学位論文要約

Interoceptive attention tendencies and their role in applications of Self-Active Relaxation Therapy

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TABLE OF CONTENTS

Chapter 1: Introduction

1.1 Statement of the Problem

Mental health promotion programs targeted at the community recovery of disasters (e.g., areas with chronic environmental stressors) must be sufficiently broad and balanced enough to appeal to healthy people while still raising awareness of common mental disorders and providing a skill that is meaningful for adaptive behavioral adjustments to the stressors relevant to everyday life (Reich & Goto, 2015). In one prominent and specific example of hospital nurses as individuals affected by and involved in this community recovery process from a compound disaster, the ability to cope with daily life burdens and work-related stressors were actually found to be more important for mental health support than that of acquiring greater knowledge, information, and know-how for control methods related to the source of the disaster (Nukui et al., 2017). This exemplar underscores the need to provide appropriate and evidence-based mental health promotion programs as support for affected individuals in the recovery phase. Toward this end, this thesis identifies a stress management program based on a Japanese psychotherapy that has been used as a vehicle for mental health support in disaster recovery and (1) provides comprehensive and culturally appropriate steps to address the validity of its underpinning framework in body awareness constructs, and (2) evaluates degrees of its effectiveness as a public mental health promotion program for applications to aforementioned contexts vis-à-vis its proposed mechanism of psychological change.

Self-Active Relaxation Therapy (SART) has successfully demonstrated applicability in the disaster recovery context of tsunami-affected areas of Iwate Prefecture over seven years. SART was formulated by Hiroyuki Ohno in 2005 as a subset configuration of the Japanese psychotherapy known as Dohsa-hou. The motor vocabulary of Dohsa-hou contains two sets of designations for the application of attentional resources to action execution: relaxation movement tasks that target the release of bodily tension through stretches, and *tate-kei* movement tasks that target re-assertion of body control by achieving postural corrections (Chervenkova, 2017). Accordingly, both approaches use the same repertoire of motor vocabulary and target changes in body awareness (Fujino, 2012; Konno, 2016) but differ in aspects of approach, procedure, and philosophy such that SART integrates agency and behavioral coping skills through *client*-generated movements that promote "self-activeness" (Ohno, 2010; Konno, 2016), over the therapist-driven and support-dependent goals of the broader approach to Dohsa-hou (e.g., using *omakase* to entrust the therapist to guide *tate-kei* movement tasks). By way of analogy, in the same way that

specified configurations of cognitive behavioral therapy (CBT) such as Trauma-Focused CBT and Mindfulness-Based Cognitive Therapy were developed as domain-centered or collaborative approaches using CBT, SART was developed as a relaxation-centered configuration derived from the theory and techniques used in Dohsa-hou and shares its goals for the experience of psychological change.

Relaxation training programs utilizing SART have shown effectiveness for changing mood states (Mukasa & Ohno, 2016), managing stress reactivity (Ohno, 2015; Ki, 2015; Motomura & Ohno, 2017), and experiencing the subjective sense of motor resonance as a form of agentic control over the body (Ohno, 2010). Despite its known utility and continuity as a program and the fact that its movement tasks have shown physiological changes through electromyography (Mukasa & Ohno, 2016), a foundational and requisite area for establishing the evidence basis in the purported changes to body awareness involves the selection and verification of a centralized framework for measuring positive psychological change. This fundamental issue is inextricably linked to overarching and incomplete validation efforts for its related measurement tools of summary constructs. A framework of focal constructs related to the experience(s) of motor action facilitating changes in feeling states and attitudes toward movement quality known as the Dohsa-hou Experience Scale was described by Ikenaga (2011) and psychometrically investigated by Inoue (2014) using both types of movement tasks in Dohsa-hou, although these efforts relied on chiefly exploratory factors with limited external validation and inadequate sample sizes for securing model specification. While criterion evidence was established with mean score increases, the evidence base regarding these constructs has been extremely limited by language and circumstantial fitness for use to Japanese samples of convenience. Thus, these emic constructs and their associated items and measures, while valued as an independently derived framework, have not been widely investigated with comprehensive comparisons of related or relevant constructs that would secure the validity of their body awareness. The lingering lack of a common platform of valid constructs and reliable measure for documenting change impedes the ability for researchers to understand how or if SART and Dohsa-hou generally might compare to other psychotherapeutic approaches that target body awareness.

