



A “fine-cuts” approach disentangling psychopathic, autistic and alexithymic traits in their associations with affective, cognitive and motor empathy

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ABSTRACT

Atypical empathy is seen in relation to psychopathy and autistic traits; however, studies typically conflate affective and cognitive facets of empathy. Moreover, motor empathy has been suggested as another facet of empathy, advocating for further delineation of empathy dimensions. In addition, alexithymia may affect responding to emotional, cognitive or motor states in others. The current study investigated how psychopathic, autistic and alexithymic traits are associated with those empathy facets. Nonclinical participants ($N = 212$) completed online self-report measures of affective, cognitive and motor empathy, primary and secondary psychopathy, autistic and alexithymic traits. A subsample ($N = 157$) also completed a behavioral measure of motor empathy (i.e., behavioral synchrony) using a virtual agent. Whilst all traits were associated with reduced cognitive empathy and behavioral synchrony; path analyses supported a mediation model of cognitive empathy difficulties through alexithymia only for primary psychopathy. Secondary psychopathy and alexithymia were associated with increased motor empathy, specifically tendencies to mimic negative emotions. In contrast, primary psychopathy was associated with reduced affective empathy and inhibition of positive emotion imitation, despite reporting self-other overlap experiences induced by behavioral synchrony. Overall, these findings highlight the need for a “fine-cuts” approach; delineating the role of empathy subfacets in atypical empathy.

1. Introduction

Empathy is a broad construct encompassing several facets. Affective (i.e., sharing affective states) and cognitive (i.e., mind reading) components are often psychometrically conflated (Hall & Schwartz, 2019), and their associations with motor components of social interactions (i.e., synchrony) remain unclear (Ayache et al., 2021). Psychopathic and autistic traits are thought to be underpinned by atypical affective and cognitive empathy, characterized by perceived difficulties in affective sharing and mind reading, compared to neurotypical populations, but could be further delineated through their respective associations with motor components of empathy. Furthermore, alexithymia, characterized by difficulties in describing and recognising one’s emotional states, may represent another underlying contributor to atypical empathy (Bird &

Viding, 2014). This study investigated the role of affective, cognitive and motor empathy in psychopathic, autistic and alexithymic traits, including performance on a motor task inducing experiences of self-other overlap.

1.1. Empathy and its multiple facets

Empathy is a crucial attribute for navigating social environments; yet the delineation of empathy facets lacks clear conceptualisation (Hall & Schwartz, 2019). Two main components are typically defined: *affective* sharing of others’ emotional states and *cognitive* capacity to understand others’ mental states (Lamm et al., 2016). Nonetheless, experimental assessments often conflate these components, challenging study comparisons (Hall & Schwartz, 2019). Thus, a “fine-cuts” approach,

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considering and delineating empathy facets, is crucial for understanding traits and behaviors associated with atypical empathy (Bird, 2024; Blair, 2008).

Motor empathy represents a core aspect of empathy (Preston & De Waal, 2002) that remains widely ignored. Indeed, it is unclear how motor empathy is linked to affective and cognitive empathy. A recent investigation found that self-reported motor empathy was associated with tendencies to experience emotional contagion (i.e., self-other overlap), whilst effective behavioral synchrony was associated with cognitive empathy (i.e., self-other distinction, Ayache et al., 2024). These distinct contributions of empathy facets to behavioral synchrony reflect distinct psychometric conceptualisations and stress the need to understand their associations with atypical empathy and related traits.

