

BRIEF REPORT

Psychometric Evaluation and Norms for the Multidimensional Assessment of Interoceptive Awareness (MAIA) in a Clinical Eating Disorders Sample

Tiffany A. Brown , Laura A. Berner , Michelle D. Jones, Erin E. Reilly, Anne Cusack, Leslie K. Anderson, Walter H. Kaye & Christina E. Wierenga*

Department of Psychiatry, University of California, San Diego, San Diego, CA, USA

Abstract

Altered interoceptive awareness (IA) has been implicated in the pathophysiology of eating disorders; however, few comprehensive self-report measures of IA exist in eating disorders. The present study sought to validate the Multidimensional Assessment of Interoceptive Awareness (MAIA), originally developed to assess IA in individuals practicing mind–body therapies, in an eating disorder sample. Adult and adolescent patients ($n = 376$) completed assessments upon admission to a partial hospital programme. Analyses examined the factor structure of the MAIA, scale means, scale–scale correlations, internal consistency and construct validity. Analyses also examined associations between MAIA subscales and eating disorder symptoms. Results supported the original eight-factor structure of the MAIA. Internal consistency was acceptable, and the scales converged with associated measures. Importantly, Not Distracting, Self-regulation, Body Listening and Trusting were most strongly associated with eating disorder symptoms. Results support use of the MAIA among eating disorders and provide further support for the relevance of IA in eating disorders. Copyright © 2017 John Wiley & Sons, Ltd and Eating Disorders Association.

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Keywords

interoception; interoceptive awareness; body awareness; questionnaire; eating disorders

*Correspondence

Dr. Christina E. Wierenga, Department of Psychiatry, University of California, San Diego, 4510 Executive Dr. Suite #315, San Diego, CA 92121, USA. Tel: 858-534-8047; Fax: 858-534-6727.

Email: cwierenga@ucsd.edu

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Introduction

Eating disorders (EDs) are serious and often chronic psychiatric disorders (American Psychiatric Association, 2013; Hudson, Hiripi, Pope, & Kessler, 2007; Keski-Rahkonen et al., 2009) associated with costly medical complications, psychosocial impairment and increased mortality (American Psychiatric Association, 2013). Given the complex nature of EDs, recent research has focused on identifying transdiagnostic processes underlying ED symptoms. One such construct, interoceptive awareness (IA), refers to the perception and integration of visceral signals relating to body states (e.g. hunger, intestinal tension, heartbeat, respiration and pain; Khalsa & Lapidus, 2016). The experience and interpretation of these sensations provide a sense of one's physical self and play a crucial role in emotional processing to help guide motivated behavior (Craig, 2002). Altered IA may contribute to ED symptoms, including altered experience of hunger and fullness sensations (Herbert, Blechert, Hautzinger, Matthias, & Herbert, 2013), body image distortion, and alexithymia (Kerr et al., 2016; Pollatos et al., 2008; Zucker et al., 2013).

Research suggests that individuals with EDs have deficits in IA. Anorexia nervosa (AN) is associated with self-reported

sensory hyper-responsivity, whereas bulimia nervosa (BN) is associated with sensory hypo-responsivity (Brand-Gothelf et al., 2016). Although individuals with AN are better able to detect their heartbeat and breathing sensations pre-meal compared with healthy controls (Khalsa et al., 2015), they experience difficulty distinguishing actual from anticipated interoceptive signals, such as feelings of fullness (Perez, Coley, Crandall, Di Lorenzo, & Bravender, 2013), touch (Crucianelli, Cardi, Treasure, Jenkinson, & Fotopoulou, 2016), and pain (de Zwaan, Biener, Bach, Wiesnagrotzki, & Stacher, 1996). Individuals with BN report lower sensation intensities during increased stomach distention than controls (Zimmerli, Walsh, Guss, Devlin, & Kisseleff, 2006) but show elevated thermal (Yamamoto, Papezova, & Uher, 2009) and mechanical pain thresholds (de Zwaan et al., 1996). Interoceptive accuracy findings are mixed, as studies report both reduced interoceptive accuracy (Klabunde, Acheson, Boutelle, Matthews, & Kaye, 2013) and no differences in BN relative to controls (Pollatos & Georgiou, 2016). Overall, results suggest AN and BN are associated with interoceptive detection deficits. Less is known about IA in other EDs, such as avoidant–restrictive food intake disorder (ARFID) and binge eating disorder (BED).