Contemplative and body-mind approaches are gaining ground as popular choices for lifestyle-oriented mental health promotion programs by dint of their focus on stress and anxiety management through proposed self-regulatory components (Hölzel, Lazar, Gard, Schuman-Olivier, Vago, & Ott, 2011). One prominent and primary driver underpinning the mechanism of their conferred benefits is through

changes in self, attentional, and regulatory awareness of bodily sensations, known as *interoceptive awareness.* In contrast to the preliminary work of Inoue (2014), Mehling et al. (2009) systematically reviewed all available body awareness constructs and measures and evaluated the status and limitations of their psychometric quality. As a result, body awareness constructs were found to encompass multiple dimensions related to processes that result from functional neuroanatomical cascades tied to *interoception*, or the neurobiological process that involves the integration and awareness of physiological signals from the body (Vaitl, 1996; Craig, 2002; Khalsa et al., 2017). In one of the major theory-driven attempts to psychometrically capture the collection of senses tied to interoceptive processes, Mehling and colleagues (2012) developed a comprehensive scale for measuring regulatory dimensions and attentional styles to neutral and adaptive ("positive") forms of body awareness (i.e., such that conceptions can be discriminated from maladaptive and anxious forms of body vigilance or arousal) known as the Multidimensional Assessment of Interoceptive Awareness (MAIA). Due to ambiguity associated with the monolithic term "interoceptive awareness", recent efforts have moved to call the dimensions modes of attention to perceived bodily signals measured by self-report methods and labeled under the umbrella of *interoceptive attention tendencies* (Khoury, Lutz, & Shuman-Oliver, 2018). The strengths of the MAIA include its widespread utility for conditions tied to issues of psychosomatic relevance, ranging from individuals with eating disorders (Brown et al., 2017), chronic pain (de Jong et al., 2016; Borg et al., 2018), post-traumatic stress symptoms (Mehling et al., 2018), and others (Mehling, 2016).

1.2 Purpose of the Study

Due to its systematic validation, cumulative evidence across numerous research contexts, and progress toward instrument maturity with operationalizable constructs, this thesis proposes that interoceptive attention tendencies measured by the MAIA might represent a candidate framework for SART to establish a basis in comparative evidence in effects on body awareness. The central questions highlighted in this summary are fourfold: (1) to determine whether positive body awareness constructs via the MAIA are valid internally and cross-culturally with latent variable analysis (Study 1) and incrementally in collaborative research using resting state EEG (Study 2); (2) to address ongoing issues with the model specification of the Japanese scale using an overlooked test of predictive validity using regressions with trait anxiety that were conducted in the original validation (Study 3.1); (3) to ensure that the transported scale of the MAIA as an etic framework demonstrates relationships with emic (focal)

constructs developed for SART using correlational analysis (Study 3.2); and (4) to evaluate whether stress management programs that use SART can be leveraged to facilitate positive psychological change via the proposed mechanism through analysis of its effects on interoceptive attention tendencies in a university student sample with a test-retest control group (Study 4) and early-career hospital nurses (Study 5) as a field test for public mental health promotion.

Chapter 2: Psychometric Properties of Interoceptive Attention Tendencies

2.1 Cross-national questionnaire survey: tests of instrument validity (Study 1)

This initial study aimed to compare the Japanese MAIA with the English MAIA to determine numerous indicators of psychometric quality and validity. A survey of the MAIA was conducted with participants from an independent random sample of the general population from Japan (N = 407, 204 females; M age = 42.73, SD = 8.45; 100% ethnically Japanese) and the United States (N = 204, 102 females, M age = 33.26, SD = 9.35; 66.19% Caucasian, 19.05% African American, 8.10% Asian American, 0.95% Native American or Alaska Native, 0.48% Native Hawaiian or Pacific Islander, 5.24% other ethnicity; multiple ethnicities allowed) using the Qualtrics internet survey research platform. The panel of participants was gender- and population density-matched across both nations to form a geographically diverse sample of community participants (42 states from the U.S. and 41 prefectures from Japan represented). All participants gave their informed consent to participate, fully completed the survey, and all responses were retained for analysis. The study was conducted in line with a protocol approved by the ethical research committee of the Graduate School of Education, Hiroshima University.