1.2. Atypical empathy in psychopathy and autism

Psychopathic and autistic traits are often associated with “atypical” empathy. Psychopathy is underpinned by difficulties in processing and sharing others’ emotional states, especially negative emotions (e.g., fear or distress; Blair, 2005; Heym et al., 2019). Importantly, psychopathy is a multidimensional construct (Skeem et al., 2003), encompassing primary (characterized by callous and interpersonal-manipulative behaviors) and secondary (characterized by impulsive behaviors) facets, that show distinct association with empathy (Heym et al., 2013). Moreover, preserved empathic capacities can be found in some individuals with elevated psychopathic traits (e.g., Dark Empaths; Heym et al., 2021), highlighting possible adaptive aspects to preserved empathy (Jonason & Krause, 2013). On the other hand, autism is a neurodevelopmental condition characterized by atypical social interactions and cognitive empathy (Baron-Cohen et al., 1985; Frith & Happé, 1994). Debate remains regarding the mechanisms underlying these traits (Dumas, Soussignan, et al., 2014; Southgate & Hamilton, 2008) and difficulties inferring mental states may result from interpersonal misunderstandings, rather than individual impairments (Milton, 2012). Consequently, the terminology “atypical empathy” is advocated to describe inter-individual differences in empathy processes without stigmatizing neurodivergent populations.

The role of mirroring processes in elevated psychopathic or autistic traits is unclear. Whilst Blair (2005) suggests intact motor empathy in psychopathy, others report reduced mimicry, especially for negative emotions (Olderbak et al., 2021) and hypo-activation of the brain areas underpinning imitation in psychopaths (Mier et al., 2014). Unfortunately, most of these assessments conflate affective and motor components of empathy, challenging the disentanglement of these facets. In autism, inconsistent findings of both hyper- (Spengler et al., 2010) and hypo- (Cook & Bird, 2012) imitation tendencies have been reported. These mixed findings may arise from variations in attentional focus (Hamilton, 2013), challenges in distinguishing self from others (Santesteban et al., 2012) or comorbidity between autism and motor coordination disorders (Wang et al., 2022). Altogether, these findings suggest that psychopathy and autism are associated with different imitation tendencies that require clarification.

1.3. Alexithymia, the capacity to be aware of one’s own body

Alexithymia, characterized by difficulties in labeling and recognising one’s emotions, often co-occurs with psychopathy and autism and could be an important mechanism underpinning atypical empathy (Bird & Viding, 2014). A recent meta-analysis suggests alexithymia as a mechanism underlying impulsive and aggressive behaviors in psychopathy (Burghart & Mier, 2022); however, the role of alexithymia in specific empathy difficulties is unclear. Previous studies already suggested a possible mediation of empathy difficulties in psychopathy through alexithymia (Burghart et al., 2024; Di Tella et al., 2024; Jonason & Krause, 2013); however, those studies either did not consider psychopathy subtypes or empathy subfacets. For autism, it has also been

suggested that atypical empathy may result from co-occurrence with alexithymia (Bird & Cook, 2013); however, autistic traits seem to be a stronger predictor of empathy difficulties than alexithymia in non-clinical populations (Shah et al., 2019). Regarding alexithymia, Moriguchi et al. (2009) reported hyper-activation of brain areas involved in imitation, possibly reflecting difficulties in distinguishing self from others. Consequently, hypo- and hyper-imitation tendencies observed in psychopathy and autism may be underpinned by co-occurring alexithymia and atypical self-other overlap experiences.

1.4. Current investigation

Despite considerable research around empathy, psychopathy and autism, their distinct pathways remain to be clarified. Alexithymia, associated with autism and psychopathy, may be driving atypical empathy; however, its association with motor empathy remains unknown. The present study adopted a “fine-cuts” approach of empathy by combining self-reports of affective, cognitive and motor empathy alongside a motor task to measure behavioral synchrony, using a virtual agent (Dumas, de Guzman, et al., 2014) for investigating their shared and distinct associations with psychopathic, autistic and alexithymic traits. Negative associations were expected between primary psychopathy and affective empathy (Heym et al., 2019), and between secondary psychopathy, autistic traits and cognitive empathy (Frith & Happé, 1994). Both psychopathy (i.e., primary and secondary) and autistic traits would be positively associated with alexithymic traits (Bird & Cook, 2013; Burghart & Mier, 2022) and with atypical motor empathy (Demartini et al., 2014). Though the specific associations of psychopathy subtypes with motor empathy must be clarified, psychopathy, in general, was hypothesised to be associated with hypo-imitation due to self-other distinction bias (Mier et al., 2014). In contrast, autistic traits were expected to be associated with reduced motor empathy, considering challenges in distinguishing self from others (Santesteban et al., 2012) and motor coordination impairments (Wang et al., 2022). Finally, it was predicted that alexithymia could mediate the associations of psychopathy and autistic traits with cognitive empathy (Bird & Viding, 2014), but also with motor empathy considering its role in functional motor disorders (Demartini et al., 2014).

