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From interoception to anxiety and social cognition: the mediating roles of intolerance of uncertainty and alexithymia

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ABSTRACT

Daily life requires navigating uncertainty arising from external events and internal bodily sensations. Although uncertainty often elicits anxiety, individuals differ markedly in their sensitivity to it, a trait termed Intolerance of Uncertainty (IU). Across two studies, we examined how IU and alexithymia (difficulties identifying and describing emotions) mediate the links between interoceptive sensibility (self-reported awareness, attention, and appraisal concerning bodily sensations) and both anxiety and social cognition. In Study 1 ($N=190$), participants completed questionnaires assessing interoceptive sensibility, alexithymia, IU, and anxiety. Study 2 ($N=154$) included additional measures of empathic tendencies and performance on an emotion recognition task analysed using Drift Diffusion Modelling (DDM). Maladaptive interoceptive attention styles were associated with elevated anxiety and greater empathic distress. Both IU and alexithymia significantly mediated the relationships between interoceptive sensibility, anxiety, and personal distress. Exploratory DDM analyses unexpectedly suggested more efficient perceptual processing in individuals with higher IU, reflected in enhanced recognition of positive emotional expressions. These findings highlight the complex interplay among interoceptive sensibility, IU, alexithymia, anxiety, and social cognition, and suggest that interventions targeting uncertainty sensitivity and emotional awareness may improve emotional well-being and social functioning.

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Navigating the world is influenced both by the information we possess and by the information we lack. In psychological research, this subjective lack of knowledge is described under the umbrella term uncertainty. Missing knowledge can stem from the indeterminacy and uncontrollability of future events or the ambiguity of current situations, and while it usually refers to unknowns in the external world, it can also involve uncertainty about one's internal bodily states and emotions. Uncertainty is typically associated with negative affect, as we feel more comfortable in situations that are predictable and controllable; otherwise, anxiety and worry may arise (Anderson et al., 2019; Carleton, 2012; Gu et al.,

2020). Yet, uncertainty does not always cause negative emotions; for instance, not knowing what is going to happen next when reading fiction or watching a movie makes the experience more pleasurable. Importantly though, there are significant individual differences in how uncertainty is perceived. The aversive disposition towards uncertain conditions has been described and studied under the term Intolerance of Uncertainty (IU; Carleton, 2012). IU refers to a dispositional difficulty enduring aversive responses to the perceived absence of sufficient information and has been identified as a transdiagnostic risk factor across anxiety-related conditions (Carleton, 2012, 2016). Individuals with high IU exhibit

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hypersensitivity to even low levels of uncertainty, negative interpretations of unknown situations, and either make intense efforts to reduce uncertainty or avoid any action – symptoms also observed across anxiety disorders (Carleton, 2012; Gu et al., 2020). These links may be particularly relevant for anxiety presentations in which bodily sensations themselves become a source of threat or uncertainty, such as panic (Carleton et al., 2013) and health anxiety (Fergus & Bardeen, 2013; Wright et al., 2016). In these conditions, ambiguous bodily sensations may be monitored closely, interpreted catastrophically, or treated as signs of danger, illness, or loss of control, suggesting a close connection between interoceptive appraisal, uncertainty, and anxiety-related distress (Freeston & Komes, 2023; Paulus & Stein, 2010). Relatedly, although IU is a complex construct, it has been strongly linked to difficulties in emotion regulation, as supported by a recent meta-analysis (Sahib et al., 2023).

Recently, several findings and theoretical accounts have connected anxiety symptomatology, among other disorders, with altered interoceptive processing (Palser et al., 2018; Paulus & Stein, 2010; Pollatos et al., 2007). Interoception refers to the sensing and interpretation of internal bodily signals (Craig, 2003), and has been operationalised in several ways. Interoceptive accuracy refers to performance-based indices of how accurately individuals detect or discriminate bodily signals, whereas interoceptive sensibility refers to self-reported beliefs, attentional tendencies, and appraisals concerning bodily sensations (Garfinkel et al., 2015). One widely used operationalization of interoceptive sensibility is the MAIA-2 questionnaire, which captures the multidimensional nature of the construct rather than providing a single global index of interoceptive functioning (Mehling et al., 2018). Accordingly, the meaning of higher scores depends on the specific dimension assessed: they may indicate greater noticing of bodily sensations, less distraction from or worry about uncomfortable sensations, greater ability to regulate attention to bodily sensations, stronger awareness of body–emotion relations, greater use of bodily sensations for self-regulation or insight, or greater trust in the body. Given this multidimensionality of interoception and interoceptive sensibility in particular, empirical evidence suggests that its relationship to anxiety and socio-affective functioning is complex (Adams et al., 2022; Domschke et al., 2010; Palser et al., 2018). Studies using questionnaires

asking participants to report the intensity of bodily sensations consistently find that higher scores on those measurements are associated with greater anxiety, somatization, hypervigilance and negative interpretations of bodily states (De Berardis et al., 2007; Olatunji et al., 2007). In contrast, a recent network analysis study using MAIA-2 subscales, showed that increased anxiety was correlated with greater worry and lower trust in one's own bodily sensations (Slotta et al., 2021). Moreover, interoceptive sensibility has been linked to emotion regulation, with self-reported and qualitative findings suggesting that recognising and understanding bodily states may support the recognition and regulation of emotions (Zamariola et al., 2019). Together, these findings suggest that the relationship between interoceptive sensibility and anxiety may depend not simply on awareness of bodily sensations, but on how those sensations are appraised, responded to, and regulated. This may be particularly relevant to IU because bodily signals are often ambiguous and difficult to interpret. Consequently, individuals who experience bodily sensations as confusing or worrying may also report greater difficulty tolerating uncertainty. From this perspective, IU may represent one psychological pathway through which specific facets of interoceptive sensibility, such as worry about bodily sensations or reduced trust in the body, are associated with anxiety. Nevertheless, it remains unclear whether and how IU statistically mediates the relationship between interoceptive processing and anxiety.

Another construct related to emotion processing is alexithymia, which refers to difficulties in identifying and describing one's emotions (Taylor, 2000). Alexithymia is associated with increased anxiety in both clinical (Berardis et al., 2008) and non-clinical populations (Karukivi et al., 2010). In addition, alexithymia has been found to predict IU (Maisel et al., 2016; Ozsivadjian et al., 2021). For example, Maisel et al. (2016) found, using structural equation modelling in a study with autistic and neurotypical adults, that alexithymia and low emotional acceptance (not IU *per se*) explained most of the autism–anxiety link, with alexithymia also positively predicting IU, underscoring their interdependence in anxiety. Another study demonstrated that alexithymia mediated the relationship between self-reported interoceptive sensibility and trait anxiety (Palser et al., 2018). Given that both alexithymia and IU play a role in emotion regulation and anxiety, it is important to understand their

relative roles in mediating different aspects of interoceptive processing and trait anxiety.

In the social domain, the limited evidence available suggests that difficulties tolerating uncertainty also affect social interactions (Boelen & Reijntjes, 2009; Carleton et al., 2010). Social encounters typically involve high levels of ambiguity and unpredictability, which may be negatively interpreted, triggering aversive responses, avoidance or maladaptive reactions. For instance, IU has been identified as a central factor underlying social anxiety and negative interpretations of social events, even when controlling for other factors often correlated with social anxiety (Boelen & Reijntjes, 2009; Carleton et al., 2010). Although social interactions appear especially challenging for those with heightened sensitivity to uncertainty, as in anxiety disorders (Lamba et al., 2020), it is not yet known how IU specifically relates to social cognition, such as affective empathy or emotion recognition skills. Conversely, several studies link interoception to social cognition. Interoceptive accuracy has been associated with greater sensitivity to others' emotions (Grynberg & Pollatos, 2015; Shah et al., 2017), while one study using a total MAIA score as an index of interoceptive sensibility also reported better emotion-recognition performance with higher scores (Hübner et al., 2021). However, associations between MAIA dimensions and self-reported empathy appear more differentiated: Stoica and Depue (2020) found that Personal Distress was negatively associated with attention regulation, mind–body integration, bodily trust, and the MAIA total score, whereas Empathic Concern showed no significant associations; Perspective Taking was positively associated with mind–body integration. Together with studies failing to find clear associations between interoception and social cognition (Ainley et al., 2015), these findings suggest that such relationships may depend on the specific dimensions and measures examined, as well as on additional individual-difference factors. Here, we examined IU as one such factor. Given the ambiguous nature of interoceptive signals, perceiving and interpreting them may be particularly challenging for individuals with high IU, especially in socially uncertain situations. In turn, difficulties in adaptively appraising bodily sensations and tolerating uncertainty may compromise self-regulation and the processing of others' emotions.

Computational approaches in cognitive psychology research are increasingly used to reveal behavioural patterns not easily discerned with traditional

methodologies (Dietel et al., 2021; White et al., 2010). One such model is the Drift Diffusion Model (DDM) which is used to examine decision-making in tasks with two available options and noisy evidence (White et al., 2010). Based on the reaction time distributions of the two alternative choices, it estimates several parameters that describe the underlying decision processes. In short, DDM models the process of accumulating information until a response boundary is reached, characterised by, at least, 4 basic parameters: (1) drift rate, which relates to the efficiency in processing each stimulus' information, (2) boundary separation, which reflects the amount of evidence required to make a decision, regardless of the response, (3) bias, which reflects a predisposition toward one response over another, and (4) the non-decision time, which quantifies time components unrelated to the decision itself. DDM approaches have recently been employed to study differences in decision-making in clinical and non-clinical populations (Dietel et al., 2021; White et al., 2010). For instance, DDM studies have shown that anxiety-related conditions can involve altered evidence accumulation and response bias during affective decision-making (Dietel et al., 2021). However, no studies to date have examined whether IU is associated with differences in decision-making using DDM. Given its overlap with social anxiety in uncertainty-related socio-affective processing, increased IU may have several implications for perceptual processing, attention, decision-making and behaviour in situations requiring categorization of ambiguous social stimuli, such as emotional facial expressions (Anderson et al., 2019; Carleton, 2012). For instance, individuals with higher IU may show altered evidence accumulation under ambiguity, greater response caution, or a bias toward interpreting ambiguous social cues negatively. DDM can help distinguish these possibilities because similar patterns of accuracy or reaction time may reflect differences in evidence accumulation efficiency (indexed by drift rate), response caution (indexed by boundary separation), or an initial tendency toward one response (indexed by starting-point bias). Thus, applying DDM to an ambiguous emotion-recognition task allowed us to examine whether IU-related performance differences were more consistent with altered evidence accumulation, response caution, or response bias.