Outcome measure. *Multidimensional Assessment of Interoceptive Awareness*. (MAIA, Mehling et al., 2012). The MAIA is a 32-item self-report measure of body awareness. It purportedly captures eight dimensions as tendencies in beliefs, attitudes, thoughts, and emotions toward interoceptive stimuli: (1) *Noticing*, (2) *Not-Distracting*, (3) *Not-Worrying*, (4) *Attention Regulation*, (5) *Emotional Awareness*, (6) *Self-Regulation*, (7) *Body Listening*, and (8) *Trusting* (see Summary Table 1 for factor descriptions and sample items). A 6-point scale from 0 (*not at all*) to 5 (*always*) is used to rate each item. Japanese versions of the items and instructions were translated by Shoji, Ohno, Herbert, and Mehling and available from the University of California, San Francisco Osher Center for Integrative Medicine website in 2014, but validation of the Japanese scale was not available until Shoji, Mehling, Hautzinger, and Herbert (2018). The original English language MAIA developed by Mehling et al. (2012) and the version of the original

items translated into Japanese language by Shoji, Ohno, Herbert, and Mehling in 2014 were distributed to the United States and Japan samples, respectively. As seen in Summary Table 1, acceptable internal consistency through alpha and omega estimates was observed for all dimensions except *Not-Distracting* and *Not-Worrying*, in line with previous studies.

Statistical analysis. Bayesian confirmatory factor analysis was performed using the *blavaan* package in *R* (Merkle & Rosseel, 2018) to evaluate and compare the validity of the previously proposed 1-factor, 8-factor, and 8-factor with cross-loadings solutions of the MAIA. Prior variances were set to 0.01 according to the method and template of the Bayesian factor analytic approach for the MAIA previously established by Reis (2017) and in accordance with Muthén and Asparouhov (2012). Output includes the Widely Applicable Information Criterion (WAIC), leave-one-out index of cross-validation (LOO), Deviance Information Criterion (DIC), Bayesian Information Criterion (BIC), and posterior predictive *p*-value (PP *p*) checking. Fit indices and information criteria were compared as model selection measures for the MAIA in the Japanese sample of participants. The number of samples was set to 20,000 after 10,000 burn-in iterations. The Potential Scale Reduction Factor (PSRF) was used to check the convergence of our models. All values of the PSRF were below 1.1, which indicates satisfactory model convergence (Gelman & Rubin, 1992; Merkle & Rosseel, 2018).

Results for structural validity. Table 2.1 displays the fit indices from each procedure for the Japanese sample. Model comparison via information criteria with particular attention to the WAIC and LOO as relative fit indices suggested that the 8-factor model with cross-loadings is the model with the most support for acceptance.

Table 2.1. *Fit indices from Bayesian confirmatory factor analysis of the MAIA in the Japanese context.*

Model	Number of Free Parameters (#)	PP *p*	BIC	DIC	WAIC	LOO
1-factor model with default priors	192	0.000	54594.51	53739.41	53798.94	53803.65
8-factor model with default priors	248	0.000	**54268.16**	53110.92	53224.31	53234.83
8-factor model with cross-loadings	696	0.000	56269.87	**52389.29**	**52712.23**	**52738.66**

Results for criterion-related validity. Experience with contemplative and body-mind health practices corresponding to higher mean scores on the MAIA were examined, emulating prior studies (Mehling et al., 2012). The general trend among the mean scores suggests that the MAIA captured lesser

awareness of bodily signals in the Japanese sample compared to the American sample (Summary Table 1). Notably, these results are similar to the lesser mean scores observed for the factors whose specification remained unchanged in the Shoji et al. (2018) MAIA-J model (*Attention Regulation, Trusting,* and *Not-Distracting*) and the 8-factor by Fujino (2019). Overall, the number of participants who routinely do contemplative or body-mind practices for health were found to be far fewer in Japan (n = 76; 18.7%) than that of the participants in the United States (n = 140; 67.6%). Between-group differences in MAIA scores for experienced study participants within Japan and the United States of America were compared with an independent sample t-test (Welch's). Participants who practice behavioral health practices demonstrated higher mean scores for the reliable MAIA dimensions in both the United States (all ts > -2.07, all ps < 0.020, except *Trusting*) and Japanese (all ts > -2.80, all ps < 0.016) survey data as contexts. This offers support for criterion-related validity for the interoceptive attention tendencies measured by the MAIA, notably unverified by Shoji et al. (2018) and Fujino (2019) in their validations of the MAIA-J.