2. Method

2.1. Population

Participants ($n = 277$) were recruited in July 2021 through Prolific and compensated with £5.00. Some participants were removed from statistical analyses due to failure to complete all items ($n = 64$) and attentional checks ($n = 1$), resulting in a final sample of two hundred twelve participants (117 men/95 women; US residents, mean age = 33.90, $SD = 10.21$ years) who completed the psychometric measures. Participants were invited to perform the motor coordination task and the trajectories of one hundred fifty-seven participants were successfully recorded (79 men/78 women; US residents, mean age = 33.57, $SD = 10.39$ years) and included in the analyses of synchrony and self-other overlap. These sample sizes were considered sufficient to conduct cross-sectional path analyses (Wolf et al., 2013) and to detect a medium effect size ($r = 0.30$), usually observed between synchrony and self-other overlap experiences (Vicaria & Dickens, 2016).

2.2. Psychometric measures

The Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011; 31 items) assessed affective and cognitive empathy (Cronbach’s alphas ranging 0.65–0.85). Motor empathy was measured using the KinEmp scale (Koehne et al., 2016; 9 items, Cronbach’s alpha 0.71) and the Somatic subscale from the Cognitive, Affective, and Somatic Empathy Scale (CASES; 10 items, Raine & Chen, 2018, Cronbach’s

alpha 0.78).¹ All items were scored on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree) to harmonize with the QCAE scoring, and scores were calculated by summing respective items.

The Autism Quotient (AQ; Baron-Cohen et al., 2001, 50 items) measured autistic traits (Cronbach's alphas ranging 0.67–0.82) and the Levenson Self-Report Psychopathy Scale (LSRP; Levenson et al., 1995; 26 items) measured primary and secondary psychopathy (Cronbach's alphas 0.78–0.81) scored on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree). The Toronto Alexithymia Scale (TAS; Bagby et al., 1994; 20 items) measured alexithymia (Cronbach's alphas >0.70) on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

2.3. Behavioral synchronization and experience of self-other overlap

A similar procedure to Ayache et al. (2024) measured behavioral synchrony using the Haken-Kelso-Bunz (HKB) model of coordination dynamics implemented using a virtual agent (Dumas, de Guzman, et al., 2014). Participants were randomly assigned to one of the two experimental conditions created for inducing self-other overlap vs distinction: (1) *Cooperation*, where the participant and virtual agent shared the goal of being in synchrony, and (2) *Competition* where the participant and virtual agent had antagonistic goals.² The agent was represented as a green sphere, and the interaction lasted 30 s. Following the interaction, participants rated their perception of similarity and closeness, using 4-point Likert scales adapted from Atherton et al. (2019), aggregated in a self-other overlap score - see Supplementary Material for items and Fig. 1 for a graphical representation of the task.

2.4. Procedure

Participants completed a Qualtrics survey comprising demographic questions (i.e., sex, age) followed by the QCAE, KINEmp, CASES and TAS questionnaires. Then, participants were redirected to the website hosting the virtual agent and randomly assigned to cooperative or competitive conditions. Participants were not aware of the virtual agent goals and were instructed to follow the dot on the screen and to synchronize their movements in-phase with it. At the end of the trial, participants rated their perceived closeness and similarity with the virtual agent and completed the AQ and LSRP questionnaires. In total, the procedure lasted 15 to 20 min.