Given the potential significance of IA for understanding ED psychopathology (Fassino, Piero, Gramaglia, & Abbate-Daga, 2004; Kerr et al., 2016; Khalsa et al., 2015; Khalsa & Lapidus, 2016; Pollatos et al., 2008), identifying an accurate assessment tool for the measurement of IA in EDs is critical. To date, the most commonly used measure of interoception in EDs is the Interoceptive Awareness subscale of the Eating Disorder Inventory (EDI-IA; Garner, Olmstead, & Polivy, 1983). Elevated EDI-IA scores in AN (Merwin et al., 2011) and BN (Fassino et al., 2004; Pollatos & Georgiou, 2016) relative to controls further support the hypothesis that EDs are characterized by interoceptive disturbances. However, the EDI-IA scale does not differentiate between emotional and body-related sensibility and thus may confound IA and alexithymia (Merwin et al., 2011). Further, the EDI-IA is limited in its ability to differentiate between different facets of IA, which is essential for identifying potential neurocognitive mechanisms of aberrant IA within EDs.

The Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012), a self-report measure designed to assess various dimensions of IA, may represent a useful tool in ED populations. The MAIA has demonstrated acceptable fit and strong construct and incremental validity in a body-aware population (Mehling et al., 2012). Because the MAIA distinguishes beneficial from maladaptive dimensions of IA (Mehling et al., 2012), it may help clarify prior inconsistent IA findings in ED populations (Brand-Gothelf et al., 2016; Khalsa et al., 2015; Pollatos et al., 2008) and identify treatment targets. However, no studies to date have validated the measure in a clinical ED sample.

In the present study, we sought first to confirm the factor structure of the MAIA and establish its reliability and construct validity in a sample of treatment-seeking adults and adolescents with EDs. We hypothesized that model fit, reliability, and validity would be comparable with those originally reported by Mehling et al. (2012). Second, we sought to establish norms for the MAIA in an ED sample. Finally, we examined whether MAIA subscale scores differed across ED diagnostic groups and explored associations of the MAIA subscales with ED symptomatology.

Materials and methods

Participants and procedures

Data from 376 patients (182 adults and 194 adolescents; mean age = 20.9 ± 9.3 years) admitted to the University of California, San Diego (UCSD) Partial Hospital Program (PHP) were included. ED diagnoses, determined by psychiatrists using semi-structured interviews at admission, included AN-restricting subtype (42.4%), AN-binge-purge subtype (15.8%), BN (23.9%), BED (3.2%), ARFID (2.1%) and other specified feeding or ED (OSFED; 12.6%). Most participants were female (94.4%) and Caucasian (72.8%), and 20.8% identified as Hispanic (Table S1).

Participants provided written informed consent before completing computerized self-report surveys within 2 weeks of treatment admission. Study procedures were approved by the UCSD Institutional Review Board.

Measures

Multidimensional Assessment of Interoceptive Awareness (Mehling et al., 2012). The MAIA is a 32-item self-report questionnaire that measures eight facets of interoceptive body awareness: (i) Noticing, (ii) Not Distracting, (iii) Not Worrying, (iv) Attention Regulation, (v) Emotional Awareness, (vi) Self-regulation, (vii) Body Listening, and (viii) Trusting (see Table S2 for individual subscale items). The MAIA subscales have demonstrated acceptable psychometric properties in non-ED populations (Mehling et al., 2012).

Validation measures

Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2004). The Difficulties in Emotion Regulation Scale (DERS) is a 36-item self-report measure that assesses emotion dysregulation and has demonstrated strong psychometric properties (Gratz & Roemer, 2004). Internal consistency in the present sample was good across all subscales ($\alpha = .86-.93$).