Results for measurement equivalence. Data from both the Japan and United States samples were cross-validated through a multi-group confirmatory factor analysis (MG-CFA)-based approximate measurement invariance (MI) procedure. For comparison of cross-cultural equivalence between the Japanese and English versions of the MAIA, the *blavaan* package in *R* was applied. The number of samples was set to 20,000 after 10,000 burn-in iterations. Determination of the level of equivalence established was based on the smallest values for each information criterion. Table 2.3 displays the fit indices from the procedure. The smallest DIC value aligned along the test of configural invariance and the smallest BIC value emerged along the test of scalar invariance. However, both the WAIC and LOO values were lowest at the test of equal factor loadings, indicating support for approximate metric invariance.

Table 2.3. *Fit indices for equivalence testing of the Bayesian model of the Japanese MAIA constrained against the reference population data of the American context. Smaller values in information criteria support the level of approximate equivalence attained.*

Measurement Invariance	Number of Free Parameters (#)	PP p	BIC	DIC	WAIC	LOO
Configural	696	0.000	56267.42	**52389.06**	52703.35	52720.39
Metric	448	0.000	54760.58	52436.79	**52667.81**	**52691.48**
Scalar	424	0.000	**54665.76**	52449.54	52674.66	52701.21

Discussion. As can be seen in Table 2.1, the values for the DIC, WAIC, and LOO indices were smaller in the 8-factor model with cross-loadings representing the best tradeoff between model fit and model complexity, as well as supporting, by extension, an alignment with the theoretically derived dimensionality along eight factors, in contrast to the findings of the MAIA-J factor structured reported by Shoji et al. (2018) and in support of an 8-factor fit reported in Fujino (2019). These results provided evidence that supports approximate metric invariance between the Japanese and English versions of the MAIA. This indicates that the subscales are measuring nomologically similar dimensions of interoceptive attention tendencies, and that the factor loadings can be compared between the United States and Japan under moderate statistical conditions. Furthermore, this offers support for the notion that perceived bodily signals have a multidimensional character that is recognized across cultures, and that the MAIA scale and its constructs form a tractable framework for attention tendencies related to body awareness.

2.2 Neurophysiological indices: incremental validity from resting-state EEG theta power (Study 2)

Pragmatically identifying and operationalizing variables that connect the subjective awareness of bodily states to physiological processes involved in interoception shows promise for providing cross-cutting insights into emotion, psychopathology, and neurophysiology. Empirical support for the validity of the constructs of the MAIA has yet to be tested using the non-invasive neurophysiological techniques of resting-state electroencephalography (rsEEG), despite the fact that power outcomes using rsEEG and attentional processes have been well-documented in healthy populations and patient groups exposed to especially mindfulness-based experimental tasks (Lomas, Ivtzan, & Fu, 2015). In addition, while relationships for the MAIA and brain regions have been mapped using fMRI (Stern et al., 2017), the MAIA scores were statistically manipulated under conditions that did not conform to its theoretical factor structure, making it difficult to draw conclusions about the role or priority of component dimensions. Furthermore, while fMRI is the standard for providing insights about spatial resolution, EEG as a method provides superior temporal resolution that might be key for capturing the attentional processes common to contemplative and bodymind health practices that the MAIA operationalizes.

Methods. This study compared individual differences in the MAIA factor scores and EEG band power for ninety-three healthy participants (49 males, *M* age = 20.08, *SD* = 1.32) under eyes-closed (EC) and eyes-open (EO) resting state conditions. This study first investigated theta-beta power ratios with the MAIA factors, but relationships were not observed (data not shown). Instead, localized mean power

intensities from rsEEG as trait-level individual differences were compared with scores on the MAIA dimensions in terms of its original factor structure as interoceptive attention tendencies.

Results. After controlling for the effects of age, gender, and body mass index, partial correlations revealed that power indices for theta oscillations was especially negatively correlated with the *Self-Regulation* subscale of the MAIA across both resting conditions at the frontal, midline, and parietal electrode locations. This main result suggests that particularly the self-reported index of *Self-Regulation,* which measures the degree that an individual feels capable of regulating perceived signals by returning to one's body and breathing, coheres with especially frontal (EO at F3: r = -0.34) and midline (EC at C3: r = -0.30) resting state theta activity processes.