2.5. Data analysis

Psychometrics properties and path analyses were performed on R using “psych” and “lavaan” packages (R Core Team, 2023; Revelle & Revelle, 2015; Rosseel, 2012). Cronbach's alpha values assessed internal consistency. Scores of kinesthetic and somatic empathy were aggregated into a unique score of motor empathy due to their positive correlation ($r = 0.57, p < .001$). Pearson's correlations computed subscales associations. Path and bootstrapping analyses explored the role of alexithymia as a mediator of the association of affective, cognitive and motor empathy with psychopathic and autistic traits. Scores of motor synchronization were computed following a similar procedure from Baillin et al. (2020). Non-parametric tests were used for comparisons across experimental conditions and Spearman ranks correlations computed correlations with questionnaires. All scripts and datasets are available in OSF: <https://osf.io/9z4kh/>

¹ CASES was originally designed for children and adolescents, but has also been expanded to and validated in adult populations (Raine et al., 2022).

² Manipulation checks revealed higher sense of overlap in the cooperative than the competitive condition ($p = .041$), however, there were no significant differences for demographics, personality traits and motor coordination scores between conditions (all $ps > .050$) – see Table A in Supplementary Material.

3. Results

3.1. Descriptive statistics and zero-correlations

All scales displayed good reliabilities (Cronbach's alphas >0.70). Affective and cognitive empathy scores were positively correlated, motor empathy was positively correlated with affective, but not cognitive empathy ($p = .47$). Primary and secondary psychopathy, autistic traits and alexithymia were all positively correlated with each other, and negatively with cognitive empathy. Only primary psychopathy displayed a negative association with affective empathy. Finally, secondary psychopathy and alexithymia were positively associated with motor empathy - see Table 1 for descriptive statistics and correlations for overall scale scores.³

3.2. Path analyses

A baseline model with a full mediation by alexithymia was tested against models with primary psychopathy and alexithymia (**model 1**); secondary psychopathy and alexithymia (**model 2**) and autistic traits and alexithymia (**model 3**) as predictors of empathy facets. **Model 1** revealed a negative association between primary psychopathy and motor empathy ($\beta = -0.18, p = .023$) and mediation of the association between primary psychopathy and cognitive empathy through alexithymia ($\chi^2(3, 212) = 10.78, p = .013$), confirmed by bootstrapping analyses (Sobel's test $p < .001$ and Average Causal Mediated Effect $p < .001$). In contrast, **model 2** supported a direct association of secondary psychopathy with cognitive empathy but not with motor empathy ($\chi^2(3, 212) = 5.99, p = .112$). Despite a trend for significance, bootstrapping analyses did not support mediation of the association between secondary psychopathy and motor empathy by alexithymia (Sobel's test $p = .045$ and Average Causal Mediated Effect $p = .064$). Finally, **model 3** confirmed a direct association of autistic traits with cognitive empathy when controlling for shared variance with alexithymia ($\chi^2(3, 212) = 29.58, p < .001$). A final model incorporating the significant paths from models 1, 2 and 3 was tested against the baseline model ($\chi^2(4, 212) = 38.39, p < .001$) - see Fig. 2 for graphical representation of the final model and Table 2 for a full summary of model comparisons' statistics.

3.3. Zero-order correlations for behavioral synchronization

Spearman correlations shown in Table 3 revealed negative associations of primary and secondary psychopathy, autistic traits and alexithymia with synchrony scores. Only primary psychopathy displayed a significant positive association with the experience of self-other overlap. Multiple linear regression analysis revealed that primary psychopathy was the only significant predictor of motor synchronization scores when controlling for secondary psychopathy, autistic and alexithymic traits ($\text{adj}R^2 = 0.19; F(4,152) = 10.05, \beta = -0.31, p < .001$).

