

Interoceptive Attention Tendencies Predict Trait Anxiety in Undergraduate Students and Hospital Nurses Participating in Stress Management Programs

Russell Sarwar Kabir

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Abstract: Interoceptive attention tendencies have been posited as the dimensions of change in body awareness gained through the acquisition of self-regulatory skills from engaging in contemplative and body-mind health practices such as mindfulness meditation, yoga, and relaxation training. However, efforts are still needed to confirm the model of the dimensions and to delineate the “positive” (adaptive) and “negative” (maladaptive) forms of attention to the body due to their relationships with anxiety. This study tests the factor and predictive incremental validity assumptions of positive body awareness through correlational and regression analysis of interoceptive attention tendencies measured by the Multidimensional Assessment of Interoceptive Awareness (MAIA) with trait anxiety as the response variable measured by the State-Trait Anxiety Inventory (STAI). Data were analyzed from one-hundred and sixty-nine undergraduate students ($n = 169$; M age = 19.07, $SD = 0.73$) and sixty-six early-career nurses ($n = 66$, M age = 25.68, $SD = 3.01$) participating in stress management programs in southwestern Japan. Negative correlations between trait anxiety and the MAIA dimensions suggested divergent validity in both samples in line with previous studies, except for *Noticing*. Providing evidence that contrasts with other work on the instrument in Japan, *Self-Regulation* was found to negatively correlate with and predict trait anxiety with regressions that were consistent in direction with the original MAIA validation for both samples. Among hospital nurses, the regression coefficient for *Body Listening* was consistent in direction but shown to differ in magnitude from the original validation. Implications for these relationships as they relate to research on the MAIA are discussed.

Key words: body awareness, Multidimensional Assessment of Interoceptive Awareness, anxiety

1. Introduction

Prior research on body awareness processes has illustrated relationships between the awareness of physiological signals from the body and the emergence of anxious arousal. Former constructs for

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understanding these relationships considered body awareness as a singular phenomenon in which a conscious level of awareness toward bodily signals represented a *negative* form of attention (e.g. somatosensory amplification) that typically indicates symptoms of psychopathology (e.g. health anxiety or illness behavior). These models of especially health anxiety were posited to depend on cognitive construal, particularly via catastrophic evaluations that misinterpret or magnify bodily signals (e.g., Rachman, 2012), although efforts to delineate empirical support for the somatic pathogenesis of health anxiety are ongoing. In contrast, contemporary research on the psychometric measurement of related processes outside of negative forms of bodily attention have shed light on a role for attention in the relationship between body awareness and anxiety such that one's awareness of the signals from the body can be co-opted to regulate one's incumbent distress or anxious arousal. This regulatory role as a style of attention is understood as a facet of mindful attention and is thus supposed to conform to a positive form of body awareness by means of the conferred ability to perform open or sustained attention that manifests as a learned skill when regulating awareness toward the body.

The nature of body awareness as a singular entity was called into question by Mehling and colleagues (2009) who systematically reviewed and evaluated all available body awareness constructs for their psychometric quality. As a result, psychologically accessible body awareness constructs were found to encompass multiple dimensions related to processes that result from neurobiological processes tied to *interoception*, or the sense of the physiological condition of the body. In a subsequent attempt to capture the collection of senses tied to interoceptive processes, Mehling and colleagues (2012) developed a comprehensive instrument known as the Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012). The MAIA attempts to measure the aforementioned regulatory dimensions and attentional styles to neutral and adaptive ("positive") forms of body awareness, especially such that conceptions can be discriminated from maladaptive and anxious forms of body vigilance or arousal (Mehling et al., 2012). The MAIA includes eight dimensions of this awareness labeled as follows: (1) *Noticing*, (2) *Not-Distracting*, (3) *Not-Worrying*, (4) *Attention Regulation*, (5) *Emotional Awareness*, (6) *Self-Regulation*, (7) *Body Listening*, and (8) *Trusting*. In subsequent research and reviews, the dimensions have been called modes of attention to perceived bodily signals as subjectively measured by self-report methods and categorized as *interoceptive attention tendencies* (Khoury, Lutz, & Shuman-Oliver, 2018).