The first objective was to examine how different aspects of interoceptive sensibility relate to IU, and how IU, together with alexithymia, mediate the

relationship between interoceptive sensibility and anxiety (Study 1). The second objective was to investigate how IU relates to social cognition, either directly or as a mediator between interoception and affective empathy or emotion perception abilities (Study 2). To address these aims, we collected online questionnaire data measuring interoceptive sensibility, alexithymia, IU, trait anxiety and affective empathy. To probe social cognition further, we used a two-alternative forced-choice emotion categorization task with ambiguous facial expressions as stimuli, and modelled RTs using DDM. Lastly, we constructed different models corresponding to our two objectives and performed path analysis to examine direct and indirect pathways among the measured traits and behavioural responses. Specifically, our main hypotheses were: (1) both IU and alexithymia would statistically mediate the relationship between different facets of interoceptive sensibility and anxiety with stronger and more consistent associations expected for MAIA dimensions reflecting the appraisal and regulation of bodily sensations than for dimensions primarily reflecting bodily awareness. (2) IU would be associated with social cognition, as measured by self-reported affective empathy and by performance in the emotion recognition task, with personal distress expected to show stronger and more positive associations with IU than empathic concern as it reflects self-oriented distress in response to others' emotions; (3) IU and alexithymia would statistically mediate the relationship between interoceptive sensibility and both affective empathy and emotion recognition, with the emotion recognition and DDM analyses treated as exploratory.

Methods

Participants

In Study 1 we recruited 190 participants (age range: 18–48, median age: 19, 120 females) and in Study 2, we recruited 154 participants (age range 18–39, median age: 19, 117 females), all Psychology students participating in exchange for course credits. Participants were recruited as non-clinical volunteers. Eligibility was assessed by self-report, including questions about psychiatric or neurological history; no structured clinical interview was conducted. All participants provided written informed consent before the beginning of the experiments. The studies were approved by the School of Psychology

Ethics Committee at the University of Kent. The sample sizes were determined based on power analyses for multiple regression models with 7 predictors, assuming a moderate effect size ($f^2 = 0.15$). This analysis indicated that approximately 103 subjects would be sufficient to achieve 80% power at an alpha level of 0.05. This target was also broadly consistent with mediation-specific sample-size recommendations indicating that approximately 115–162 participants are sufficient to detect indirect effects with half-medium to medium component paths at 80% power (Fritz & MacKinnon, 2007).

Questionnaires

Interoceptive sensibility

To measure interoceptive sensibility we used the Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2; Mehling et al., 2018). This self-report questionnaire comprises 37 questions assessing the different ways people process and pay attention to their bodily sensations, including subjective tendencies, beliefs, and regulatory styles related to bodily sensations. Specifically, it consists of 8 subscales: noticing (awareness of uncomfortable, comfortable, and neutral body sensations), not-distracting (tendency to ignore or distract oneself from sensations of pain or discomfort), not-worrying (emotional distress or worry with sensations of pain or discomfort), attention regulation (ability to sustain and control attention to body sensations), emotional awareness (awareness of the connection between body sensations and emotional states), self-regulation (ability to regulate psychological distress by attention to body sensations), body listening (actively listens to the body for insight), and trust (experiences one's body as safe and trustworthy). Participants are asked to indicate, on a 6-point Likert scale ranging from 0 (never) to 5 (always), how often each statement applies to them generally in daily life.

Alexithymia

To assess participants' understanding of their own emotions, we used the 20-item Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994). This test measures alexithymia with questions like "I am often confused about what emotion I am feeling" where participants indicate their level of agreement on a 5-point scale.

Interpersonal reactivity index (IRI)

The IRI is a self-report questionnaire that measures differences in empathic social interactions across 4 subscales assessing perspective taking, fantasy, empathic concern and personal distress (Davis, 1983). The first two subscales assess cognitive empathy while the latter two assess affective empathy. It includes 28 items where participants respond on a 5-point Likert-type scale from 0 to 4. Here, we focused only on the two affective subscales.

Intolerance of uncertainty (IU)

To measure IU, we used the 27-item Intolerance of Uncertainty Scale developed by Freeston et al. (1994). It comprises two subscales: (i) one is described as “uncertainty has negative behavioural and self-referent implications”; (ii) the other is described as “uncertainty is unfair and spoils everything”. Respondents report the degree to which each item applies to them on 5-point Likert-type scales ranging from 1 to 5. For our analyses, we used the total IUS score because our focus was on IU as a broad dispositional tendency to experience uncertainty as aversive; modelling the two subscales separately would have added complexity without clear subscale-specific hypotheses.

Trait anxiety

To assess the general tendency to feel anxiety, we used the State Trait Anxiety Inventory – Trait (STAI-T; Spielberger et al., 1983). The STAI-T includes 20 items where respondents report how they generally feel based on a 4-point Likert-type scale ranging from 1 to 4.

Questionnaires were presented to participants in random order. In Study 1, participants completed the MAIA, IUS, TAS-20, and STAI-T questionnaires. In Study 2, participants completed the same questionnaires with the addition of the IRI and the emotion recognition task. Internal consistency reliability was calculated for all questionnaire scales and subscales used in the analyses and is reported in the Supplementary Materials (S5). Data quality was monitored using instructed-response attention-check items embedded across the questionnaires, specifically two were included in the MAIA and one in each of the other 4 questionnaires. Participants were excluded if they responded incorrectly to more than half of these items.

Emotion recognition task

The emotion recognition task consisted of a 2-alternative forced-choice (2AFC) emotion identification task in which participants had to identify the dominant emotion displayed in ambiguous facial expressions. The task was adapted, with minor changes, from Brennan and Baskin-Sommers (2020), where a DDM approach was also used. The stimuli consisted of emotional face images drawn from the Racially Diverse Affective Expression (RADIATE) face stimulus set (see <http://fablab.yale.edu/page/assays-tools>; Conley et al., 2018). We used images from 10 different male models from 3 racial backgrounds: 4 Black, 3 Hispanic and 3 White. Male models were used to maintain consistency with the task design adapted from Brennan and Baskin-Sommers (2020) and to reduce additional stimulus heterogeneity related to model gender, while preserving variation in racial background. Stimuli were created by morphing images of two emotional expressions (anger-fear; anger-happiness; fear-happiness) at a 30%–70% level (Figure 1). Thus, for each blend category there were two stimulus types according to the dominant emotion displayed. For instance, for the anger-happiness blend, the two sets of stimuli were the 30% happiness/70% anger and 30% anger/70% happiness morphings, where the dominant emotion was anger and happiness, respectively. This level of blending ensured that the categorization was of moderate difficulty, to allow performance at an average accuracy level appropriate for drift diffusion modelling (Ratcliff & McKoon, 2008). The task included three blocks based on these combinations: the anger-happiness (block 1), the anger-fear (block 2 – data not analysed; see below), and the fear-happiness (block 3). Each block included 40 trials, 20 for each dominant emotion, presented in random order.

The task was created in PsychoPy and presented online on the Pavlovía platform. On each trial, participants were asked to identify the emotional expression with a key press (left/right) as fast and as accurately as possible, within 3s from stimulus onset. After each response they were also asked to report their confidence in their decision on a scale ranging from 1 (not confident) to 5 (very confident). Before each stimulus, a fixation cross was presented for a variable intertrial interval of 1.5–2 s. Before starting the task, participants completed 12 practice trials and rest breaks were provided between blocks. The total duration of the task was around 20 min.

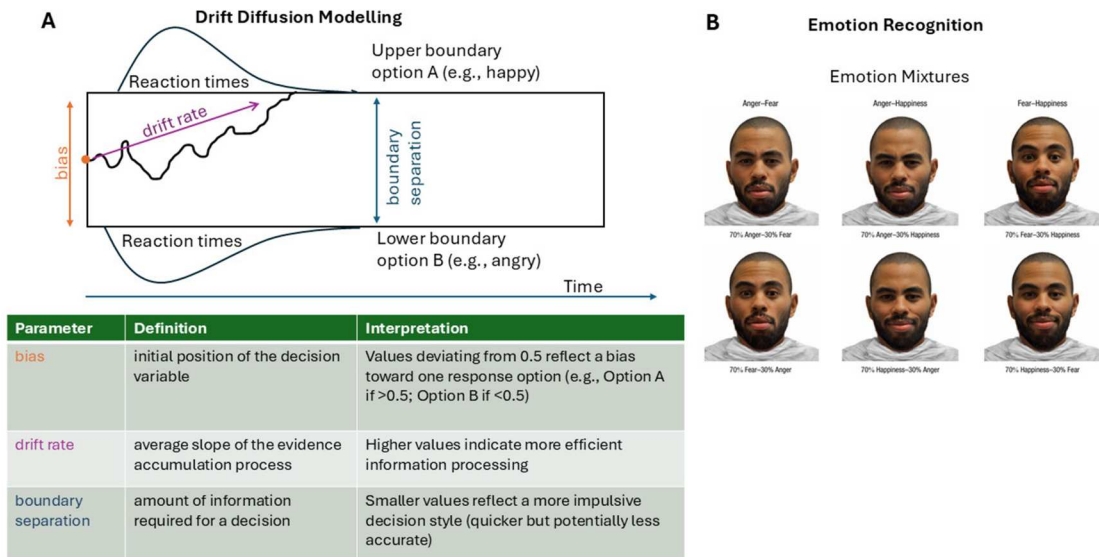


Figure 1. Drift Diffusion Modelling (DDM) and Emotion Recognition Task. (A) The DDM schematic represents the decision process as noisy evidence accumulation toward one of two response boundaries. The accompanying table defines the main model parameters and their task-specific interpretation. In the present task, higher drift rates indicate more efficient evidence accumulation toward positive or negative emotion decisions; larger boundary separation indicates more cautious responding, usually reflected in slower but more accurate decisions; and starting-point bias indicates a relative predisposition toward one response boundary before stimulus evidence is accumulated. (B) The emotion recognition task involved categorising ambiguous facial expressions, with stimuli varying in emotional blends between anger-fear, happiness-anger and happiness-fear across three blocks.