Toronto Alexithymia Scale (Bagby, Parker, & Taylor, 1994).

The Toronto Alexithymia Scale (TAS) is a 20-item self-report measure that assesses difficulty understanding, processing and describing emotions. The TAS has demonstrated good psychometric properties (Bagby et al., 1994). Internal consistency in the present sample was good ($\alpha = .87$).

State-Trait Anxiety Inventory-Trait subscale (Spielberger, Gorsuch, & Lushene, 1970). The State-Trait Anxiety Inventory-Trait subscale (STAI-T) is a 20-item self-report measure of trait anxiety. The overall STAI demonstrates excellent reliability and validity (Spielberger & Vagg, 1984), and STAI-T internal consistency in the present study was excellent ($\alpha = .91$).

Eating pathology measure

Eating Disorder Examination Questionnaire (Fairburn & Beglin, 1994). The Eating Disorder Examination Questionnaire (EDE-Q) is a 31-item self-report measure designed to assess cognitive and behavioral (e.g. binge eating) features of EDs over the last 28 days. In the current study, self-induced vomiting and laxative misuse frequencies were summed to create a composite purging frequency variable (Gideon et al., 2016). The EDE-Q subscales have excellent psychometric properties (Luce & Crowther, 1999). Internal consistency in the present study ranged from $\alpha = .84-.97$.

Data analyses

Confirmatory factor analyses (CFA) and exploratory factor analyses (EFA) were conducted using the lavaan package in R (Rosseel, 2012). First, a CFA examined the fit of the original eight-factor structure of the MAIA. Model fit acceptability was assessed per recommendations of Hu and Bentler (1999) and Brown (2006) using comparative fit index (CFI) and Tucker-Lewis index (TLI; values for CFI and TLI >.95 indicating good fit, .90-.95 indicating acceptable fit); root-mean-square error of approximation (values <.05 indicating good fit, .06-.08 indicating acceptable fit); and standardized root-mean-square residual

Table 1 Reliability, item scale correlations and descriptive statistics

MAIA subscale	No. of items	Mehling et al. (2012)	Present sample	Item scale correlations	Mehling et al. (2012)	ED full sample (<i>n</i> = 362)	Subsamples	
							Adult ED sample (<i>n</i> = 176)*	Adolescent ED sample (<i>n</i> = 186)*
		α	α	<i>r</i>	M (<i>SD</i>)	M (<i>SD</i>)	M (<i>SD</i>)	M (<i>SD</i>)
Noticing	4	0.69	0.76	.36–.47	3.94 (0.59)	3.14 (1.15)	3.17 (1.12)	3.12 (1.18)
Not Distracting	3	0.66	0.67	.35–.47	3.20 (0.87)	2.12 (1.18)	2.01 (1.12)	2.21 (1.23)
Not Worrying	3	0.67	0.62	.16–.58	3.27 (0.84)	2.39 (1.17)	2.29 (1.12)	2.49 (1.20)
Attention Regulation	7	0.87	0.91	.44–.76	3.79 (0.64)	2.33 (1.22)	2.28 (1.29)	2.37 (1.15)
Emotional Awareness	5	0.82	0.84	.31–.72	4.16 (0.64)	2.88 (1.22)	2.96 (1.23)	2.80 (1.20)
Self-regulation	4	0.83	0.89	.56–.77	3.86 (0.74)	2.08 (1.34)	2.08 (1.37)	2.08 (1.32)
Body Listening	3	0.82	0.89	.66–.76	3.50 (0.87)	1.72 (1.35)	1.67 (1.36)	1.76 (1.35)
Trusting	3	0.79	0.92	.73–.86	4.13 (0.74)	1.73 (1.55)	1.50 (1.43)	1.94 (1.63)

Note: ED = eating disorder; MAIA = Multidimensional Assessment of Interoceptive Awareness; *SD* = standard deviation.

*Given differences in sample sizes across MAIA subscales, the range of participants was as follows: total *n* = 362–373; adults *n* = 176–180; adolescents *n* = 186–192.