Discussion. These findings of rsEEG correlates for MAIA dimensions as interoceptive attention tendencies is consistent with previous studies that found enhanced theta power in healthy groups that conduct mindfulness as a behavioral health practice (Lomas, Ivtzan, & Fu, 2015). The result also reflects not only trait coherence from rsEEG as theta activity is tied to phenomena such as behavioral variability reduction, cognitive control mechanisms, and relief from anxiety. The main finding shows support that underlying neurophysiological processes in especially frontal theta oscillations are reflected in self-reported scores for a regulatory interoceptive attention tendency, which is in alignment with theories of enhanced self-regulation from body awareness (Hölzel et al., 2011).

Chapter 3: Integrated Tests of Nomothetic Span with the Combined Emic-Etic Approach

3.1 Predictive validity: multidimensional model with self-regulatory items replicated from regressions onto trait anxiety (Study 3-1)

As mentioned in earlier sections, two studies on the factor structure of the Japanese version of the MAIA have been conducted to date (Shoji et al., 2018; Fujino, 2019) that provided important indicators of external validation. However, specification for the *Self-Regulation* dimension for the MAIA among Japanese participants was not supported in the 6-factor model put forth by Shoji et al. (2018). The authors surmised that the resultant item assignment and model changes could be amenable to using university students as sample participants. The line of evidence from findings of this thesis are contrary to this lack of specification for *Self-Regulation* on two accounts: the demonstration of approximate metric invariance for the English and Japanese scales that suggests factor identification of *Self-Regulation* in the general population and the emergence of trait coherence for the factor with theta power indices using rsEEG with

university students as participants. Neither Shoji et al. (2018) nor Fujino (2019) conducted the construct validity test for the MAIA factors to predict trait anxiety scores performed in Mehling et al. (2012; Part 5, p. 18). As a test of the multidimensional configuration that includes *Self-Regulation* items in the original validation, and to clarify the contribution of these factors with as an indication of predictive validity, this study performs regressions of the MAIA factors onto trait anxiety in a sample of university students.

Study design. A stress management education program with SART relaxation asks based on Ki (2015) and Yamanaka and Tominaga (2000) using a study design for evaluation of intervention effects was implemented across the remaining three studies summarized in this report. The experimental flow for providing the SART-based stress management education program (shared for Study 3-1, 3-2, 4, and 5) are depicted in Table 3.1A.

Table 3.1A. Implementation design flow for the psychoeducational application, "Stress Management Education Program with Self-Active Relaxation Therapy Movement Tasks."

1. **Examining the State of Your Mind and Body**
   Raising awareness about your mind and body in the here-and-now
   - Explanation of the distributed questionnaire packet materials
   - Postural and center-of-gravity check

2. **Responses to Stress and Coping Strategies**
   Learning about stress as a phenomenon and understanding ways of coping
   - Listing and recognizing your own personal stressors and coping strategies
   - Sharing your strategies in group discussion and learning about the experiences of others

3. **Measuring the State of Your Mind and Body**
   Testing of the current state of your attitudes toward your mind and body
   - Obtaining informed consent to collect the answers as data
   - Systematic provision of test instructions and providing pre-test answers to the psychometric instruments: *STAI-T, STAI-S (Pre), MAIA (Pre)*

4. **Acquiring Relaxation as a Coping Skill for Stress Management**
   - Performing Seated SART Relaxation Tasks: Shoulder Raise and Drop *(Elevation and Depression at the Shoulder Joint)*, Chest Block and Shoulder Blade Stretch (*Flexion and Extension of the Shoulder Joint)*, Static Neck Stretch *(Abduction of the Neck Muscles from the Shoulder Joint),* Trunk Twist *(Extension at the Hip Joint)*

5. **Comparing Changes to the State of Your Mind and Body**
   - Proctoring instructions and providing post-test answers to the psychometric instruments: *Dohsa-hou Experience Scale (DES), STAI-S (Post), MAIA (Post)*
   - Self-calculation of summary scores and discussion of effects, if they emerged

6. **Applying Stress Management Strategies in Everyday Life**
   - Further details and open discussion about ways to recognize your coping strategies as ways to conduct stress management at-home
   - Emphasizing the connection between the body and mind and how to leverage that awareness in adaptive ways

Methods. Cross-sectional data at pre-test (Step 3 of Table 3.1A) were collected from university students participating in the stress management education program (N = 169; 80 males, 89 females; 53% female; M age = 19.07, SD = 0.73; range: 18-23 years old). The MAIA dimensions were entered as

predictors with STAI-T (trait anxiety) as the response variable through a linear regression in line with the analysis conducted in the original MAIA validation study by Mehling et al. (2012; p. 18, R^2 = .41.).