Data analysis

Drift diffusion modelling

Diffusion models conceptualise decision-making in 2AFC tasks as a stochastic continuous accumulation of information until evidence reaches one of the two boundaries corresponding to each response. This modelling approach is useful for examining implicit processes underlying decision-making when stimuli are ambiguous, time is limited, and decisions are difficult. DDM models the RT distributions and binary responses using four parameters. The drift rate (v) models the speed of evidence accumulation towards one boundary and can vary with endogenous cognitive factors, such as attention, or exogenous factors, such as stimulus characteristics. The boundary separation (a) defines the distance between the decision boundaries and reflects the amount of evidence required to make a decision. Larger boundary separation indicates that more evidence is needed, leading to slower but usually more accurate decisions. The starting point or bias (z) represents the initial position of the evidence accumulation process relative to the decision boundaries, reflecting initial preference for a response. The non-decision time (t_{er}) quantifies the time taken, before and after decision-making, by

processes such as sensory processing and motor response.

In this work, we modelled data from the first (anger-happiness) and third (fear-happiness) blocks, excluding block 2 (anger-fear), which is analysed separately for a different report. The anger-fear block was not included in the present analyses because it did not contain a positive-emotion category and therefore did not map onto the valence-based happy/unhappy decision process modelled here. By combining data from blocks 1 and 3, we increased the number of trials available for participant-level diffusion modelling and simplified subsequent analyses. Specifically, we assumed a single decision process based on perceived valence (positive or negative expressions) where participants identified whether a face was happy or unhappy (expressing fear or anger). This categorization based on valence for ambiguous stimuli is relevant to IU research, given the reported negative affective predictions among individuals with high IU in ambiguous situations (Carleton, 2016). Descriptive checks comparing anger- and fear-dominant trials, and happy-dominant trials across the two analysed blocks, are reported in the Supplementary Materials (S4).

The decision process was modelled using the DDM, with the upper boundary representing negative expressions and the lower boundary representing positive expressions. We assumed different drift rates for each emotion type, as suggested by similar procedures (Brennan & Baskin-Sommers, 2020; Myers et al., 2022; Ratcliff & McKoon, 2008). The other three DDM parameters (bias, boundary separation, and non-decision time) did not vary with stimulus characteristics, resulting in five participant-level parameters. Thus, for each participant, we fitted a model with separate drift-rate parameters for positive and negative stimuli, while boundary separation, starting-point bias, and non-decision time were estimated as condition-invariant parameters. Data were modelled using the Rwiener package in R (Wabersich & Vandekerckhove, 2014). Parameters were estimated using Maximum Likelihood Estimation (MLE), which is fast, accurate, and suitable for smaller trial counts (<40) as in our study (Deng et al., 2018). We used neutral starting values for all parameters and increased the maximum number of iterations (from 500 to 1000) to improve convergence. All included participants produced convergent model fits.

Of the 154 participants who took part in the study, 30 were excluded from the main analyses because they failed to pass two out of three catch trials or did not respond to at least 20% of the trials. Thus, the final sample for the emotion recognition task comprised 124 participants. We excluded trials with $RT < 0.2$ s (less than 4% of total trials), as recommended in guidelines for DDM analysis (Myers et al., 2022), as well as those without a response within the 3s time limit.

Correlation analysis

As a preliminary step of our statistical analysis, we ran zero-order correlations between all variables included in the two studies (Supplementary Material S1-S2). These zero-order correlations were subsequently used to inform the selection of specific MAIA dimensions and outcomes for the path analyses, according to the criteria described below.

Path analysis

Path analysis estimates direct and indirect effects among observed variables, allowing simultaneous evaluation of multiple predictors and mediators. It is conceptually similar to structural equation modelling but does not include latent variables. This approach was appropriate because our hypotheses concerned

theoretically defined questionnaire subscales, total scale scores, and DDM-derived participant-level parameters, rather than latent constructs. The MAIA subscales were therefore analysed as distinct facets of interoceptive sensibility. The path analyses tested whether IU and alexithymia statistically accounted for indirect associations between interoceptive sensibility and the outcomes, while recognising that the cross-sectional design cannot establish causal or temporal ordering.

We used a theory-guided overall model structure, while the selection of specific MAIA dimensions was informed by the magnitude of the observed zero-order associations. Our theoretical expectation concerned the broader distinction between MAIA dimensions reflecting the appraisal and regulation of bodily sensations and dimensions primarily involving bodily awareness elements (Noticing, Emotional Awareness), rather than a prespecified set of individual subscales. However, the existing literature did not provide a sufficiently precise basis for determining a priori which specific MAIA dimensions should be included in each model. We therefore considered all eight dimensions as candidate predictors and allowed the observed zero-order associations to inform the final selection. At the same time, including all eight dimensions would have resulted in overly complex models relative to the available sample size. Consequently, we used $|r| \geq .20$ with the relevant outcome as a parsimony criterion and limited the main models to a maximum of five MAIA dimensions; where more than five dimensions met this criterion, the five showing the largest absolute correlations with the outcome were retained. The overall path structure was theory-driven: interoceptive sensibility (MAIA subscales) was specified at the exogenous-lower level, alexithymia at the next level, IU above that, and finally the target outcome (anxiety (Model 1), affective empathy (Model 2), or emotion-recognition performance (Models 3a and 3b)). Our hypotheses concerned both direct associations among the constructs and indirect associations linking interoceptive sensibility with anxiety and socio-emotional outcomes through alexithymia and IU. Therefore, MAIA dimensions were specified to have paths to both mediators and to the outcome, while alexithymia and IU also had paths to the outcome. For the anxiety and affective-empathy models, we entered only MAIA subscales showing $|r| \geq .20$ with the outcome, and we modelled only those outcomes that also showed $|r| \geq .20$ with at least one mediator.

These criteria were used to specify focused and interpretable models relative to the available sample size, rather than as formal prerequisites for testing indirect effects. Accordingly, although the broader model structure and theoretical expectations were theory-guided, the exact MAIA dimensions entering each model and the resulting subscale-specific paths were data-informed and should be interpreted as exploratory. For the emotion-recognition models, associations between task outcomes and both the mediators and most MAIA dimensions were generally below $|r| = .20$. These analyses were therefore treated as exploratory, and the outcome-selection criterion used for the main questionnaire models was relaxed. For emotion-recognition outcomes taken forward to path analysis, MAIA dimensions were included when they showed $|r| \geq .20$ with either the relevant outcome or one of the mediators (alexithymia or IU), while retaining the same hierarchical structure.

Path analyses were performed in R using the lavaan package (Rosseel, 2012). Model fit was assessed with the following criteria: root mean square error of approximation ($RMSEA \leq 0.08$) and comparative fit index ($CFI \geq 0.95$) as the most reliable indices of model fit for models with small degrees of freedom (Shi et al., 2022).

Results

Model 1a (Anxiety)

Model 1a (Study 1) included five MAIA subscales with $|r| \geq .20$ zero-order correlations with anxiety (Not-Worrying, Attention Regulation, Self-Regulation, Not Distracting, and Trust) as predictors, with alexithymia and IU as mediators (Figure 2). The model showed excellent fit to the data ($\chi^2(5) = 5.61$, $p = .344$, $CFI = .998$, $RMSEA = .025$) and explained 58.8% of the variance in anxiety ($R^2 = .588$), corresponding to a large effect size ($f^2 = 1.49$).

The direct regressions showed that anxiety was significantly associated with lower Not-Worrying ($\beta = -.49$, $p = .002$) and Trust ($\beta = -1.37$, $p < .001$), and higher Alexithymia ($\beta = .22$, $p < .001$) and IU ($\beta = .16$, $p < .001$). IU was negatively associated with Not-Worrying ($\beta = -1.76$, $p < .001$) and Not Distracting ($\beta = -.59$, $p = .024$), and positively with Alexithymia ($\beta = .77$, $p < .001$). Alexithymia was itself negatively associated with Not-Worrying ($\beta = -.41$, $p = .054$), Not Distracting ($\beta = -.45$, $p = .005$), and Trust ($\beta = -.91$, $p = .002$).

Regarding indirect paths, IU significantly mediated the relationship between Not Worrying and anxiety ($\beta = -.30$, $p < .001$) and between Not Distracting and anxiety ($\beta = -.09$, $p = .038$). Additionally, Alexithymia mediated the paths from Not Distracting ($\beta = -.10$, $p = .020$) and Trusting ($\beta = -.20$, $p = .013$) to anxiety, while a dual indirect pathway through Alexithymia and IU was significant for Not Distracting ($\beta = -.04$, $p = .030$) and Trust ($\beta = -.08$, $p = .022$).

The Study 2 replication model showed a similar pattern and explained a comparable proportion of variance in anxiety, $R^2 = .58$ (Supplementary Material S1). Anxiety was associated with lower Trust and Self-Regulation and higher alexithymia and IU, with indirect effects again involving IU and alexithymia.

Model 2 (personal distress)

For Model 2 (study 2), PD was modelled as the outcome because it correlated with both mediators, whereas EC did not (Supplementary Material S2). The model included five MAIA dimensions with $|r| \geq .20$ with PD as predictors (Figure 3). The model demonstrated excellent fit ($\chi^2(5) = 5.222$, $p = .389$, $CFI = .999$, and $RMSEA = .018$) and explained 48.2% of the variance in PD ($R^2 = .482$), corresponding to a large effect size ($f^2 = 0.93$). The direct regressions showed that PD was negatively associated with Not-Worrying ($\beta = -1.103$, $SE = 0.393$, $p = .005$) and positively associated with alexithymia ($\beta = 0.097$, $SE = 0.036$, $p = .007$) and IU ($\beta = 0.076$, $SE = 0.019$, $p < .001$). The remaining MAIA subscales and age were non-significant predictors ($ps > .14$). IU was negatively associated with Not-Worrying ($\beta = -6.638$, $SE = 1.657$, $p < .001$) and Trust ($\beta = -6.504$, $SE = 1.706$, $p < .001$) and positively associated with alexithymia ($\beta = 0.738$, $SE = 0.148$, $p < .001$). In turn, alexithymia was negatively associated with Not-Worrying ($\beta = -2.274$, $SE = 0.945$, $p = .016$) and Trust ($\beta = -2.340$, $SE = 0.959$, $p = .002$).

