operate in tandem to guide goal-directed behaviour (Diamond, 2013). Therefore, analysing EF as interrelated profiles rather than as isolated continuous variables provides a more holistic understanding of their impact. Each EF measure often faces the challenge of task impurity, where performance may not purely reflect a singular EF (Friedman & Miyake, 2017). By creating profiles based on a range of tasks, LPA mitigates this issue, offering a more comprehensive view that better reflects the multifaceted nature of EF in real-life contexts. The profiles identified in this study showcased a consistent trend in cool EF performance: one profile displayed low performance, another showed moderate performance, and the third exhibited high performance on the MCST and N-Back. This pattern aligns with findings highlighting a positive correlation between cognitive flexibility and working memory (Nweze & Nwani, 2020), reflecting the unitary nature of EFs, as outlined by Friedman and Miyake (2017). The intertwined nature of these functions is evident when considering that cognitive flexibility, our capacity to shift mental perspectives, relies on our ability to temporarily store and process information (i.e., working memory). Consequently, proficiency in one domain generally enhances capability in the other (Friedman & Miyake, 2017).

The profiles revealed an unexpected pattern regarding affective decision-making. Whilst the High EF profile demonstrated superior performance on the IGT, the Moderate Cool EF group surprisingly underperformed, ranking below the Low Cool EF profile. Historically, the relationship between hot and cool EFs has been less robust than within measures of cool EF alone (Poon, 2018; Zelazo & Carlson, 2012). However, the unexpected superior performance of the Low Cool EF group on the IGT compared to the Moderate Cool EF group should be interpreted with caution. The Low Cool EF group exhibited the highest variability in IGT performance and had the smallest sample size, their defining feature as per the results of the LPA appears to be lower performance across cool EF tasks. Regardless, in this sample, those with superior working memory and cognitive flexibility also excelled in affective decision-making. Superior cognitive flexibility aids in rule discernment during probabilistic tasks (Feng et al., 2020), while enhanced working memory assists in referencing past decisions to inform future decisions (Bagneux et al., 2013). Together, these EFs contribute to strategic decision-making, especially in emotionally laden scenarios like the IGT.

The High EF group likely demonstrated lower levels of conspiracy belief due to their enhanced working memory, cognitive flexibility, and affective decision-making. Working memory not only enables individuals to hold multiple pieces of information, but also enhances our capacity to evaluate evidence (Cowan, 2014), reducing the allure of oversimplified explanations for events. Cognitive flexibility, on the other hand, enables individuals to consider diverse viewpoints, preventing a rigid attachment to singular conspiracy narratives. This flexibility is closely tied to analytical and critical thinking, which are key skills in countering conspiracy beliefs (Douglas et al., 2019). Finally, superior affective decision-making has been linked to implementing more effective emotional regulation strategies (Brevers et al., 2013).

Given that conspiracy theories often arise during times of uncertainty and anxiety (Douglas et al., 2019), individuals possessing robust emotional regulation are less inclined to turn to such theories for emotional relief. Interestingly, no significant difference emerged between the three profiles on control of information conspiracies. One item from the GCBS tied to this theme states that information is intentionally hidden from the public due to self-interest. This notion may be credible to individuals regardless of EF ability due to historical precedents or scepticism towards institutions.

When comparing the Low Cool EF and Moderate Cool EF profiles, the former consistently held stronger conspiratorial beliefs, although fewer of these differences were statistically significant. This observation might stem from the smaller differences in cool EF performances between these two groups as compared to the disparities between the Low Cool EF and High EF profiles. Alternatively, the superior affective decision-making demonstrated by the Low Cool EF group compared to the Moderate Cool EF group could have also influenced results. Whilst both factors likely contributed to the observed outcomes, cool EFs seem to have a dominant influence on diminishing conspiracy belief. This is underscored by significant differences in the domains of government malfeasance and extra-terrestrial cover-ups only emerging between the High EF and Low Cool EF groups, despite the Moderate Cool EF group's inferior affective decision-making. Therefore, the reduced intensity in malevolent global, personal wellbeing, and Covid-19 conspiracy domains for the Moderate Cool EF group, in comparison to the Low Cool EF group, can likely be attributed to their enhanced ability to process and flexibly assess information.

4.1. Limitations and future direction

The EF profiles constructed in this study utilised a single task to represent each construct. Given the vast array of EF test library, expanding and diversifying the constructs assessed might yield more nuanced profiles, elucidating the cognitive mechanisms underpinning conspiracy beliefs more precisely. Another potential limitation was that participants were recruited exclusively from the Prolific platform which raises questions about the generalisability of the results. Recruitment through Prolific captures individuals who have internet access and are inclined to participate in online studies for monetary compensation. This specific demographic may not fully encompass the diverse attributes and perspectives of the broader population, thereby limiting the representativeness of our findings. Future research might benefit from directly recruiting from online conspiracy communities to verify if the patters observed in this study persist. Such targeted recruitment would provide a distinct perspective on the cognitive profiles of conspiracy-driven individuals and offer insights into how EFs influence the acceptance of conspiracy theories among those more engaged with them. Additionally, the current study was correlational in nature, precluding us from establishing causality between EF and conspiracy belief. Future research should explore whether cognitive exercises or "brain training" programs targeting working memory and cognitive flexibility can reduce an individual's susceptibility to conspiracy theories to better establish causality. Outcomes from EF training research are mixed, although some studies have indicated that this training can improve academic performance (Niebaum & Munakata, 2023), and daily functioning in individuals with mild cognitive impairments (Chen et al., 2021). Lastly, another avenue for further study would be to explore how EFs operate as a potential mediator in the relationship between education or social media use and conspiracy belief, while also considering the influential role of analytical and critical thinking.

5. Conclusion

Overall, the present study showed a link between executive functioning and strength in conspiracy beliefs. Our findings demonstrated that individuals with weaker performance in working memory and

cognitive flexibility are more inclined to embrace various conspiracy theories when compared to their higher performing counterparts. Whilst executive functioning is typically associated with goal-directed behaviour, our data emphasises the role that EFs may have in influence belief systems and how we evaluate information. Superior executive functioning, especially within the cool EF domain, allows individuals to flexibly appraise evidence, ensuring they are more likely to reject unsubstantiated theories. Given these results individuals with executive dysfunction or younger individuals with still developing EFs may be particularly vulnerable to being influenced by conspiracy beliefs. Endeavours to enhance executive functioning have met with varied outcomes, but if these cognitive abilities can be strengthened, then EF training may offer a promising avenue to decrease an individual's susceptibility to conspiracy theories.

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Ethical approval

The study was approved by the institutional Human Research Ethics Committee.

CRediT authorship contribution statement

Stjepan Sambol: Conceptualisation, Methodology, Software, Formal analysis, Writing – Original Draft; **Ebony Sans:** Writing – Original Draft; **Jessica Scarfo:** Writing – Review & Editing; **Melissa Kirkovski:** Writing – Review & Editing; **Michelle Ball:** Conceptualisation, Methodology, Writing – Review & Editing.

Declaration of competing interest

The authors declare that they have no conflict of interest in publishing this work.

Data availability

Data can be provided via email requests to the corresponding author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2023.112537.

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