Results. The results for the 169 university students are depicted in Table 3.1B. 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 was neutral and strongly unrelated. 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 university students, although a modestly higher standardized regression coefficient for *Body Listening* was observed.

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

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

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

Discussion. This study replicated psychometrically identifiable sources of body awareness that support the notion of multidimensional construct validity and nomothetic span established by Mehling et al. (2012) that suggest retaining the factor of *Self-Regulation* for Japanese participants. With the exception of *Noticing*, the results favor generalizability of the original validation through supported path coefficients for especially *Not-Worrying* and *Self-Regulation*. This trait-related prediction for *Self-Regulation* also aligns with the major finding by Bornemann et al. (2015) who observed longitudinal changes for the factor from body scan training. These findings indicate trait-relevant support for *Self-Regulation* from predictive validity of STAI-T among Japanese university students and stand in further contrast to the findings of Shoji et al. (2018) who performed validation with participants sharing these sample characteristics.

3.2 Emic and etic agreement: concurrent validity from convergent associations with measures used in SART (Study 3-2)

Using data from the same intervention study of the sample of 169 university students, theoretical and cultural considerations as tests of nomothetic span under a combined emic-etic approach were explored for the DES and MAIA as they were concurrently measured at post-test (Step 5 in Table 3.1A). Precise relationships between the constructs of body awareness were compared to establish agreement between the focal constructs from the DES as an indigenous (emic) scale and the MAIA as a transported (etic) scale (Cheung, van de Vijver, & Leong, 2011). In addition, associations were used to disambiguate areas of content validity using the more psychometrically mature MAIA instrument. This study examined whether dimensions of positive body awareness are convergently or divergently associated with variables from an existing framework of responses to movement experiences described by SART.

Methods. Interoceptive attention tendencies were measured using the Multidimensional Assessment of Interoceptive Awareness (MAIA) and compared with the Dohsa-hou Experience Scale (DES; a post-test evaluation instrument) in the same sample and dataset of university students ($N = 169$) participating in the SART-based stress management program using Pearson's correlations.

Results and discussion. In support of two foundational accounts of theoretical convergence for the nomothetic span between the DES and the MAIA, positive correlations were observed for *Bodily Self-Awareness* and *Noticing* (*r*s: 0.31-0.34) and *Experience of Feeling States* and *Emotional Awareness* (*r*s: 0.30-42). In addition, the control-related constructs of the DES correlated with regulatory MAIA dimensions and provided insights into the content of the more internally consistent "Sense of Self-Activeness" as a facet (*Attention Regulation*: $r = 0.39$, *Emotional Awareness*: $r = 0.38$, *Self-Regulation*: $r = 0.37$, *Trusting*: $r = 0.41$). Overall, the observed relationships offer indications of emic and etic agreement for body awareness constructs in an integrated measurement approach (Church, 2001; Cheung, 2009; Cheung, van de Vijver, & Leong, 2011).

Chapter 4: Effects of Stress Management Applications of Self-Active Relaxation Therapy on Interoceptive Attention Tendencies

4.1 Effects of the intervention on interoceptive attention tendencies in university students (Study 4)

Study design. Pre-post changes in self-reported anxiety as a manipulation check for the intended effect of intervention (State-Trait Anxiety Inventory, Form-X; STAI) and attention styles to the body

characterized as positive body awareness (MAIA) were investigated to evaluate degrees of change in interoceptive attention tendencies, if any, that might occur from the stress management education program with university students ($N = 169$).

Results. Paired sample *t*-tests showed decreases from baseline in state anxiety with an effect size ($t = 10.542$, $d = 0.804$) and modest increases in the dimensions of *Noticing, Emotional Awareness, Self-Regulation, Body Listening,* and *Trusting* at post-test (ts > 4.922, ps < 0.001, ds > 0.379) within subjects.

A between-subjects independent sample *t*-test of the MAIA dimensions (Welch's) was performed between a test-retest control group of university students who separately participated in the stress management lecture as psychoeducation but did not conduct the SART tasks ($N = 29$) and the university student sample ($N = 169$) who experienced the SART tasks as relaxation coping skills. The mean scores for MAIA dimensions within the test-retest control group did not significantly change from psychoeducation at pre-test (ts < 1.353, ps > 0.187) or post-test (ts < 0.854, ps > 0.401). The mean pre-test scores between the test-retest control group and SART group were not different for all MAIA dimensions (ts < 1.605, ps > 0.117), allowing for a simple comparative examination of intervention effects between the groups at post-test.