4. Discussion

The present study adopted a “fine-cuts” approach in investigating the association of psychopathic and autistic traits with affective, cognitive and motor empathy facets, and whether these were mediated by alexithymia. Using self-reports and a motor task, the results from this study shed new lights on the nuanced associations of these traits with atypical empathy.

³ Distribution boxplots and further complementary analyses for subfacets of motor empathy and Alexithymia are shown in Figure A and Table B in Supplementary Materials.

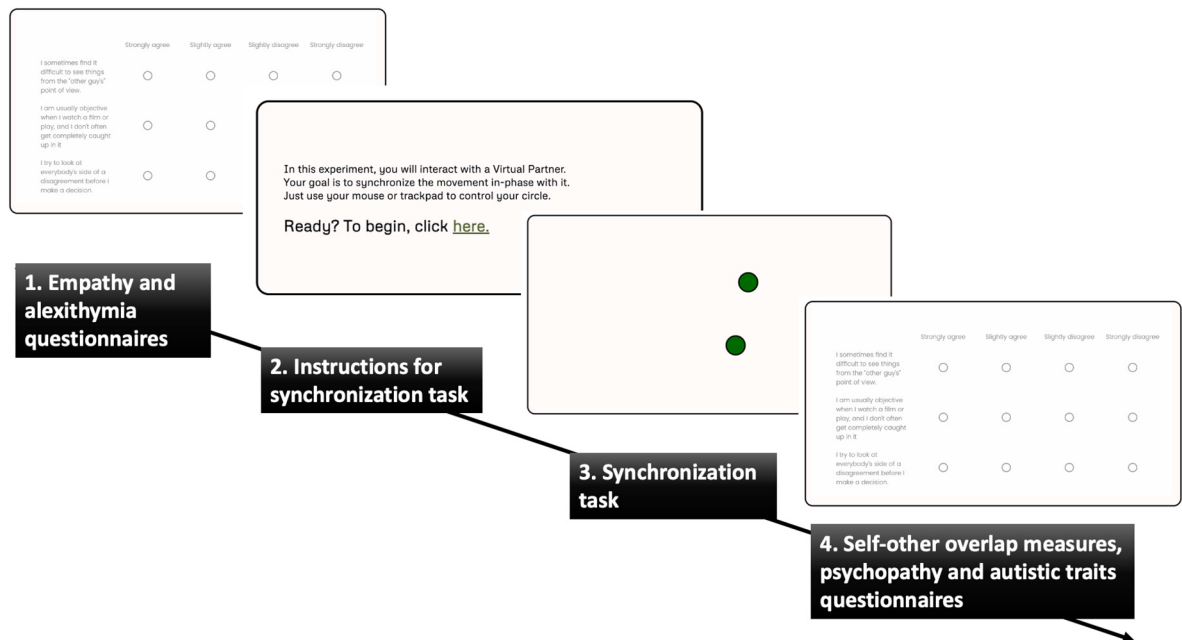


Fig. 1. Graphical representation of the overall experimental procedure, green dots represent the virtual agent (top) and the participant (bottom).

Table 1
Descriptive statistics and Pearson's correlations between questionnaires.

	Mean (SD)	Range values	Alpha	CE	AE	ME	PP	SP	AQ
Cognitive Empathy (CE)	58.14 (9.46)	27–76	0.92	–					
Affective Empathy (AE)	33.61 (5.17)	21–47	0.75	0.38***	–				
Motor Empathy (ME)	51.46 (9.23)	20–74	0.86	0.05	0.55***	–			
Primary Psychopathy (PP)	32.5 (8.5)	16–50	0.86	–0.31***	–0.20*	<0.01	–		
Secondary Psychopathy (SP)	19.68 (5.32)	10–33	0.77	–0.36***	–0.02	0.20*	0.56***	–	
Autism Quotient (AQ)	117.67 (12.76)	85–159	0.77	–0.49***	–0.12	0.10	0.26**	0.40***	–
Alexithymia (TAS)	50.85 (12.73)	22–76	0.88	–0.40***	–0.04	0.24*	0.54***	0.66***	0.51***

Note: $N = 212$; *** $p < .001$, ** $p < .01$, * $p < .05$.