Regarding indirect effects, IU significantly mediated the relationships between Not-Worrying and PD ($\beta = -0.507$, $SE = 0.180$, $p = .005$) and between Trust and PD ($\beta = -0.497$, $SE = 0.181$, $p = .006$). Additional indirect paths were observed through alexithymia, including a significant Trust-to-alexithymia-to-PD effect ($\beta = -0.296$, $SE = 0.144$, $p = .040$) and a serial mediation via alexithymia and IU ($\beta = -0.171$, $SE = 0.077$, $p = .027$). The corresponding serial pathway for Not-Worrying was marginal ($\beta = -0.128$, $SE = 0.067$, $p = .057$). Overall, lower PD was

Model 1a – Anxiety

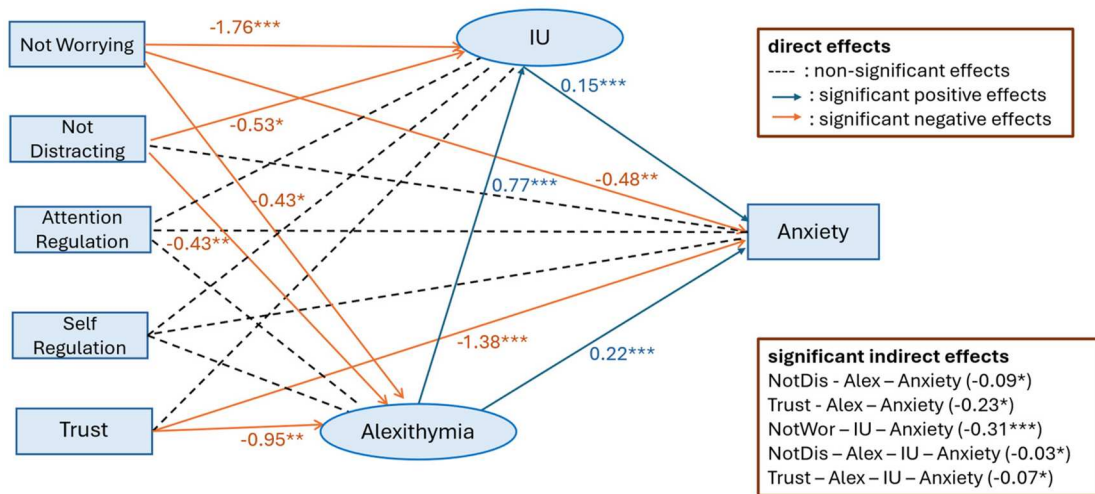


Figure 2. Path Analysis Results for Anxiety Model 1a. This figure presents the path analysis examining the direct and indirect effects on trait anxiety (STAI). Model predictors are 5 dimensions of MAIA (Not-Worrying, Not Distracting, Attention Regulation, Self-Regulation, Trust), with alexithymia and IU as mediators. The negative and positive direct and indirect effects are accompanied by regression coefficients (β), with asterisks denoting significance levels (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

associated with less bodily worry, greater bodily trust, lower alexithymia, and lower IU.

Model 3a (emotion recognition – accuracy)

Overall performance in the analysed emotion-recognition blocks was above chance and below ceiling, indicating that participants were able to categorise the ambiguous expressions while the task retained sufficient difficulty (accuracy: $M = .838$, $SD = .063$; mean RT: $M = 1.34$ s, $SD = .231$). Descriptive performance by block and emotion condition is reported in the Supplementary Materials (S3).

Because positive-emotion accuracy showed only small associations with the mediators, this model was treated as exploratory. It retained the same structure as the previous models and included MAIA subscales showing correlations of $|r| > .20$ with either the outcome or a mediator (Figure 4(a)). No model was estimated for negative-emotion accuracy because it showed near-zero correlations with both mediators.

The model showed good fit ($\chi^2(5) = 5.23$, $p = .389$; CFI = .999; RMSEA = .019) and explained 14.4% of the variance in accuracy ($R^2 = .144$), 17.4% in alexithymia ($R^2 = .174$), and 46.8% in IU ($R^2 = .468$). Direct effects showed that accuracy was higher with lower

alexithymia ($\beta = -0.250$, $SE = .092$, $p = .007$) and higher IU ($\beta = 0.264$, $SE = .100$, $p = .008$), and increased with age ($\beta = 0.206$, $SE = .032$, $p < .001$). Attention Regulation showed a marginal negative association ($\beta = -0.199$, $SE = .106$, $p = .061$); the other MAIA subscales were n.s. ($ps > .31$). Regarding indirect paths, we observed a positive indirect effect of Trust via alexithymia on accuracy ($\beta = 0.081$, $SE = .040$, $p = .043$). In contrast, Not-Worrying ($b = -0.076$, $SE = .034$, $p = .024$) and Trust each showed negative indirect effects via IU ($\beta = -0.087$, $SE = .039$, $p = .027$).

Model 3b (emotion recognition – drift rate)

A similar exploratory approach was adopted here, as, among the 4 DDM parameters, only the drift rate for positive stimuli had a small correlation with the mediators. Thus, we built a model similar to model 3a with drift-pos as DV.

The model showed excellent fit ($\chi^2(5) = 5.23$, $p = .394$, CFI = .999, RMSEA = .019). Higher Attention Regulation ($\beta = .23$, $p = .023$) and IU ($\beta = .26$, $p = .023$) were significantly associated with increased drift rate, whereas higher Alexithymia ($\beta = -.22$, $p = .029$) and older age ($\beta = -.17$, $p = .047$) were associated with lower drift rate. Indirect effects indicated a

Model 2 – Personal Distress

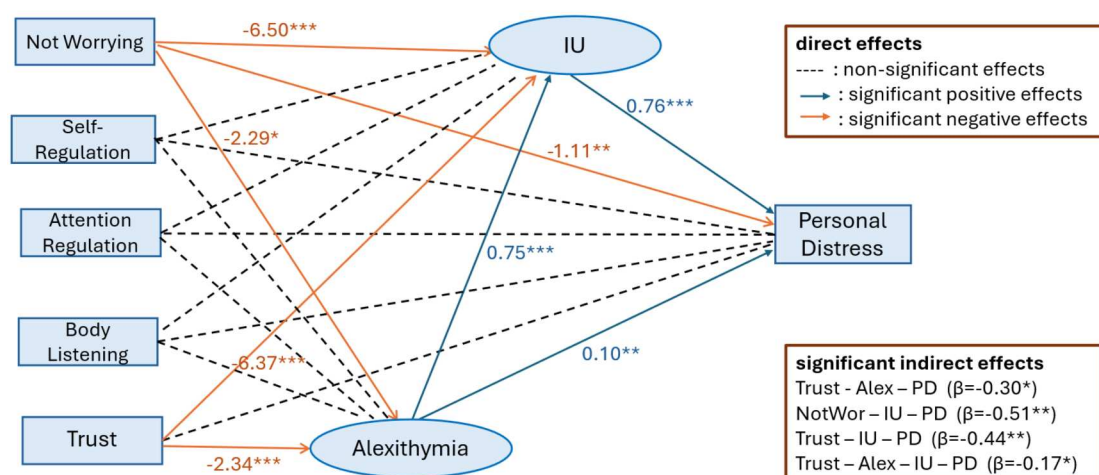


Figure 3. Path Analysis Results for Personal Distress Model 2. This figure presents the path analysis examining the direct and indirect effects on Personal Distress subscale of IRI. Model predictors are 5 dimensions of MAIA (Not-Worrying, Self-Regulation, Attention Regulation, Body Listening, Trust), Alexithymia and Intolerance of Uncertainty. The negative and positive direct and indirect effects are accompanied by regression coefficients (β), with asterisks denoting the significance level (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

small but significant negative indirect path via IU linking Not-Worrying to drift rate ($\beta = -.08$, $p = .046$), and a trend-level negative indirect path through IU for Trust ($\beta = -.09$, $p = .054$). Overall, the model explained 12.8% of variance in drift rate, suggesting that higher body-related attention regulation, higher uncertainty intolerance, and lower alexithymia were associated with more efficient evidence accumulation when identifying positive emotions.

Discussion

Interoceptive processing and bodily appraisal are key factors in the processing of affective information, related either to the self or others, and have been implicated in clinical conditions like anxiety (Quadt et al., 2018). This may be particularly important under uncertainty, when understanding one's bodily and affective responses may provide cues for dealing with ambiguity. However, given that interoceptive states themselves may often feel elusive and ambiguous, incorrect or insecure appraisal of bodily reactions can, in fact, be relevant to increased perceptions of uncertainty and anxiety-related feelings. Yet, few studies have examined how interoceptive and

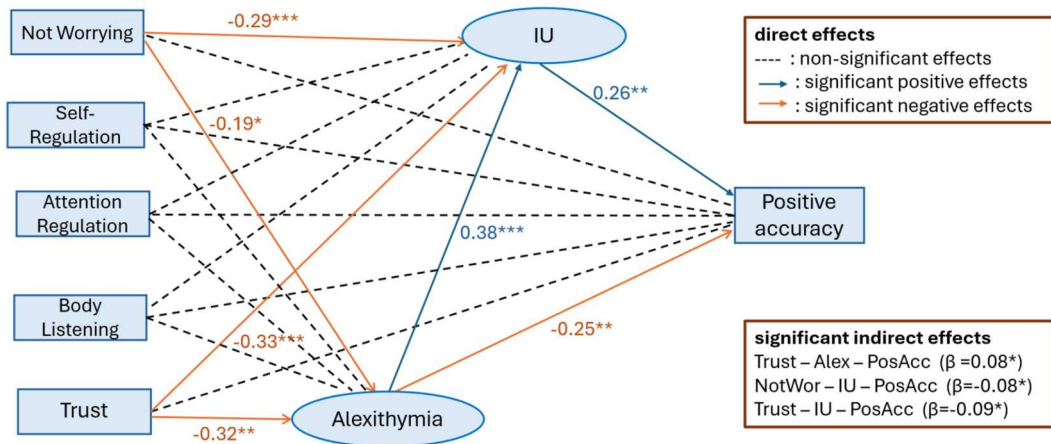
emotional processing are related to perceptions of, and attitudes towards, uncertain conditions.