Discussion. The results showed that stress reduction via state anxiety occurred to verify the effect of the intervention as a manipulation check, and that compared to the test-retest control group, the positive body awareness constructs of *Attention Regulation* ($d = 0.532$)*, Self-Regulation* ($d = 0.437$)*,* and *Trusting* ($d = 0.569$) favored the intervention group including SART relaxation tasks in the stress management program. These results provided specificity of the body awareness components above with effect sizes that can be compared with global studies and programs utilizing the MAIA.

4.2 Effects of the community intervention on interoceptive attention tendencies in a primary prevention program for hospital nurse burnout (Study 5)

Methods. The intervention was applied to a public mental health promotion context of early-career nurses ($n = 66$, M age = 25.68, $SD = 3.01$) at a hospital in Hiroshima City to evaluate degrees of change in positive body awareness with the same stress management intervention and study design protocol depicted in Table 3.1A.

Results and discussion. Paired sample *t*-tests showed decreases from baseline in state anxiety (State-Trait Anxiety Inventory, Form-JYZ; $t = 11.262$, $p < 0.001$, $d = 1.386$), and increases in the

dimensions of *Attention Regulation* ($t = 2.256$, $p < 0.027$, $d = 0.278$), *Self-Regulation* ($t = 3.158$, $p = 0.002$, $d = 0.389$), *Body Listening* ($t = 4.168$, $p < 0.001$, $d = 0.513$), and *Trusting* ($t = 2.198$, $p = 0.031$, $d = 0.271$) at post-test. Overall, the results indicated that SART-based stress management provided within-subject changes to these four valid interoceptive attention tendencies. While only an initial field test implementation in a brief session format, these effects can be preliminarily compared to changes in MAIA factor scores from global implementation studies. The ability for the program to confer state anxiety reduction and positive body awareness enhancement along these four factors suggests that the program could applied to address the needs for hospital nurses to deal with daily life burdens and work-related stressors in contexts such as those reported in Nukui et al. (2017).

Chapter 4: General Discussion

4.1 Summary of Main Findings

Interoceptive attention tendencies encompass the ability to sense and interpret of signals from the body in a regulatory manner. SART packages versatile body movement tasks designed to induce a relaxed response and foster a sense of bodily awareness attenuation through self-generated, habituated performance. Findings from a comprehensive review of SART emphasized the need for a formal and internationally recognized framework of constructs to better understand the domains and precision of gains in or regulation of bodily awareness.

As a result of the psychometric evaluations of the properties of the Japanese version of the MAIA (Study 1), evidence of structural (internal) validity for the theoretical structure of the MAIA was supported. Concurrent with previous studies demonstrating criterion-related validity, the difference in mean scores among participants experienced and inexperienced with contemplative and bodymind health practices suggests that the MAIA framework for interoceptive attention tendencies constructs are sensitive to change related to behavioral health practices that hold promise as candidates for intervention in bodily-focused psychological conditions (Rogers, Hagan, & Joiner, 2018; Mehling et al., 2018; De Jong et al., 2016). For cross-cultural validity, approximate metric invariance was supported by comparison of information criteria, and analysis of salient loadings supported factor determinacy. These findings suggest that the Japanese and English MAIA instruments measure dimensions of interoceptive attention tendencies that are comparable in terms of factor loadings.

Providing indications of empirical support for the MAIA dimensions in collaborative research with the cognitive psychology laboratory, Study 2 evaluated incremental validity considerations using resting-state EEG power indices. The negative relationship discovered between *Self-Regulation* and theta power aligns with other studies that have connected individual differences from self-report to cognitive interference reduction and relief from anxiety through their trait coherence and adds to the discussion of psychobiological implications for interoceptive processes. Predictive incremental validity for factor structures of the MAIA that retain *Self-Regulation* was also established through supported regressions onto trait anxiety that largely replicated the test of construct validity in the original validation (Study 3.1).

Finally, fitness for use of the MAIA with SART was evaluated in a series of applications of SART to a stress management program in Chapter 4. Building upon the findings from Study 1 suggesting that interoceptive attention tendencies are sensitive to change, positive body awareness enhancement was observed in two contexts of university students (Study 3) and nurses (Study 4) for state anxiety and the MAIA dimensions *Attention Regulation, Self-Regulation,* and *Trusting*. These findings show that the MAIA framework and SART possess indicators and degrees of effectiveness in applications of targeted positive change via body awareness in public mental health settings.