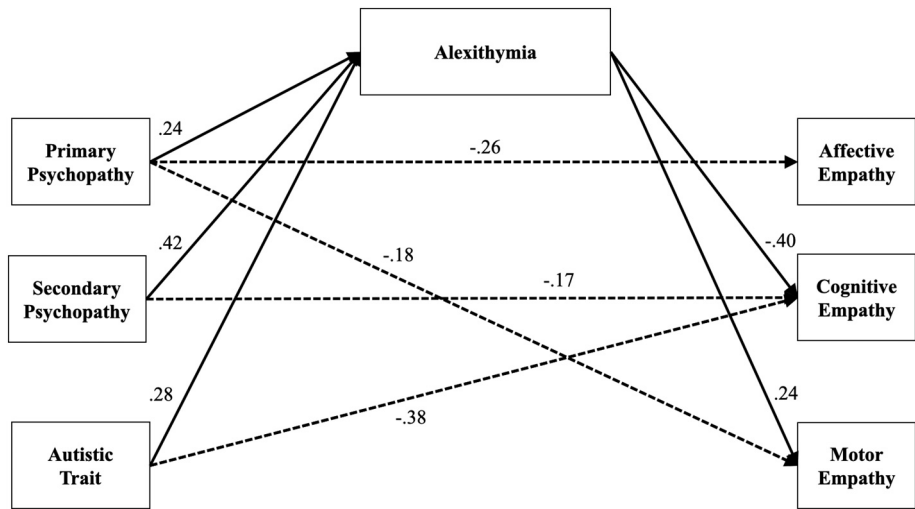


Fig. 2. Final path model ($n = 212$) showing only the significant associations of primary/secondary psychopathy and autistic traits with alexithymia as a mediator and affective, cognitive and motor empathy as outcome variables. Solid lines represent the baseline model, dotted lines the additional paths added after model comparisons.

4.1. Unpacking empathy differences in psychopathic and autistic traits

In line with predictions, primary psychopathy was uniquely and directly associated with reduced affective empathy (Blair, 2008),

whereas secondary psychopathy, autistic and alexithymic traits were associated with reduced cognitive empathy. The latter aligns with atypical mentalizing capacities in autism (Baron-Cohen et al., 1985; Frith & Happé, 1994), and the difficulties of labeling one's emotional

Table 2Summary of goodness of fit indexes for each model tested and χ^2 comparisons.

	DF	AIC	BIC	χ^2	CFI	TLI
Baseline model with full mediation by alexithymia	9	5756.4	5800	47.498	0.896	0.793
Model 1: Primary psychopathy and alexithymia	6	5751.6	5805.3	36.717	0.917	0.752
Model 2: Secondary psychopathy and alexithymia	6	5756.4	5810.1	41.510	0.904	0.713
Model 3: Autistic trait and alexithymia	6	5732.8	5786.5	17.919	0.968	0.904
Final model	6	5725	5778.7	10.121	0.989	0.967

Note: $N = 212$; DF stands for Degree of Freedom, AIC for Akaike information criterion, BIC for Bayesian Information Criterion, CFI for Comparative Fit Index and TLI for Tucker-Lewis Index.

Table 3

Spearman's correlations (regression coefficients in brackets) of the traits with synchronization and self-other overlap.