The main aim of the present study was to examine how IU and alexithymia mediate the relationship between different facets of interoceptive sensibility and trait anxiety (Study 1) or social cognition (Study 2). Our findings expand previous studies associating different aspects of interoceptive processing with anxiety (e.g. Palser et al., 2018; Slotta et al., 2021) by revealing the mediating role of alexithymia and IU. Interestingly, we found that these two traits also accounted for indirect associations between interoception and socio-emotional outcomes, measured through self-reported measures of empathy and, to a lesser extent, the recognition of ambiguous facial expressions in a behavioural task. Although the broader pattern of associations was theory-guided, the specific MAIA dimensions entering each model were selected based on the observed correlation structure, and consequently the resulting subscale-specific patterns should be considered exploratory.

Anxiety

The observed subscale-level pattern was broadly consistent with previous studies using the MAIA

A Model 3a – Emotion recognition (positive accuracy)



B Model 3b – Emotion recognition (positive drift rate)

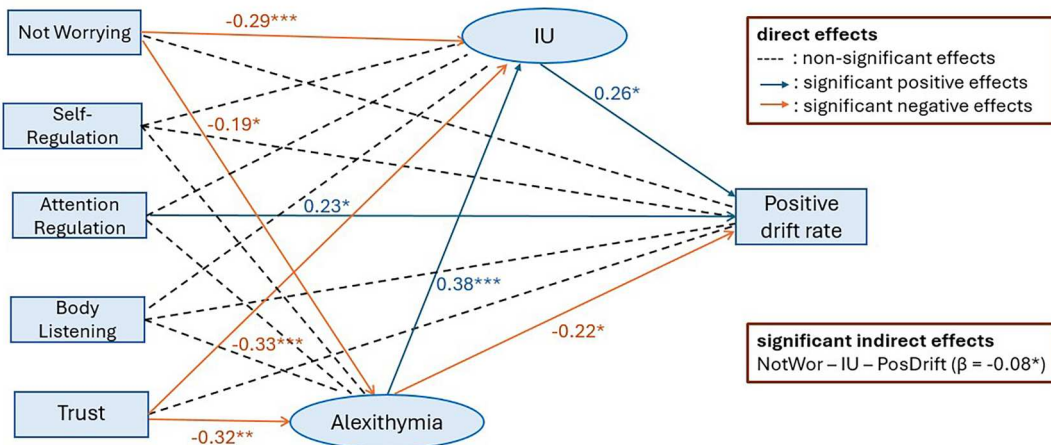


Figure 4. Path Analysis Results for the Emotion Recognition Models. (A) Path analysis examining the direct and indirect effects on emotion recognition accuracy for positive stimuli. (B) Path analysis examining the direct and indirect effects on the drift rate for positive stimuli. In both models, predictors included five dimensions of the MAIA (Not-Worrying, Attention Regulation, Emotional Awareness, Body Listening, and Trust), Alexithymia, and Intolerance of Uncertainty. Positive and negative standardised regression coefficients (β) are displayed along each path, with asterisks denoting significance levels (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

questionnaire to probe the link between adaptive processing of interoceptive sensations and anxiety (Lee et al., 2024; Paulus & Stein, 2010; Slotka et al., 2021). Here, we found that the MAIA dimensions reflecting less worrying and more trust in bodily

sensations, as well as the ability to regulate emotions via intentional attention to the body, are associated with reduced anxiety. Conversely, greater noticing of bodily sensations and greater reported awareness of body–emotion relations were associated with higher

anxiety levels. Although the specific subscale-level pattern was data-informed and should therefore be considered exploratory, it was broadly consistent with our expectation that anxiety would show stronger and more consistent associations with dimensions concerning the appraisal and regulation of bodily sensations than with bodily awareness alone. The associations involving bodily trust and regulatory dimensions also broadly converge with previous MAIA-based findings, while the positive association with awareness-oriented dimensions is consistent with evidence that greater bodily noticing is not necessarily associated with lower anxiety (Lee et al., 2024; Slotta et al., 2021). These findings highlight the importance of aspects of interoceptive processing beyond bodily awareness, particularly the appraisal and regulation of bodily sensations, in relation to anxiety. While increased perception of bodily signals, especially in negative contexts, can enhance anxiety-related sensations (Paulus & Stein, 2010) – possibly due to maladaptive focus and interpretations of bodily signals – being able to attend to, and experience, one's body as safe and trustworthy can help reduce the ambiguity inherent in many affective and social situations and promote a coherent understanding of one's affective responses.

This idea is supported by the observed roles of IU and alexithymia in the mediation between interoceptive processing and anxiety. Firstly, across both studies, we demonstrate that individuals reporting higher trait anxiety also tend to exhibit lower emotional awareness and tolerance of uncertainty. Our results also confirm and extend previous findings, using different measures of interoception, showing that alexithymia mediates the relationship between interoceptive processing and anxiety (Palser et al., 2018). Specifically, an indirect association between trust in bodily sensations and anxiety was observed through alexithymia, suggesting that difficulties in experiencing one's body as trustworthy might form part of a broader pattern linking difficulties in understanding one's emotions with greater anxiety.

Regarding IU, our findings are largely in line with a recent study examining the moderating role of IU in the relationship between MAIA dimensions and body dissatisfaction (Bijsterbosch et al., 2023). In particular, while initial results showed several MAIA subscales to be correlated with both IU and anxiety, the path analysis model revealed that IU statistically mediated the relationship between anxiety and the

dimensions Not-Worrying and Trust. The Not Worrying subscale assesses aversive emotional reactions to detected bodily signals because of their negative interpretation, while the Trust subscale assesses the meta-awareness of bodily feelings, specifically, the sense of trust in one's body (Mehling et al., 2018). It is thus easy to consider how these may resonate with IU which is characterised by negative interpretations of the unknown and feelings of worry about the future (Carleton, 2016). Individuals with high IU may also worry excessively about ambiguous bodily sensations, interpreting them as signs of potential threats or health issues, which can in turn fuel feelings of anxiety. This aligns with recent accounts framing IU as emerging from interoceptive "somatic errors," whereby ambiguous bodily signals are experienced as unsafe and thus amplify distress (Freeston & Komes, 2023). Therefore, our findings highlight specific affective and likely metacognitive paths by which IU and alexithymia mediate facets of interoceptive processing associated with trait anxiety.

Recent studies have implicated both IU and alexithymia in a range of body-related clinical conditions or symptoms, suggesting that these constructs may play a key role in the development or maintenance of a variety of conditions. For example, IU and alexithymia were associated with somatic symptoms in autistic and neurotypical individuals (Larkin et al., 2023), body dissatisfaction (Bijsterbosch et al., 2023), anorexia nervosa (Abbate-Daga et al., 2015) and externalizing and internalizing behaviour in autism (Ozsi-vadjian et al., 2021). Our findings expand on this by highlighting the joint involvement of alexithymia and IU in the indirect association between Trust and anxiety through the serial alexithymia–IU pathway. Individuals with alexithymia may struggle with IU because difficulties identifying and expressing emotions can make uncertainty harder to tolerate. This may create a feedback loop in which reduced emotional clarity and lower bodily trust heighten anxiety in ambiguous situations.

Affective empathy

The second objective was to examine how different aspects of interoceptive processing affect social skills through feelings about uncertainty and emotional awareness. For that, we first explored how these traits are linked to the affective dimensions of empathy measured through the EC and PD scales of the IRI. Zero-order correlations showed that EC correlated with some MAIA subscales (Noticing, Not

Distracting, Emotional Awareness) but it did not correlate with either IU or alexithymia scores, and therefore was not included in the path analysis. Conversely, PD showed moderate-to-high positive correlations with IU, Alexithymia and negative correlations with several MAIA subscales (Not-Worrying, Self-Regulation, Emotional Awareness, Body Listening, Trust). However, when modelling all predictors together in the path analyses, only the Not-Worrying subscale was a significant direct predictor of PD. These findings are in line with a previous study regarding the direction and magnitude of the relationships between EC/PD and MAIA subscales (Stoica & Depue, 2020). Additionally, this exploratory pattern at the subscale level also broadly mirrored the anxiety models, with appraisal-related dimensions, particularly Not-Worrying and Trust, again more consistently implicated in direct and/or indirect associations than awareness-oriented dimensions. It should be noted that EC, which refers to feelings of compassion and concern for others, contrasts with PD, which involves feelings of anxiety and discomfort in response to others' distress. Our results thus suggest that IU and Alexithymia are more related to (negative) self-focused emotional reactions than other-oriented responses to others' distress.

We also found that IU and alexithymia statistically mediated, separately and serially, the association between facets of interoceptive sensibility and PD. Specifically, IU accounted for the relationships between the MAIA dimensions of Not-Worrying and Trust and PD. In fact, IU and alexithymia were found to fully mediate the association between Trust and PD, as Trust did not directly predict PD in the path model. Lower trust in bodily responses may be particularly relevant to feelings of distress in empathic situations among individuals who are more averse to uncertainty or have greater difficulty identifying their own emotions. It is worth noting the high consistency across Studies 1 and 2: both PD and trait anxiety were negatively associated with Not-Worrying and Trust, and in both studies alexithymia and IU showed similar mediating roles in these relationships. This is not surprising as PD refers to feelings of discomfort, and likely anxiety, in response to others' suffering and has been shown to be heightened in people with high trait anxiety (Nair et al., 2024). Individuals who have difficulties in identifying their feelings and worry about bodily sensations tend to experience more anxiety in social interactions and empathic personal distress (Cosmoiu & Nedelcea,

2022). IU could mediate this relationship, as high IU could exacerbate worry and difficulty in understanding and managing bodily sensations and, in turn, further fuel feelings of discomfort and incompetence when managing others' distressing emotions.