(values <.08 indicating good fit, values <.10 indicating acceptable fit). We did not rely on chi-square as a fit indicator, as it is highly susceptible to type I error. We next ran an EFA to determine whether specific items of the MAIA loaded onto the appropriate subscales as designated by Mehling et al. (2012) when constraining the model to an eight-factor solution employing varimax rotation.

Bivariate Pearson's correlations examined associations of MAIA subscales with construct validity indicators (DERS, STAI-T and TAS scores; Mehling et al., 2012).

Multivariate analyses of covariance compared MAIA subscale scores across ED diagnoses, controlling for age and gender. Post hoc analyses were Bonferroni corrected.

Exploratory linear regression analyses examined associations of MAIA subscales with ED symptomatology. Predictor variables [MAIA subscales and covariates (age, gender and diagnosis)] were entered simultaneously. Separate regression models were run for each dependent variable (EDE-Q subscales, binge eating and purging frequencies). Because binge eating and purging frequency variables were zero inflated, logistic regression analyses first examined whether MAIA subscales were associated with the presence of binge eating or purging. Next, among the subset of patients who endorsed binge eating or purging, linear regressions examined whether MAIA subscales predicted behavior frequency. Binge eating and purging frequency variables were log transformed to correct for positive skew.

Results

Confirmatory and exploratory factor analyses

For the CFA model, root-mean-square error of approximation (.074, 90% CI = .069–.079) and standardized root-mean-square residual (.085) both indicated acceptable model fit, while TLI (.863) and CFI (.880) were just below the cut-off for acceptable model fit. All fit indices were comparable with those from the original eight-factor model developed by Mehling and colleagues (2012). All factor loadings were statistically significant, and standardized estimates ranged from .34 (item 10) to .99 (item 9; Table S2).

The EFA results supported the factor structure of the MAIA in our sample, as the greatest loading for each individual item corresponded to the appropriate subscale (Table S3). The sums of squared loadings for the eight factors ranged from 1.37 to 4.89 and accounted for a cumulative variance of .62.¹

Internal consistency and means

Table 1 presents the reliability, item scale correlations, and descriptive statistics for the MAIA within the full sample. Cronbach's alpha estimates for six of the eight subscales (Noticing, Attention Regulation, Emotional Awareness, Self-regulation, Body Listening and Trusting) ranged from .76 to .92. The Not Distracting and Not Worrying subscales fell within the questionable range (α = .62–.67).

Means in the full sample ranged from 1.72 (Body Listening) to 3.14 (Noticing). Adult and adolescent samples differed only on the Trusting subscale, with adolescents demonstrating higher scores (Table S4).

Scale-scale correlations

Correlations among the MAIA subscales support subscale independence (Table S5). The strongest associations were between Self-regulation and Body Listening (r = .74), Attention Regulation and Self-regulation (r = .67), and Body Listening and Trusting (r = .67). Not Distracting was not significantly correlated with any of the other subscales. Patterns in adult and adolescent subsamples were generally comparable (Table S6).

Construct validity

Table S7 presents associations among MAIA subscales and DERS, STAI-T and TAS scores. As expected, nearly all MAIA subscales demonstrated significant negative associations with the DERS, STAI-T and TAS. Notably, the MAIA Trusting subscale demonstrated the strongest negative associations with all indicators.

¹Given the small number of BED, ARFID and male patients, CFA and EFA were also run excluding these groups, and the pattern of results was comparable.

Diagnostics differences across the MAIA subscales

Diagnostic groups differed on the Attention Regulation and Trusting subscales (Table 2). Bonferroni-corrected post hoc comparisons revealed higher Attention Regulation scores among patients with ARFID compared with those with BN ($p=.03$) and other specified feeding or ED ($p=.02$). Patients with ARFID had the highest Trusting scores of any group, but post hoc analyses did not indicate any statistically significant between-group differences on this subscale.

Associations among the MAIA subscales and eating disorder variables

Table 3 presents results from regression analyses examining associations between the MAIA subscales and ED variables.