	Behavioral synchronization	Self-Other Overlap
Primary Psychopathy (PP)	−0.47*** (beta = −0.31***)	0.36***
Secondary Psychopathy (SP)	−0.31** (beta = −0.14)	0.13
Autism Quotient (AQ)	−0.20* (beta = −0.08)	<0.01
Alexithymia (TAS)	−0.31** (beta = −0.09)	0.06

Note: $N = 157$; * $p < .05$, ** $p < .01$, *** $p < .001$.

states in alexithymia (Bird & Cook, 2013). Though primary psychopathy was also associated with reduced cognitive empathy in the zero-order correlations, this association disappeared once shared variance with alexithymic traits was accounted for. This result aligns with previous models suggesting a mediating role of alexithymia in empathy deficits in psychopathy (Burghart et al., 2024; Di Tella et al., 2024; Jonason & Krause, 2013). Importantly, this reduction of effect was only observed for primary but not secondary psychopathy, stressing the need to distinguish primary and secondary psychopathy when considering their comorbidity with alexithymia (Burghart & Mier, 2022).

Motor empathy was positively correlated with affective (but not cognitive) empathy (replicating Ayache et al., 2024), secondary psychopathy and alexithymia but not related to primary psychopathy. When controlling for alexithymia, reduced motor empathy emerged for primary psychopathy, suggesting a suppression effect of alexithymia on the relationship between primary psychopathy and motor empathy. Further complementary analyses dividing motor empathy into positive or negative emotions, revealed tendencies for inhibiting the imitation of positive emotions in primary psychopathy.⁴ In contrast, secondary psychopathy was associated with tendencies for increased imitation of negative emotions. These nuanced associations might explain mixed findings around psychopathy and mimicry (Blair, 2005; Mier et al., 2014), suggesting different associations of psychopathy subtypes with imitation as a function of emotional valence.

Interestingly, similar to secondary psychopathy, alexithymia was associated with reduced cognitive, but increased motor empathy (and unrelated to affective empathy). This suggests difficulty in recognising and labeling mental states, but an increased capacity to mimic emotional states. The complementary facet analyses supported that, similarly to secondary psychopathy, alexithymia was specifically associated with the imitation of negative emotions. Moreover, when affective and cognitive components of alexithymia are considered separately (Grynberg et al., 2010), only affect-related alexithymia facets were associated with motor empathy. Thus, alexithymia should also be considered as a

multidimensional construct, encompassing affective-related facets (i.e., identifying and describing emotions) and cognitive style (i.e., external orienting) when considering associations with empathy facets.

4.2. Alexithymia, a possible underlying mechanism of empathy deficits?

Psychopathic and autistic traits were both associated with increased alexithymia, even after accounting for their shared variance; supporting their co-occurrence (Bird & Viding, 2014). However, the role of alexithymia in atypical empathy in autism and/or psychopathy was unclear. The present study shows that whilst alexithymia does not account for the direct associations of secondary psychopathy and autistic traits with reduced cognitive empathy, a unique mediating role of alexithymia is seen for the indirect effects of primary psychopathy with reduced cognitive and motor empathy. These findings suggest a potential driving role of alexithymia in atypical cognitive and motor empathy in primary psychopathy. Only a few studies investigated the co-morbidity of alexithymia with psychopathy but did not consider the distinction between primary and secondary psychopathy or their association with different empathy constructs (Bird & Viding, 2014; Burghart & Mier, 2022; Lander et al., 2012). Future investigations are required to clarify the behavioral consequences of this mediation. Whilst in clinical populations empathy impairments observed in autism appear to result from co-occurrence with alexithymia (Bird & Cook, 2013), the current study found that alexithymia did not drive reduced cognitive empathy in autistic traits, in line with previous studies showing that autistic traits are the main predictor of empathy difficulties in non-clinical populations (Shah et al., 2019). Consequently, this study further highlights the need to distinguish between clinical and non-clinical populations in studying empathy difficulties in relation to autism.