Emotion recognition

The two exploratory models predicting the perception of ambiguous facial expressions, either based on accuracy or the DDM's drift rate, revealed a similar, but noticeably weaker, pattern of factors involved. Firstly, we did not find any MAIA dimension showing a significant association with emotion recognition performance as reported in a previous study using the MAIA and dynamic emotional facial expressions (Hübner et al., 2021). On the other hand, the association between higher alexithymia and lower emotion-recognition performance is consistent with previous findings linking difficulties identifying and understanding one's own emotions with lower social-cognitive and emotion-recognition performance (Cook et al., 2013; Di Tella et al., 2020; Sunahara et al., 2022). Interestingly, Attention Regulation (reflecting adaptive control of attention directed toward internal bodily signals) was also positively associated with the drift rate for happy stimuli, suggesting that individuals who can flexibly adjust attentional focus may process positive social cues more efficiently. Contrary to expectations, individuals with higher IU showed better accuracy and better efficiency in processing happy, but not negative, facial expressions. That is, given its relationship with anxiety and negative affect, it could be reasonable to expect enhanced vigilance and sensitivity towards threat-signalling stimuli in individuals with high IU, but instead we found facilitated identification of happy expressions. There was, however, no bias towards positive expressions (as indexed by the respective DDM parameter, see Supplementary Material S2) that could reflect a tendency to identify or prefer happy emotions. Instead, this pattern may reflect the involvement of distinct perceptual processes beyond preference or avoidance.

To the best of our knowledge, only one study to date has examined the association between IU and emotion recognition ability and found no correlation between the two (Monferrer et al., 2023). There are, however, several studies suggesting better emotion recognition in people with anxiety-related disorders, at least, under specific conditions. Most often, anxiety is related to enhanced processing of threat-

related emotions (e.g. Lazarov et al., 2016; Surcinelli et al., 2006), while several studies have also found greater emotion recognition ability irrespective of emotional valence (e.g. Bui et al., 2017; Kolassa et al., 2009). For example, Bui et al. (2017) found enhanced detection of emotional expressions in individuals with generalised anxiety disorder, compared to social anxiety and controls. Another study found stronger responses in the visual cortex in individuals with higher social anxiety irrespective of stimulus emotional valence (Kolassa et al., 2009). It may be that the hypervigilance that characterises anxiety, and IU, and is typically related only to stimuli with negative valence, could actually reflect generally increased attention towards social stimuli, possibly to resolve ambiguity and/or avoid threat. In support of this, IU has been associated with attentional processes, suggesting a more active alerting system, to help deal with ambiguity and uncertainty (Fergus & Carleton, 2016). Attention, in turn, has been shown to enhance evidence accumulation and increase drift rate (Nunez et al., 2017). Interestingly, a recent study using diffusion modelling to examine the influence of social anxiety disorder on decision-making in a probabilistic reward task with social feedback found faster accumulation of information for individuals with higher social anxiety, as reflected by the drift rate parameter (Dillon et al., 2022).

Another possible explanation could be related to the known advantage in the recognition of happy expressions (Nummenmaa & Calvo, 2015), which are believed to have particularly distinctive features, making them less ambiguous than other facial expressions, such as anger and fear (Du & Martinez, 2011; Johnston et al., 2003). Thus, IU-related differences in emotion recognition may reflect stimulus ambiguity rather than threat value, although this interpretation remains tentative. Interestingly, we found that IU mediated the positive associations between the interoceptive dimensions of Trust and Not-Worrying and the outcome variables accuracy and drift rate for happy expressions. This could mean that the advantage conferred by these interoceptive styles on emotion recognition (of happy expressions) could be partially dependent on how the individuals deal with uncertainty. However, we note that these interpretations of the associations between IU and emotion recognition are mostly speculative, requiring future follow-up studies to shed further light on this.

Notably, our predictors were not significantly associated with any other DDM parameters. We could expect, for example, that individuals with high IU would show more cautious behaviour and need to accumulate a larger amount of evidence to make a perceptual decision, which would be reflected in larger parameter values of boundary separation (a). Previous research has indicated more risk-averse behaviour (e.g. higher *avoidance*) in individuals with increased IU in several tasks involving decision-making under uncertainty (Carleton et al., 2016; Thibodeau et al., 2013). However, several other studies failed to demonstrate this link (Carleton et al., 2016; Jacoby et al., 2014), suggesting that this relationship may depend on the task being used and affective context (Anderson et al., 2019).

Limitations and future steps

There are several limitations in this study. First, the sample consisted primarily of undergraduate female students, limiting generalisability. Relatedly, the emotion-recognition task used only male face models. Although this reduced stimulus heterogeneity and maintained consistency with the adapted task, future work should include more diverse samples and both male and female face stimuli to test whether participant-stimulus gender combinations influence ambiguous emotion recognition and its associations with IU.

Additionally, although the questionnaire-based path models had sample sizes broadly consistent with mediation-specific recommendations for detecting indirect effects with at least half-medium component paths, they were not designed to provide high power for indirect effects involving small component paths. Fritz and MacKinnon (2007) indicate that samples of approximately 115–162 participants are sufficient for indirect effects with half-medium to medium component paths, whereas substantially larger samples are required when one or both component paths are small. Thus, the Study 1 anxiety model ($N=190$) and the Study 2 anxiety and personal-distress models ($N=154$) were sufficiently powered for the main moderate indirect associations observed. Power was more limited for the exploratory emotion-recognition/DDM models ($N=124$), where the observed associations were weaker and the analyses were not the primary basis for sample-size planning. Future studies should use model-specific Monte Carlo power analyses for similarly complex indirect-path models (Schoemann et al., 2017).

Third, the number of trials was adequate for DDM estimation but at the lower end for reliable drift-rate estimation (Lerche et al., 2017). We used MLE, which is suitable for relatively low trial numbers and produced convergent fits for all included participants. To support participant-level estimation, we modelled a broad positive-versus-negative categorisation and collapsed anger- and fear-dominant trials into a negative-emotion category. This improves estimation but limits interpretation, as anger and fear differ in social meaning and differed descriptively in accuracy (Supplementary Material S4). The emotion-recognition findings should therefore be interpreted as valence-based categorisation under ambiguity rather than anger- or fear-specific recognition.

A further limitation concerns the interpretation of the path models. The cross-sectional design prevents conclusions about causal or temporal mediation. The indirect effects should therefore be interpreted as theory-driven indirect associations, and alternative models remain possible, including reciprocal relations or moderation by IU. In addition, although the overall path structure and broader theoretical expectations were theory-driven, the inclusion of specific MAIA subscales was informed by zero-order associations. Accordingly, the resulting subscale-specific direct and indirect associations should be considered exploratory and may be sample-specific. This helped specify interpretable models for the available sample size, but the specific indirect paths should be tested in larger, preregistered samples using fully prespecified MAIA dimensions, alternative observed-variable or latent-variable SEM specifications.

While our exploratory analyses showed significant effects of IU in the emotion recognition task, the correlations and regression coefficients observed were considerably smaller than those observed for the outcome measures based on self-report and should, therefore, be interpreted with caution. This may be related to the somewhat limited statistical power mentioned above and/or to methodological limitations. Future studies could improve the power and scope of these effects by increasing the number of trials and promoting stronger affective engagement by, for example, creating a social environment where decisions have emotional implications. Such modifications could increase the importance of risk and uncertainty calculations associated with IU characteristics. In addition, DDM analyses of a wider range of specific positive and negative emotions could elucidate emotion processing differences

related to IU. Lastly, future studies should also include a non-social perceptual decision-making task to demonstrate the specificity of IU effects on social perception.

Conclusion

This study demonstrated for the first time different ways in which IU and interoceptive sensibility are implicated in anxiety and social cognition. Specifically, we showed that IU, along with alexithymia, was involved in indirect associations linking specific facets of interoceptive sensibility to anxiety and socio-emotional outcomes, particularly those related to personal distress. We also found that IU was directly associated with personal distress and, more tentatively, with indices of emotion recognition. Notably, to the best of our knowledge, this study is the first to use diffusion modelling to examine associations between IU and ambiguous emotion recognition, with exploratory findings suggesting that higher IU may be linked to more efficient processing of positive emotional expressions. By examining the interplay between interoceptive sensibility, alexithymia, and IU, our findings point to potential pathways through which bodily appraisal, emotional awareness, and uncertainty sensitivity may relate to emotional well-being and social functioning. These pathways may also inform future intervention research targeting uncertainty tolerance, emotional awareness, and more flexible or trusting forms of bodily appraisal, although experimental and longitudinal work is needed before drawing causal or clinical conclusions. Future research involving larger and more representative samples, preregistered analytic plans, and improved emotion recognition task designs, would further elucidate how IU relates to social perception and decision-making under uncertainty.

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Author contribution statement

VK and RA designed the study. VK and RA conducted testing and data collection. VK and RA analysed the

data. VK and RA wrote the manuscript. Both authors approved the final version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

All data and analysis code are available at the following anonymized OSF link: OSF repository. The repository includes figures, raw and processed datasets, scripts for DDM statistical analyses as well as supplementary materials. Further materials and clarifications are available from the corresponding author upon reasonable request.