Not Distracting was inversely associated with all EDE-Q subscale scores. Similarly, Trusting was inversely associated with all EDE-Q subscale scores and higher likelihood of engaging in binge eating and purging, and higher frequency of binge eating in the 28 days before treatment admission (Table S8). Self-regulation scores were inversely associated with EDE-Q Global and Eating Concern scores, while Body Listening was positively associated with EDE-Q Eating Concern scores.

Discussion

The present study was the first to examine the psychometric properties of the MAIA among individuals with EDs. We confirmed the measure’s reliability and validity in adult and

Table 2 Estimated marginal means comparing MAIA subscales across diagnoses controlling for age and gender

MAIA subscale	AN-R	AN-BP	BN	BED	ARFID	OSFED	F	p
	n = 142	n = 56	n = 80	n = 11	n = 8	n = 42		
	M (SE)							
Noticing	3.19 (0.10)	3.06 (0.15)	3.09 (0.13)	2.76 (0.35)	3.53 (0.44)	3.28 (0.18)	0.70	.63
Not Distracting	2.15 (0.10)	2.17 (0.16)	1.92 (0.14)	2.43 (0.36)	2.40 (0.46)	2.07 (0.18)	0.69	.63
Not Worrying	2.36 (0.10)	2.58 (0.15)	2.31 (0.13)	3.11 (0.35)	2.38 (0.44)	2.14 (0.18)	1.64	.15
Attention Regulation	2.36 (0.11)	2.31 (0.16)	2.22 (0.14)	2.32 (0.37)	3.74 (0.47)	2.11 (0.19)	2.21	.05
Emotional Awareness	2.97 (0.11)	2.69 (0.17)	2.89 (0.14)	2.81 (0.38)	3.37 (0.48)	2.71 (0.19)	0.77	.58
Self-regulation	2.09 (0.12)	2.19 (0.18)	2.17 (0.15)	2.13 (0.41)	3.18 (0.52)	1.68 (0.21)	1.79	.12
Body Listening	1.77 (0.12)	1.48 (0.18)	1.74 (0.15)	1.53 (0.41)	2.91 (0.51)	1.59 (0.21)	1.63	.15
Trusting	2.00 (0.13)	1.42 (0.20)	1.40 (0.17)	1.63 (0.46)	3.16 (0.58)	1.45 (0.23)	3.37	.006

Note: MAIA = Multidimensional Assessment of Interoceptive Awareness; AN-R = anorexia nervosa-restricting subtype; AN-BP = anorexia nervosa–binge–purge subtype; BN = bulimia nervosa; BED = binge eating disorder; ARFID = avoidant–restrictive food intake disorder; OSFED = other specified feeding or eating disorder; SE = standard error.

Table 3 Regression analyses examining MAIA subscales predicting eating disorder symptoms, controlling for gender, age and diagnosis

Predictor variables	EDE-Q Global		EDE-Q Restraint		EDE-Q Eating		EDE-Q Shape		EDE-Q Weight		Binge eating presence*		Purging presence*	
	β	p	β	p	β	p	β	p	β	p	Exp(B)	p	Exp(B)	p
Gender	.13	.005	.10	.06	.11	.02	.15	.001	.10	.03	.80	.67	2.88	.13
Age	.02	.69	-.03	.56	.09	.06	.00	.88	.02	.68	1.04	.002	1.01	.45
Diagnosis	.00	.95	-.06	.30	-.02	.66	.02	.70	.06	.18	1.11	.16	1.14	.08
MAIA Noticing	.01	.80	.03	.62	-.00	.95	.02	.66	.00	.97	.82	.14	.86	.28
MAIA Not-Distract	-.14	.003	-.15	.005	-.15	.002	-.11	.02	-.12	.01	1.12	.28	.96	.67
MAIA Not-Worry	-.01	.91	-.01	.87	-.05	.31	.02	.71	.01	.84	1.21	.08	1.08	.49
MAIA Attn Reg	.10	.16	.15	.07	.10	.19	.06	.37	.08	.27	1.23	.18	.95	.72
MAIA Emot Aware	-.01	.85	-.05	.53	.01	.88	-.01	.93	.00	.99	.88	.35	.86	.27
MAIA Self-Reg	-.16	.04	-.14	.11	-.19	.01	-.13	.09	-.15	.06	.94	.65	1.10	.52
MAIA Body Listen	.12	.12	.01	.93	.15	.049	.14	.07	.14	.07	1.29	.09	1.30	.11
MAIA Trusting	-.57	<.001	-.35	<.001	-.52	<.001	-.61	<.001	-.59	<.001	.68	.001	.56	<.001
R ² value	.360		.185		.332		.380		.362		.103		.144	