4.3. Synchrony and self-other overlap experiences

Psychopathic, autistic and alexithymic traits were all associated with reduced behavioral synchronization. These results were expected for secondary psychopathy, autistic and alexithymic traits considering their associations with behavioral disinhibition and difficulties in motor coordination (Demartini et al., 2014; Moriguchi et al., 2009; Wang et al., 2022), but not for primary psychopathy. Importantly, secondary psychopathy and alexithymia were both positively associated with self-reports of motor empathy, stressing a discrepancy between self-reports and behavioral measures of motor empathy that requires clarification. More interestingly, once shared variance was controlled for, only primary psychopathy remained a significant predictor of reduced motor synchrony. Primary psychopathy was also uniquely associated with the experience of self-other overlap. Together, these findings suggest reduced tendencies to mimic others despite a perception of feeling more connected with others; however, the latter may also reflect a tendency for reporting socially desirable responses. Indeed, primary psychopathy is characterized by manipulative behaviors, suggesting that studies investigating interpersonal coordination should control for this trait. Finally, despite previous studies suggesting impairments in self-other distinction in autism and alexithymia (Moriguchi et al., 2009; Santies-teban et al., 2012), this was not observed in the current study. The experimental setting with a virtual agent might have prevented the occurrence of such experiences, and future studies need to explore these associations in human-human interaction settings.

4.4. Strengths and limitations

Despite this study using a fine-cuts approach to get a more in-depth understanding of atypical empathy in psychopathy and autism, it also entails some limitations that future investigations need to address. Firstly, these associations were tested in a community sample and are not simply generalizable to clinical populations (Burghart et al., 2024; Shah et al., 2019). Secondly, psychopathy was conceptualized using the

⁴ See Table B in Supplementary Materials.

two dimensions of primary and secondary psychopathy (Skeem et al., 2003), but findings may differ when using other conceptualizations such as a three-factor model (Burghart et al., 2024). Similarly, affective and cognitive empathy traits were operationalized using the QCAE (Reniers et al., 2011), a questionnaire addressing previous confluences between those facets, yet with limitations (Ayache et al., 2024). Thus, future research needs to test the validity of the findings across different empathy measures. Thirdly, considering the restricted sample size, path analyses rather than structural equation modelling (i.e., including latent constructs) were employed, and sex differences were not considered despite their distinct contributions to empathy (Jonason & Krause, 2013). Finally, given the cross-sectional nature of this study, any firm conclusions about causality cannot be drawn from the mediation analyses, instead, results should be interpreted as reflective of a confounding nature of relationships amongst the constructs (MacKinnon et al., 2000), and as such the potential impact of their co-occurrence. Despite these limitations, this study provides new insights into different facets of atypical empathy by examining the role of alexithymia in primary and secondary psychopathy subtypes and autistic traits, and combining self-reports and behavioral measurements.

4.5. Conclusion

This study investigated the nuanced associations between psychopathic and autistic traits with affective, cognitive and motor empathy components and considered alexithymia as a potential underlying mechanism. Findings highlighted distinct associations of primary, secondary and autistic traits with affective, cognitive and motor empathy, supporting the “fine-cuts” approach for explaining more distinctly atypical empathy in those traits. The findings do not support alexithymia as a driving mechanism for reduced cognitive empathy in secondary psychopathy and autistic traits in non-clinical populations. Instead, they highlight a specific role of co-occurring alexithymia for reduced cognitive and motor empathy in primary psychopathy. Behaviorally, reduced motor synchronization was observed for all the traits, but specifically for primary psychopathy - a novel finding that might highlight motor synchronization deficits in psychopathy, not previously considered. This is paving the way for more systematic investigations using motor tasks alongside the standard psychometric assessments including motor empathy, to study the consequences of distinct atypical empathy facets in social interactions.

CRedit authorship contribution statement

Julia Ayache: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Nikki Stevenson:** Writing – review & editing. **Elisha Patel:** Writing – original draft, Visualization. **Alexander Sumich:** Writing – review & editing, Supervision, Conceptualization. **Guillaume Dumas:** Writing – review & editing, Software, Investigation, Formal analysis, Data curation, Conceptualization. **Nadja Heym:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all participants included in the study.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.paid.2025.113279>.

Data availability

All scripts and datasets are available in OSF: https://osf.io/9z4kh/Alexithymia_SYNC (Original data) (OSF)

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