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References

- Abbate-Daga, G., Quaranta, M., Marzola, E., Amianto, F., & Fassino, S. (2015). The relationship between alexithymia and intolerance of uncertainty in anorexia nervosa. *Psychopathology*, 48(3), 202–208. <https://doi.org/10.1159/000381587>
- Adams, K. L., Edwards, A., Peart, C., Ellett, L., Mendes, I., Bird, G., & Murphy, J. (2022). The association between anxiety and cardiac interoceptive accuracy: A systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews*, 140, 104754. <https://doi.org/10.1016/j.neubiorev.2022.104754>
- Ainley, V., Maister, L., & Tsakiris, M. (2015). Heartfelt empathy? No association between interoceptive awareness, questionnaire measures of empathy, Reading the mind in the eyes task or the director task. *Frontiers in Psychology*, 6, 554. <https://doi.org/10.3389/fpsyg.2015.00554>
- Anderson, E. C., Carleton, R. N., Diefenbach, M., & Han, P. K. (2019). The relationship between uncertainty and affect. *Frontiers in Psychology*, 10, 2504. <https://doi.org/10.3389/fpsyg.2019.02504>
- Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The twenty-item Toronto alexithymia scale—I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research*, 38(1), 23–32. [https://doi.org/10.1016/0022-3999\(94\)90005-1](https://doi.org/10.1016/0022-3999(94)90005-1)
- Berardis, D. D., Campanella, D., Nicola, S., Gianna, S., Alessandro, C., Chiara, C., Valchera, A., Marilde, C., Salerno, R., & Ferro, F. M. (2008). The impact of alexithymia on anxiety disorders: A review of the literature. *Current Psychiatry Reviews*, 4(2), 80–86. <https://doi.org/10.2174/157340008784529287>
- Bijsterbosch, J. M., Hasenack, B., van Rooijen, B., Sternheim, L. C., Boelen, P. A., Dijkerman, H. C., & Keizer, A. (2023). Intolerable feelings of uncertainty within the body: Associations between interoceptive awareness, intolerance of uncertainty, and body dissatisfaction. *Journal of Adolescence*, 95(8), 1678–1688. <https://doi.org/10.1002/jad.12237>
- Boelen, P. A., & Reijntjes, A. (2009). Intolerance of uncertainty and social anxiety. *Journal of Anxiety Disorders*, 23(1), 130–135. <https://doi.org/10.1016/j.janxdis.2008.04.007>
- Brennan, G. M., & Baskin-Sommers, A. R. (2020). Aggressive realism: More efficient processing of anger in physically aggressive individuals. *Psychological Science*, 31(5), 568–581. <https://doi.org/10.1177/0956797620904157>
- Bui, E., Anderson, E., Goetter, E. M., Campbell, A. A., Fischer, L. E., Barrett, L. F., & Simon, N. M. (2017). Heightened sensitivity to emotional expressions in generalised anxiety disorder, compared to social anxiety disorder, and controls. *Cognition and Emotion*, 31(1), 119–126. <https://doi.org/10.1080/02699931.2015.1087973>
- Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: Theoretical and practical perspectives. *Expert Review of Neurotherapeutics*, 12(8), 937–947. <https://doi.org/10.1586/ern.12.82>
- Carleton, R. N. (2016). Into the unknown: A review and synthesis of contemporary models involving uncertainty. *Journal of Anxiety Disorders*, 39, 30–43. <https://doi.org/10.1016/j.janxdis.2016.02.007>
- Carleton, R. N., Collimore, K. C., & Asmundson, G. J. (2010). It's not just the judgements—it's that I don't know": Intolerance of uncertainty as a predictor of social anxiety. *Journal of Anxiety Disorders*, 24(2), 189–195. <https://doi.org/10.1016/j.janxdis.2009.10.007>
- Carleton, R. N., Durand, S., Shulman, E. P., Zerff, M., Gonzales, J., & Mishra, S. (2016). Self-reported intolerance of uncertainty and behavioural decisions. *Journal of Behavior Therapy and Experimental Psychiatry*, 51, 58–65. <https://doi.org/10.1016/j.jbtep.2015.12.004>
- Carleton, R. N., Fetzner, M. G., Hackl, J. L., & McEvoy, P. (2013). Intolerance of uncertainty as a contributor to fear and avoidance symptoms of panic attacks. *Cognitive Behaviour Therapy*, 42(4), 328–341. <https://doi.org/10.1080/16506073.2013.792100>
- Conley, M. I., Dellarco, D. V., Rubien-Thomas, E., Cohen, A. O., Cervera, A., Tottenham, N., & Casey, B. J. (2018). The racially diverse affective expression (RADIATE) face stimulus set. *Psychiatry Research*, 270, 1059–1067. <https://doi.org/10.1016/j.psychres.2018.04.066>
- Cook, R., Brewer, R., Shah, P., & Bird, G. (2013). Alexithymia, not autism, predicts poor recognition of emotional facial expressions. *Psychological Science*, 24(5), 723–732. <https://doi.org/10.1177/0956797612463582>
- Cosmou, A., & Nedelcea, C. (2022). Factors impacting the experience of empathic distress in social anxiety: A path analysis approach. *The Journal of Social Psychology*, 162(1), 57–70. <https://doi.org/10.1080/00224545.2021.2003284>
- Craig, A. D. (2003). Interoception: The sense of the physiological condition of the body. *Current Opinion in Neurobiology*, 13(4), 500–505. [https://doi.org/10.1016/S0959-4388\(03\)00090-4](https://doi.org/10.1016/S0959-4388(03)00090-4)
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44(1), 113–126. <https://doi.org/10.1037/0022-3514.44.1.113>
- De Berardis, D., Campanella, D., Gambi, F., La Rovere, R., Sepede, G., Core, L., Canfora, G., Santilli, E., Valchera, A., Mancini, E.,

- Salerno, R. M., Moschetta, F. S., & Ferro, F. M. (2007). Alexithymia, fear of bodily sensations, and somatosensory amplification in young outpatients with panic disorder. *Psychosomatics*, 48(3), 239–246. <https://doi.org/10.1176/appi.psy.48.3.239>
- Deng, L., Yang, M., & Marcoulides, K. M. (2018). Structural equation modeling with many variables: A systematic review of issues and developments. *Frontiers in Psychology*, 9, 580. <https://doi.org/10.3389/fpsyg.2018.00580>
- Dietel, F. A., Möllmann, A., Bürkner, P. C., Wilhelm, S., & Buhlmann, U. (2021). Interpretation bias across body dysmorphic, social anxiety and generalized anxiety disorder—A multilevel, diffusion model account. *Cognitive Therapy and Research*, 45(4), 715–729. <https://doi.org/10.1007/s10608-020-10180-7>
- Dillon, D. G., Lazarov, A., Dolan, S., Bar-Haim, Y., Pizzagalli, D. A., & Schneier, F. R. (2022). Fast evidence accumulation in social anxiety disorder enhances decision making in a probabilistic reward task. *Emotion*, 22(1), 1–18. <https://doi.org/10.1037/emo0001053>
- Di Tella, M., Adenzato, M., Catmur, C., Miti, F., Castelli, L., & Ardito, R. B. (2020). The role of alexithymia in social cognition: Evidence from a non-clinical population. *Journal of Affective Disorders*, 273, 482–492. <https://doi.org/10.1016/j.jad.2020.05.012>
- Domschke, K., Stevens, S., Pfleiderer, B., & Gerlach, A. L. (2010). Interoceptive sensitivity in anxiety and anxiety disorders: An overview and integration of neurobiological findings. *Clinical Psychology Review*, 30(1), 1–11. <https://doi.org/10.1016/j.cpr.2009.08.008>
- Du, S., & Martinez, A. M. (2011). The resolution of facial expressions of emotion. *Journal of Vision*, 11(13), 24–24. <https://doi.org/10.1167/11.13.24>
- Fergus, T. A., & Bardeen, J. R. (2013). Anxiety sensitivity and intolerance of uncertainty: Evidence of incremental specificity in relation to health anxiety. *Personality and Individual Differences*, 55(6), 640–644. <https://doi.org/10.1016/j.paid.2013.05.016>
- Fergus, T. A., & Carleton, R. N. (2016). Intolerance of uncertainty and attentional networks: Unique associations with alerting. *Journal of Anxiety Disorders*, 41, 59–64. <https://doi.org/10.1016/j.janxdis.2016.03.010>
- Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? *Personality and Individual Differences*, 17(6), 791–802. [https://doi.org/10.1016/0191-8869\(94\)90048-5](https://doi.org/10.1016/0191-8869(94)90048-5)
- Freeston, M., & Komes, J. (2023). Revisiting uncertainty as a felt sense of unsafety: The somatic error theory of intolerance of uncertainty. *Journal of Behavior Therapy and Experimental Psychiatry*, 79, 101827. <https://doi.org/10.1016/j.jbtep.2022.101827>
- Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science*, 18(3), 233–239. <https://doi.org/10.1111/j.1467-9280.2007.01882.x>
- Garfinkel, S. N., Seth, A. K., Barrett, A. B., Suzuki, K., & Critchley, H. D. (2015). Knowing your own heart: Distinguishing interoceptive accuracy from interoceptive awareness. *Biological Psychology*, 104, 65–74. <https://doi.org/10.1016/j.biopsycho.2014.11.004>
- Grynberg, D., & Pollatos, O. (2015). Perceiving one's body shapes empathy. *Physiology & Behavior*, 140, 54–60. <https://doi.org/10.1016/j.physbeh.2014.12.026>
- Gu, Y., Gu, S., Lei, Y., & Li, H. (2020). From uncertainty to anxiety: How uncertainty fuels anxiety in a process mediated by intolerance of uncertainty. *Neural Plasticity*, 2020(1), 1–8. <https://doi.org/10.1155/2020/8866386>
- Hübner, A. M., Trempler, I., Gietmann, C., & Schubotz, R. I. (2021). Interoceptive sensibility predicts the ability to infer others' emotional states. *PLoS One*, 16(10), e0258089. <https://doi.org/10.1371/journal.pone.0258089>
- Jacoby, R. J., Abramowitz, J. S., Buck, B. E., & Fabricant, L. E. (2014). How is the beads task related to intolerance of uncertainty in anxiety disorders? *Journal of Anxiety Disorders*, 28(6), 495–503. <https://doi.org/10.1016/j.janxdis.2014.05.005>
- Johnston, P. J., McCabe, K., & Schall, U. (2003). Differential susceptibility to performance degradation across categories of facial emotion—a model confirmation. *Biological Psychology*, 63(1), 45–58. [https://doi.org/10.1016/S0301-0511\(03\)00026-7](https://doi.org/10.1016/S0301-0511(03)00026-7)
- Karukivi, M., Hautala, L., Kaleva, O., Haapasalo-Pesu, K. M., Liuksila, P. R., Joukamaa, M., & Saarijärvi, S. (2010). Alexithymia is associated with anxiety among adolescents. *Journal of Affective Disorders*, 125(1–3), 383–387. <https://doi.org/10.1016/j.jad.2010.02.126>
- Kolassa, I. T., Kolassa, S., Bergmann, S., Lauche, R., Dilger, S., Miltner, W. H., & Musial, F. (2009). Interpretive bias in social phobia: An ERP study with morphed emotional schematic faces. *Cognition and Emotion*, 23(1), 69–95. <https://doi.org/10.1080/02699930801940461>
- Lamba, A., Frank, M. J., & FeldmanHall, O. (2020). Anxiety impedes adaptive social learning under uncertainty. *Psychological Science*, 31(5), 592–603. <https://doi.org/10.1177/0956797620910993>
- Larkin, F., Ralston, B., Dinsdale, S. J., Kimura, S., & Hayiou-Thomas, M. E. (2023). Alexithymia and intolerance of uncertainty predict somatic symptoms in autistic and non-autistic adults. *Autism*, 27(3), 602–615. <https://doi.org/10.1177/13623613221109717>
- Lazarov, A., Abend, R., & Bar-Haim, Y. (2016). Social anxiety is related to increased dwell time on socially threatening faces. *Journal of Affective Disorders*, 193, 282–288. <https://doi.org/10.1016/j.jad.2016.01.007>
- Lee, S. J., Lee, M., Kim, H. B., & Huh, H. J. (2024). The relationship between interoceptive awareness, emotion regulation and clinical symptoms severity of depression, anxiety and somatization. *Psychiatry Investigation*, 21(3), 255–264. <https://doi.org/10.30773/pi.2023.0221>
- Lerche, V., Voss, A., & Nagler, M. (2017). How many trials are required for parameter estimation in diffusion modeling? A comparison of different optimization criteria. *Behavior Research Methods*, 49(2), 513–537. <https://doi.org/10.3758/s13428-016-0740-2>
- Maisel, M. E., Stephenson, K. G., South, M., Rodgers, J., Freeston, M. H., & Gaigg, S. B. (2016). Modeling the cognitive mechanisms linking autism symptoms and anxiety in adults. *Journal of Abnormal Psychology*, 125(5), 692–703. <https://doi.org/10.1037/abn0000168>
- Mehling, W. E., Acree, M., Stewart, A., Silas, J., & Jones, A. (2018). The multidimensional assessment of interoceptive awareness, version 2 (MAIA-2). *PLoS One*, 13(12), e0208034. <https://doi.org/10.1371/journal.pone.0208034>