The MAIA was developed in reference to the definition of interoception elucidated by Craig (2009) and went through extensive external validation against constructs such as deficits in emotional regulation, facets of mindfulness, pain catastrophizing, emotional approaches to coping, bodily dissociation, body responsiveness, body consciousness, anxiety sensitivity indexes, and state and trait anxiety (Mehling et al., 2012; Mehling, 2016). In a key test of construct validity for the multidimensional character of interoceptive attention tendencies, predicting incremental validity using state and trait anxiety was of special importance for providing evidence of the MAIA as a measure of body awareness with implications for clinical outcomes. Mehling and colleagues (2012) performed a series of correlational and regression analyses using the MAIA dimensions to predict trait anxiety from the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). A contribution of multiple MAIA subscales as dimensions were found to demonstrate negative relationships with trait anxiety which were used to infer a degree of validity for the multidimensional hypothesis of body awareness. In particular, all dimensions except for *Attention Regulation* and *Body Listening* provided statistically significant or marginally significant paths in the negative direction for levels of trait anxiety. However, an unexpected suppressor effect was observed for *Emotional Awareness*, which was found to share variance with *Self-Regulation*, and was shown to change directions when removed from the analysis. Fascinatingly, according to Mehling et al. (2012), this suggested that the mere recognition of body signals from awareness of the relationship between emotional states and body awareness alone in the absence of a perceived ability to use that

awareness to regulate distress could lead to anxiety. This was posited as a possible role for the MAIA as a proving ground for “dual theories” of body awareness and anxiety, however, the authors offered that this conclusion be cautiously interpreted as their sample was limited to experienced mind-body practitioners and required confirmation in another sample.

The MAIA has tracked body awareness changes in numerous applications of behavioral health practices (Bornemann et al., 2015; Fissler et al., 2016; De Jong et al., 2016) and continues to be theorized to harmonize across them due to the common goals of programs to leverage interoceptive awareness (Gard et al., 2014; Farb et al., 2015; Kabir, Haramaki, Ki, & Ohno, 2018; Price & Hooven, 2018). Compared to the sample of experienced practitioners of behavioral health practices described in Mehling et al. (2012), the current study aims to draw conclusions from two other samples: university students and early-career nurses.

University students have been the target of two of the validation studies of the Japanese MAIA items (Shoji et al., 2018; Fujino, 2019), however, the test of construct validity by predicting STAI-T was not performed in either study. Young adults embarking on a path to higher education go through a number of psychological changes that are amenable to the transition from home to the university (Michie et al., 2001). The sources of stress and anxiety afforded by this period of growth and change in college include academic issues, financial concerns, and social strains related to interpersonal relationships (Pierceall & Keim, 2007; Smith & Renk, 2007), making them an important target population for anxiety and stress reduction. In addition, early-career nurses tend to demonstrate greater proximity to sub-clinical outcomes related to anxiety due to the numerous occupational stressors associated with nursing work that often lead to burnout (Laal, 2013; Chang & Chan, 2015; Edwards & Burnard, 2003). In a notable effort illustrating improvement in occupational health outcomes for nurses, an 8-week yoga intervention was utilized as a prevention program for nurse burnout (Alexander, Rollins, Walker, Wong, & Pennings, 2015). In a similar vein but with an eye on brief sessions of psychoeducation as a vehicle, the primary prevention programs to which data was obtained for the current study utilized a form of relaxation training used in an original Japanese psychotherapy that shares elements of mind-body and third-wave approaches (Kabir et al., 2018; Haramaki, Kabir, Abe, & Yoshitake, 2019).

This study tests incremental predictive validity for the MAIA dimensions as identified in the original validation by examining their relationships with trait anxiety in a sample of university students and a sample of hospital nurses (Hunsley & Meyer, 2003). The same statistical procedure for body awareness and anxiety was performed as a test of construct validity using the MAIA and STAI (Mehling et al., 2012). This analysis aims to contribute to the cumulative evidence base on the status of the MAIA dimensions as “positive” (adaptive) and “negative” (maladaptive) forms of attention to the body and to offer insights on the relationships between body awareness and anxiety from data in known groups targeted for mental health promotion and primary prevention. Additionally, this analysis aims to build upon and offer insights on issues of construct validation and factor structure of the Japanese MAIA documented by Shoji et al. (2018) and Fujino (2019).