Note: MAIA = Multidimensional Assessment of Interoceptive Awareness; EDE-Q Global = Eating Disorder Examination Questionnaire Global Score; EDE-Q Restraint = Eating Disorder Examination Questionnaire Restraint; EDE-Q Eating = Eating Disorder Examination Questionnaire Eating Concern; EDE-Q Shape = Eating Disorder Examination Questionnaire Shape Concern; EDE-Q Weight = Eating Disorder Examination Questionnaire Weight Concern; Binge Eating Presence = presence of binge eating as assessed by the EDE-Q; Purging Presence = presence of self-induced vomiting or laxative use as assessed by the EDE-Q; MAIA Not-Distract = MAIA Not Distracting; MAIA Not-Worry = MAIA Not Worrying; MAIA Attn Reg = MAIA Attention Regulation; MAIA Emot Aware = MAIA Emotional Awareness; MAIA Self-Reg = MAIA Self-regulation; MAIA Body Listen = MAIA Body Listening.

MAIA subscales and gender, age and diagnosis represent predictor variables, while EDE-Q subscales and symptoms represent dependent variables.

*Models for binge eating and purging presence were run using logistic regression, and R² estimates for logistic regression models represent Cox and Snell R² values.

adolescent ED patients in a PHP level of care, examined preliminary differences among the ED diagnoses in MAIA subscales and identified MAIA subscales most strongly associated with ED symptoms.

Prior studies confirming the factor structure of the MAIA have focused on healthy samples, and one study has confirmed the factor structure in a clinical sample with chronic pain (Mehling, 2016; Mehling *et al.*, 2013). To our knowledge, no study to date has confirmed the MAIA factor structure in a psychiatric sample. Although fit indices for our CFA were slightly lower than those in prior studies, our factor analytic results are consistent with those of prior validation studies (Mehling, 2016), and we confirmed the original eight-factor structure of the MAIA in an ED sample. Further, results of our EFA confirmed that the highest loadings for each item corresponded with the appropriate subscale (Mehling *et al.*, 2012). These findings support the construct validity of the MAIA in ED samples.

Also consistent with prior research (Bornemann, Herbert, Mehling, & Singer, 2015; Mehling *et al.*, 2012, 2013; Valenzuela-Moguillansky & Reyes-Reyes, 2015), we found that four out of eight subscales demonstrated good internal consistency. In addition, questionable internal consistency of the Not Worrying and Not Distracting subscales is in line with numerous similar findings that have prompted Mehling and colleagues (2016) to continue to refine these subscales. As expected, means for all subscales in our ED sample were lower than those reported in the original validation sample (Mehling *et al.*, 2012). Overall, our findings suggest that the MAIA subscales have acceptable internal consistency in ED populations.

The subscale intercorrelations observed in our sample were mostly consistent with those found in other samples and support the independence of the MAIA subscales in an ED sample. As in prior studies, Not Worrying and Not Distracting, which assess worry about sensations and efforts to distract from uncomfortable sensations, respectively, were weakly associated with all other subscales, and Attention Regulation and Self-regulation were moderately strongly correlated (Mehling *et al.*, 2012; Valenzuela-Moguillansky & Reyes-Reyes, 2015). In contrast, Body Listening and Trusting have been relatively weakly associated in other samples but were moderately positively associated in our sample. This suggests a potentially stronger relationship between listening to cues from the body and trusting sensations from the body in individuals with EDs.