- Monferrer, M., García, A. S., Ricarte, J. J., Montes, M. J., Fernández-Caballero, A., & Fernández-Sotos, P. (2023). Facial emotion recognition in patients with depression compared to healthy controls when using human avatars. *Scientific Reports*, 13(1), 6007. <https://doi.org/10.1038/s41598-023-31277-5>
- Myers, C. E., Interian, A., & Moustafa, A. A. (2022). A practical introduction to using the drift diffusion model of decision-making in cognitive psychology, neuroscience, and health sciences. *Frontiers in Psychology*, 13, 1039172. <https://doi.org/10.3389/fpsyg.2022.1039172>
- Nair, T. K., Waslin, S. M., Rodrigues, G. A., Datta, S., Moore, M. T., & Brumariu, L. E. (2024). A meta-analytic review of the relations between anxiety and empathy. *Journal of Anxiety Disorders*, 101, 102795. <https://doi.org/10.1016/j.janxdis.2023.102795>
- Nummenmaa, L., & Calvo, M. G. (2015). Dissociation between recognition and detection advantage for facial expressions: A meta-analysis. *Emotion*, 15(2), 243–256. <https://doi.org/10.1037/emo0000042>
- Nunez, M. D., Vandekerckhove, J., & Srinivasan, R. (2017). How attention influences perceptual decision making: Single-trial EEG correlates of drift-diffusion model parameters. *Journal of Mathematical Psychology*, 76, 117–130. <https://doi.org/10.1016/j.jmp.2016.03.003>
- Olatunji, B. O., Deacon, B. J., Abramowitz, J. S., & Valentiner, D. P. (2007). Body vigilance in nonclinical and anxiety disorder samples: Structure, correlates, and prediction of health concerns. *Behavior Therapy*, 38(4), 392–401. <https://doi.org/10.1016/j.beth.2006.09.002>
- Ozsivadjian, A., Hollocks, M. J., Magiati, I., Happé, F., Baird, G., & Absoud, M. (2021). Is cognitive inflexibility a missing link? The role of cognitive inflexibility, alexithymia and intolerance of uncertainty in externalising and internalising behaviours in young people with autism spectrum disorder. *Journal of Child Psychology and Psychiatry*, 62(6), 715–724. <https://doi.org/10.1111/jcpp.13295>
- Palser, E. R., Palmer, C. E., Galvez-Pol, A., Hannah, R., Fotopoulou, A., & Kilner, J. M. (2018). Alexithymia mediates the relationship between interoceptive sensibility and anxiety. *PLoS One*, 13(9), e0203212. <https://doi.org/10.1371/journal.pone.0203212>
- Paulus, M. P., & Stein, M. B. (2010). Interoception in anxiety and depression. *Brain Structure and Function*, 214(5–6), 451–463. <https://doi.org/10.1007/s00429-010-0258-9>
- Pollatos, O., Traut-Mattausch, E., Schroeder, H., & Schandry, R. (2007). Interoceptive awareness mediates the relationship between anxiety and the intensity of unpleasant feelings. *Journal of Anxiety Disorders*, 21(7), 931–943. <https://doi.org/10.1016/j.janxdis.2006.12.004>
- Quadt, L., Critchley, H. D., & Garfinkel, S. N. (2018). The neurobiology of interoception in health and disease. *Annals of the New York Academy of Sciences*, 1428(1), 112–128. <https://doi.org/10.1111/nyas.13915>
- Ratcliff, R., & McKoon, G. (2008). The diffusion decision model: Theory and data for two-choice decision tasks. *Neural Computation*, 20(4), 873–922. <https://doi.org/10.1162/neco.2008.12.06.420>
- Rossee, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48(2), 1–36. <https://doi.org/10.18637/jss.v048.i02>
- Sahib, A., Chen, J., Cárdenas, D., & Calear, A. L. (2023). Intolerance of uncertainty and emotion regulation: A meta-analytic and systematic review. *Clinical Psychology Review*, 101, 102270. <https://doi.org/10.1016/j.cpr.2023.102270>
- Schoemann, A. M., Boulton, A. J., & Short, S. D. (2017). Determining power and sample size for simple and complex mediation models. *Social Psychological and Personality Science*, 8(4), 379–386. <https://doi.org/10.1177/1948550617715068>
- Shah, P., Catmur, C., & Bird, G. (2017). From heart to mind: Linking interoception, emotion, and theory of mind. *Cortex*, 93, 220–223. <https://doi.org/10.1016/j.cortex.2017.02.010>
- Shi, D., DiStefano, C., Maydeu-Olivares, A., & Lee, T. (2022). Evaluating SEM model fit with small degrees of freedom. *Multivariate Behavioral Research*, 57(2–3), 179–207. <https://doi.org/10.1080/00273171.2020.1868965>
- Slotta, T., Witthöft, M., Gerlach, A. L., & Pohl, A. (2021). The interplay of interoceptive accuracy, facets of interoceptive sensibility, and trait anxiety: A network analysis. *Personality and Individual Differences*, 183, 111133. <https://doi.org/10.1016/j.paid.2021.111133>
- Spielberger, C. D., Gorsuch, R. L., Lushene, R. E., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Consulting Psychologists Press.
- Stoica, T., & Depue, B. (2020). Shared characteristics of intrinsic connectivity networks underlying interoceptive awareness and empathy. *Frontiers in Human Neuroscience*, 14(14), 524. <https://doi.org/10.3389/fnhum.2020.571070>
- Sunahara, C. S., Rosenfield, D., Alvi, T., Wallmark, Z., Lee, J., Fulford, D., & Tabak, B. A. (2022). Revisiting the association between self-reported empathy and behavioral assessments of social cognition. *Journal of Experimental Psychology: General*, 151(12), 3304–3322. <https://doi.org/10.1037/xge0001226>
- Surcinelli, P., Codispoti, M., Montebanacci, O., Rossi, N., & Baldaro, B. (2006). Facial emotion recognition in trait anxiety. *Journal of Anxiety Disorders*, 20(1), 110–117. <https://doi.org/10.1016/j.janxdis.2004.11.010>
- Taylor, G. J. (2000). Recent developments in alexithymia theory and research. *The Canadian Journal of Psychiatry*, 45(2), 134–142. <https://doi.org/10.1177/070674370004500203>
- Thibodeau, M. A., Carleton, R. N., Gómez-Pérez, L., & Asmundson, G. J. (2013). ‘What if I make a mistake?; Intolerance of uncertainty is associated with poor behavioral performance. *The Journal of Nervous and Mental Disease*, 201(9), 760–766. <https://doi.org/10.1097/NMD.0b013e3182a21298>
- Wabersich, D., & Vandekerckhove, J. (2014). The RWiener package: An R package providing distribution functions for the wiener diffusion model. *R Journal*, 6(1), 49. <https://doi.org/10.32614/RJ-2014-005>
- White, C. N., Ratcliff, R., Vasey, M. W., & McKoon, G. (2010). Using diffusion models to understand clinical disorders. *Journal of Mathematical Psychology*, 54(1), 39–52. <https://doi.org/10.1016/j.jmp.2010.01.004>
- Wright, K. D., Lebell, M. A. A., & Carleton, R. N. (2016). Intolerance of uncertainty, anxiety sensitivity, health anxiety, and anxiety disorder symptoms in youth. *Journal of Anxiety Disorders*, 41, 35–42. <https://doi.org/10.1016/j.janxdis.2016.04.011>
- Zamariola, G., Frost, N., Van Oost, A., Corneille, O., & Luminet, O. (2019). Relationship between interoception and emotion regulation: New evidence from mixed methods. *Journal of Affective Disorders*, 246, 480–485. <https://doi.org/10.1016/j.jad.2018.12.101>