2. Methods

2.1 Study design and participants

One-hundred and eighty-one undergraduate students and sixty-seven early-career nurses participated in a stress management lecture and relaxation training workshop. The stress management education program was based on the content and format established by Yamanaka and Tominaga (2000) and implemented by Ki (2015) with relaxation training. The program involved learning about, noticing, and finding ways to cope with stress and experiencing mood state changes by performing movement tasks designed to induce relaxation.

The measurements of the study variables were taken before and after the program in a pre-post design. All participants took part in the program. The points explaining the purpose of the research and request for informed consent were distributed in a single questionnaire packet and written informed consent was obtained. The research protocol was approved by the ethical research committee of the Graduate School of Education at Hiroshima University. To adhere to the scope of the present study, only the results of the specific tests of incremental predictive validity performed by Mehling et al. (2012) for the MAIA and STAI at pre-test are described in this report.

2.2 Measures

State-Trait Anxiety Inventory (STAI, Spielberger, 1983; Japanese adaptation by Hidano, Fukahara, & Spielberger, 2000). STAI is a domain-specific measure of negative affect that consists of 2 factors: state anxiety (STAI-S, 20 items) and trait anxiety (STAI-T, 20 items). The current study focuses only on the scores for STAI-T. Responses to the STAI-T scale are made on a 4-point scale ranging from 1 (*almost never*) to 4 (*almost always*), garnering raw scores that range from 20-80. STAI has been validated across numerous populations from as many as 8000 studies and has been translated into at least 58 languages. Examinations of its psychometric properties have shown that the instrument typically has a Cronbach alpha-based internal consistency of 0.89 and a test-retest reliability of 0.88 (Grös, Antony, Simms, & McCabe, 2007).

Multidimensional Assessment of Interoceptive Awareness. (MAIA, Mehling et al., 2012; Japanese items translated by Shoji, Mehling, Hautzinger, & Herbert, 2018). The MAIA is a 32-item self-report measure of body awareness. It is designed to capture eight dimensions in the tendencies in beliefs, attitudes, thoughts, and emotions toward interoceptive stimuli from the body. A 6-point scale from 0 (*not at all*) to 5 (*always*) is used to rate each item. The MAIA has been translated into at least 16 languages and validated in 8 different cultural contexts (Mehling, 2016; Machorrinho, Veiga, Fernandes, Mehling, & Marmeleira, 2019; Shoji et al., 2018).

3. Results

3.1 Descriptive statistics and reliability analysis

Descriptive statistics were generated using JASP (Version 0.8.6, JASP Team, 2018) and are depicted in Table 1. A total of 181 university students (85 males, 96 females; 53% female) and 67 hospital nurses (2 males, 65 females; 97% female) gave their informed consent to participate in the stress management programs and granted the use of their questionnaire data. During screening, data from 12 university students and 1 hospital nurse were missing. Listwise deletion left a subset of 169 undergraduate students ($n = 169$, M age = 19.07, $SD = 0.73$) and 66 hospital nurses ($n = 66$, M age = 25.68, $SD = 3.01$) with fully completed data that was retained for analysis. Cronbach's alpha and McDonald's omega estimates were selected for evaluating internal consistency of the items and performed using JASP.

Acceptable internal consistency was observed for the STAI-T subscale in both samples (α range: 0.74-0.88, ω range: 0.77-0.90) in accordance with conventional guidelines for determining reliability via Cronbach's alpha (α) and McDonald's omega (ω) that favor values greater than 0.7. For the MAIA, internal consistency was supported at pre-test and post-test for the dimensions *Not-Distracting*, *Attention Regulation*, *Emotional Awareness*, *Self-Regulation*, *Body Listening*, and *Trusting* (α range: 0.71-0.93, ω range: 0.73-0.93). In line with previous studies on the Japanese MAIA (Fujino, 2019), the subscale for *Not-Worrying* (pre-test: $\alpha = 0.22$, $\omega = 0.44$, post-test: $\alpha = 0.32$, $\omega = 0.50$) demonstrated poor internal consistency and in both samples and were thus cautiously interpreted. In contrast to previous findings on the instrument in global settings, reliability coefficients for *Noticing* were notably poor in the case of the sample of nurses, but not the undergraduate students.