Analyses examining associations with other measures suggest that construct validity was highest for the Trusting subscale score in our ED sample. Individuals reporting the highest levels of trust of their body sensations were those who reported the lowest levels of emotion dysregulation, anxiety and alexithymia. The relationships in our sample among MAIA Attention Regulation and Emotional Awareness and DERS and STAI-T scores were similar to those reported in prior samples (Mehling *et al.*, 2012). However, we observed consistently weaker associations of Noticing, Not Distracting and Not Worrying scales with DERS and STAI-T scores, and stronger associations of Self-regulation, Body Listening and Trusting scales with DERS and STAI-T scores. Our findings add to prior reports linking interoceptive deficits to anxiety and

alexithymia in EDs (Strigo *et al.*, 2013; Zucker *et al.*, 2013) and suggest that individuals with EDs who do not listen to their bodies for emotional information and behavioral guidance, do not trust their body sensations, and experience the least relief from turning their attention to their body sensations, may be the most anxious, emotionally dysregulated and alexithymic.

Consistent with observed associations with non-ED psychopathology, across ED diagnoses, ages, and genders, Not Distracting, Self-regulation, and Trusting were most consistently associated with ED symptomatology. Individuals who were distracted from uncomfortable body sensations, had a low ability to regulate distress by attending to their bodily signals and trusted their bodies the least had the most severe ED symptoms. Given the questionable reliability of the Not Distracting subscale, replication of these results is needed. However, these findings further suggest that at treatment admission, the Not Distracting, Self-regulation and Trusting subscales may be most relevant for individuals with EDs.

Low levels of trust in body signals may result from 'noisy' interoceptive signalling that is hypothesized to contribute to several psychopathologies. A mismatch between, or difficulty integrating, expected and experienced body sensations (an 'interoceptive prediction error') may promote uncertainty and behavioral avoidance (Khalsa & Lapidus, 2016; Paulus & Stein, 2006). Both self-report and neuroimaging data support the notion of unhelpful prediction signals in EDs. Individuals ill with AN show exaggerated interoceptive bias during the anticipation of eating (Khalsa *et al.*, 2015), and women remitted from AN show altered neural responses in the insula, the hub for evaluating interoceptive cues, before and during the processing of food images (Oberndorfer *et al.*, 2013). Aberrant insula activation in anticipation of pain is associated with increased alexithymia (Strigo *et al.*, 2013) in remitted AN, suggesting that this altered signal may make emotion identification more difficult. Existing evidence suggests that women ill with BN relative to controls show reduced prediction error signalling for palatable sucrose in reward-processing regions (Frank, 2011). Thus, our MAIA Trust subscale findings add to evidence suggesting that altered integration of signals before and during interoception may contribute to individuals with EDs feeling mistrustful of their experience and unable to use that experience to effectively self-regulate. This could ultimately promote anxiety, avoidance and ED behaviors.

The present study benefitted from methodological strengths, including the use of a large clinical sample of adults and adolescents. However, several limitations are worth noting. First, our study included unbalanced sample sizes across diagnoses. Although this distribution of diagnoses is reflective of patients presenting for PHP treatment, future studies with more balanced sample sizes are needed. Second, we lacked sufficient data to examine the test-retest reliability or divergent validity of the MAIA. Relatedly, while our study included several measures relevant to IA, because of feasibility constraints, we did not collect data on other IA measures that could further support the construct validity of MAIA. Future studies should explicitly examine the convergent validity between the MAIA and EDI-IA in EDs. Finally, our data are cross-sectional and from a

treatment-seeking sample with smaller samples of men and BED and ARFID patients. Thus, results within these underrepresented groups require replication.

In sum, results support the validity and reliability of the MAIA in ED populations, establish initial norms in adolescent and adult

ED patients and indicate facets of IA that may be most relevant to ED symptomatology. Findings suggest that future use of the MAIA among individuals with eating psychopathology is warranted and provide further evidence supporting the relevance of IA for EDs.

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Supporting information

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