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Table 1. Descriptive statistics and tests of internal consistency for the study variables at pre-test.

<i>Instrument</i>	<i>Study variable</i>	<i>No. items</i>	<i>Undergraduate students</i>				<i>Hospital nurses</i>			
			<i>M</i>	<i>SD</i>	<i>Cronbach's α</i>	<i>McDonald's ω</i>	<i>M</i>	<i>SD</i>	<i>Cronbach's α</i>	<i>McDonald's ω</i>
STAI	Trait anxiety (STAI-T)	20	48.20	9.57	.74	.77	50.38	7.09	.84	.85
MAIA-J	Noticing	4	2.77	.92	.79	.80	2.53	.73	.33	.48
	Not-Distracting	3	2.57	1.03	.80	.81	3.62	1.02	.76	.77
	Not-Worrying	3	2.40	.72	.34	.37	2.99	.78	.22	.44
	Attention Regulation	7	2.74	.85	.90	.90	2.24	.75	.84	.85
	Emotional Awareness	5	2.94	.84	.81	.82	2.75	.85	.77	.79
	Self-Regulation	4	2.89	.89	.79	.79	2.38	.77	.71	.73
	Body Listening	3	2.41	1.05	.87	.87	1.88	.90	.80	.82
	Trusting	3	2.99	.96	.84	.86	2.18	.99	.82	.84

3.2 Correlational analysis

Table 2 depicts the correlations for the dimensions of the MAIA and trait anxiety from both samples at pre-test. As shown, a pattern and direction of negative correlations for trait anxiety was established for all MAIA dimensions in both samples with the exception of *Noticing* among undergraduate students. Undergraduate students also provided correlations of greater magnitude than the hospital nurses.

Table 2. Bivariate correlations for STAI-T scores and MAIA dimensions.

<i>STAI-T</i>	<i>Noticing</i>	<i>Not-Distracting</i>	<i>Not-Worrying</i>	<i>Attention Regulation</i>	<i>Emotional Awareness</i>	<i>Self-Regulation</i>	<i>Body Listening</i>	<i>Trusting</i>
<i>Undergraduate students</i>	0.14	-0.12	-0.42***	-0.25***	-0.10	-0.45***	-0.18*	-0.44***
<i>Hospital nurses</i>	-0.01	-0.21*	-0.06	-0.13	-0.21*	-0.20*	-0.04	-0.09

Note. Coefficients with asterisks: $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$.

3.3 Regression analysis

Simultaneous entering of the MAIA dimensions as predictors with STAI-T scores of trait anxiety as the response variable through a linear regression was chosen in line with the analysis conducted in the original MAIA validation study by Mehling et al. (2012). The former study resulted in the following estimates for the MAIA regressed onto STAI-T: *Noticing* ($\beta = -0.16$, $p = 0.005$), *Not-Distracting* ($\beta = -0.15$, $p = 0.003$), *Not-Worrying* ($\beta = -0.26$, $p < 0.0001$), *Attention Regulation* ($\beta = 0.04$, $p = 0.55$), *Emotional Awareness* ($\beta = 0.11$, $p = 0.07$), *Self-Regulation* ($\beta = -0.29$, $p < 0.0001$), *Body Listening* ($\beta = 0.03$, $p = 0.63$), *Trusting* ($\beta = -0.19$, $p = 0.0001$), with a model R^2 of 0.41 (Mehling et al., 2012).

The results for undergraduate students are depicted in Table 3.1. In line with the original validation, *Not-Worrying* and *Self-Regulation* showed the two strongest paths for negatively predicting trait anxiety. The direction of supported regressions also matched the original validation for the rest of the dimensions except for *Noticing*, which was positive in association, and *Not-Distracting*, which

Table 3.1. Regression analysis demonstrating incremental validity for the MAIA dimensions in the prediction of STAI-T scores for undergraduate students.

<i>STAI-T</i>	<i>B</i>	<i>SE</i>	<i>β</i>	<i>t</i>	<i>p</i>
<i>Noticing</i>	2.42	0.80	0.22	3.02	.003
<i>Not-Distracting</i>	0.01	0.62	0.001	0.01	.99
<i>Not-Worrying</i>	-4.29	0.81	-0.33	-5.30	<.001
<i>Attention Regulation</i>	-0.41	0.91	-0.03	-0.45	.66
<i>Emotional Awareness</i>	1.12	0.85	0.10	1.32	.19
<i>Self-Regulation</i>	-4.53	0.96	-0.43	-4.72	<.001
<i>Body Listening</i>	0.93	0.73	0.10	1.28	.20
<i>Trusting</i>	-2.31	0.83	-0.24	-2.78	.006

Note. $R = .67$, R^2 for model = .45.

was neutral. In favor of the predictive validity test by Mehling et al. (2012), the paths for *Emotional Awareness* and *Body Listening* were also convergent for the undergraduate students, although a modestly higher standardized regression coefficient for *Body Listening* was observed.

The results of the regression for hospital nurses are depicted in Table 3.2. The direction of supported regressions matched the original validation for dimensions except for *Noticing* and *Trusting*, although the latter was of a smaller magnitude in association. Again, *Not-Worrying* and *Self-Regulation* provided supported standardized regression coefficients that were consistent with the original validation. Compared to incremental validity observed in the original study, however, our sample of nurses showed a larger supported regression coefficient for *Body Listening*.

Table 3.2. Regression analysis demonstrating incremental validity for the MAIA dimensions in the prediction of STAI-T scores for hospital nurses.

<i>STAI-T</i>	<i>B</i>	<i>SE</i>	<i>β</i>	<i>t</i>	<i>p</i>
<i>Noticing</i>	1.74	1.52	0.18	1.14	0.26
<i>Not-Distracting</i>	-2.01	0.93	-0.29	-2.15	0.04
<i>Not-Worrying</i>	-2.37	1.21	-0.26	-1.95	0.06
<i>Attention Regulation</i>	-1.70	1.77	-0.18	-0.96	0.34
<i>Emotional Awareness</i>	-1.65	1.45	-0.20	-1.14	0.26
<i>Self-Regulation</i>	-3.65	1.68	-0.40	-2.18	0.03
<i>Body Listening</i>	2.52	1.36	0.32	1.85	0.07
<i>Trusting</i>	0.63	1.22	0.09	0.52	0.61

Note. $R = .45$, R^2 for model = .20.

4. Discussion

The present study provided notable replications and new insights on the ability for the MAIA to predict trait anxiety. As more than one dimension showed paths predicting trait anxiety at pre-test, this study replicated that there are psychometrically identifiable sources of body awareness that support the notion of multidimensional construct validity established by Mehling et al. (2012). With the exception of *Noticing*, STAI-T scores were generally not positively associated with the MAIA dimensions (Table 2.1) in favor of the generalizability of the results of the original validation. In contrast, the poorer reliability among hospital nurses whose trait scores were elevated and the observation of positive relationships with STAI-T in both samples suggest that the *Noticing* subscale might contain elements of awareness that encompass negative attention to the body. As this has not been previously reported in studies on the MAIA, this observation should be cautiously interpreted but explored in future studies perhaps investigating item content validity or the plausible influence of issues in translation or cultural factors as they relate to Japan. However, as the chief interpretation of the results, the supported path coefficients for *Not-Worrying* and *Self-Regulation* especially offer support in favor of the original validation and add to the evidence base that suggests that the MAIA measures multidimensional and positive forms of attention related to body awareness (Bornemann et al., 2015; Brown et al., 2018) that are generally separate and divergent from trait anxiety itself.

The inconsistencies in reliability and path coefficients for *Not-Worrying* and *Not-Distracting* are well-documented in previous studies and have since been addressed in work on the MAIA-2 (Mehling et al., 2018) whose revised version and items were not available at the time of the study. Thus, the most interpretable results are those for *Self-Regulation* as a strong and supported predictor of trait anxiety in both samples, but especially among undergraduate students, and represents a key finding for the construct in Japan. This is due to the fact that validation studies on the Japanese MAIA by Shoji and colleagues (2018) and Fujino (2019) provided support for a 6-factor model that was investigated in undergraduate students but did not specify *Self-Regulation* as a dimension. Instead, their model did not identify *Self-Regulation* but retained one item from the original subscale that loaded onto *Body Listening*. Our study used a known groups validation approach to incremental predictive validity for trait anxiety and replicated the construct validity test of the original validation by Mehling et al. (2012). The results depicted in Table 3.1 do not support the specification of the proposed 6-factor model of the Japanese MAIA among undergraduate students in its loss of the theoretically important dimension of *Self-Regulation*. Enhanced self-regulation continues to be one of the most important drivers of the mechanisms of mindful attention to and awareness of the body (Hölzel, Lazar, Gard, Schuman-Olivier, Vago, and Ott, 2011) and *Self-Regulation* was the result of a theory-driven component of the a *priori* conceptual framework for identifying “mind-body integration” in the original MAIA (Mehling et al., 2012). Our findings for trait-related prediction of *Self-Regulation* also align with the major finding by Bornemann et al. (2015) who observed longitudinal changes in *Self-Regulation* from body scan training which serves as a key indicator for the merits of the MAIA framework of constructs. Given synthesis with these results, our findings that indicate trait-relevant support for *Self-Regulation* in Japanese samples of participants suggest that the limitations in sample characteristics noted by Shoji et al. (2018) and Fujino (2019) might be influencing the idiosyncrasies in confirmatory factor structure identification for the Japanese MAIA.

Our findings also offer implications for trait anxiety and attention tendencies among university students in Japan. Adaptation to university life is facilitated by effective time management, access to social support, belief in academic abilities, and the development of effective coping styles for new tasks (Shankland et al., 2010; Macan et al., 1990). As interoceptive attention tendencies have shown sensitivity to change from interventions (Bornemann et al., 2015; Mehling et al., 2018), the present study suggests

that the MAIA dimensions might be a worthy target for evaluating outcomes from stress management with relaxation training (Ki, 2015) or health promotion that emphasizes self-regulatory management through educational vehicles of body awareness (Landsman-Dijkstra, van Wijck, Groothoff, and Rispens, 2004).

This study also yielded unique insights on the relationship between body awareness and anxiety in hospital nurses undergoing a stress management program for burnout prevention. The mean STAI-T scores for the nurses in our study were higher than normative data by Iwata et al. (1998) on Japanese professional adults, but less than the cutoff score of 54 suggested to signify or detect clinical symptoms of anxiety in adults. This suggests that the hospital nurses represented a known group with higher anxiety proneness that is suitable for a primary prevention context. The mean scores for *Body Listening* among hospital nurses were comparably lower than the undergraduate students in our study, and a positive regression coefficient for *Body Listening* was observed for the nurses as a predictor of marginal significance for trait anxiety. Previous studies have observed characteristically lower mean scores for *Body Listening* in adults with eating disorders in Brown et al. (2018) and veterans undergoing an exercise program for post-traumatic symptoms in Mehling et al. (2018). Our findings offer further support for *Body Listening* as an attention tendency of relevance to public mental health outcomes and suggests that altered interoceptive sensibility in samples with higher anxiety proneness might be worthy of further study.

5. Limitations

This study was limited by its cross-sectional design. For the sample of hospital nurses, as in other studies of nurse burnout, our sample was also overwhelmingly female, limiting the generalizability across genders. Future studies could work to incorporate other predictors or investigate the model in a larger sample size in ways that could continue to account for sample variation. Finally, as burnout symptoms were not directly measured, future studies or efforts to provide primary prevention should consider including relevant psychometric instruments such as the Maslach Burnout Inventory for greater specificity of effects or relationships with interoceptive attention tendencies (e.g., *Body Listening*).

6. Conclusion

This study largely replicated the findings of the original validation by Mehling et al. (2012) in support of incremental validity for the MAIA as a measurement tool for interoceptive attention tendencies in public mental health educational settings. Key convergence occurred in self-regulatory body awareness and key differences emerged for the tendency to notice and inform changes about the body and listen to the body for insight. With the exception of *Noticing*, the assumption that the instrument measures “positive” body awareness dimensions was maintained from comparison and confirmation of predicted relationships to trait anxiety.

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