4.2 Study Strengths and Implications

Mental health promotion programs are known to contribute to mechanisms of self-awareness, and it has been posited that similar training may allow people to achieve skills for self-regulation or emotional regulation through the promotion of especially positive or regulatory forms of body awareness as understood by instruments such as the MAIA (Price & Hooven, 2018). In a first attempt to apply the MAIA framework to a stress management program, the studies conducted in this report provided supported effect sizes for changes in regulatory interoceptive attention tendencies upon experiencing SART. The MAIA was employed as an outcome assessment of targeted programs or interventions with results that can be assessed in line with previous studies (Bornemann et al., 2015; Farb et al., 2015; Fissler et al., 2016; De Jong et al., 2016). While former SART studies have observed qualitative reports of body awareness and within-subject changes in mood and stress responses with case-control designs in children, this is the first set of studies to systematically account for changes with a formal framework of body awareness in adults and compared with a test-retest control group. Theoretical convergence between the scales made to track changes in SART applications also indicated emic-etic support for interoceptive

attention tendencies as a common platform as the body awareness constructs of the DES were found to correlate with the MAIA dimensions in a convergent manner (Study 3.2).

Establishing self-regulatory trait coherence for a dimension of the MAIA with resting-state EEG theta power represents an original finding of significance to researchers of interoceptive attention tendencies across the world. Studies have shown that resting state EEG indices function as a stable trait over time (Corsi-Cabrera et al., 2007) and are governed by genetic factors (Smit et al., 2005), and reflect human behavioral and autonomic activation processes (Massar, Kenemars, & Schutter, 2014; Vaitl, 1996; Takahashi et al., 2005). Theta band power in midfrontal areas has been associated with the transient application of cognitive control to prevent impulsive responses as mindful attention style facilitating self-regulation (Papies, Barsalou, & Custers, 2012), and frontal theta is involved in the recruitment of cognitive control (Cavanaugh & Frank, 2014; Massar et al., 2014), suggesting convergent evidence with the content and purpose of *Self-Regulation* as an indicator.

4.3 Limitations and Future Directions

While this dissertation offers support for applicability from generalizable samples of healthy populations into clinical settings, the direct relationship between these groups and domains will require further scrutiny under strong experimental conditions. In addition, the claims of inferential synthesis for the self-regulatory relationships between the MAIA and SART are limited as they were not directly investigated at the level of task and neural activation, but associations among individual differences that were ad hoc interpreted as *a priori* assumptions with theta-beta ratios as indicators of attentional control were not observed. Therefore, tests perhaps utilizing task-related EEG or other experimental paradigms will be crucial to support or refute direct effects of SART relaxation tasks on theta activity.

According to posterior predictive *p*-value checking as an absolute fit index, models in this study provided a poor fit to the data. However, researchers have recognized that aspects of PP *p*-value-based Bayesian model checking are still tentative and require further research (Muthén & Asparouhov, 2012; De Bondt & Van Petegem, 2015; Hotjink & van de Schoot, 2017). Despite meeting the model selection criteria for approximate metric invariance under moderate statistical assumptions, it should be noted that this study did not achieve a level of approximate scalar invariance, thus the influence of cultural contexts on response tendencies or other psychosocial factors for the MAIA cannot be ruled out and require further investigation. However, the lack of Japanese students familiar with practices in Shoji et al. (2018) that

resulted in differing structural validity, together with the fewer number of Japanese participants who did them in Study 1 suggest that differences in behavioral health practices could be an influential cultural factor.

4.4 Conclusion

This dissertation provides a framework of common constructs of interest to the mechanism of body awareness change in SART with interoceptive attention tendencies measured by the MAIA and offers evidence of positive body awareness enhancement from stress management applications employing SART. Comprehensively addressing questions of validity, it offers indicators of effectiveness for a system of constructs in a mental health promotion format that could be flexibly and feasibly applied to address the needs of individuals undergoing community recovery from disasters with chronic features (Landsman-Dijkstra, van Wijck, Groothoff, & Rispens, 2004; Reich & Goto, 2015; Nukui et al., 2017).

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Summary Table 1. *Reliability estimates and between-group differences in MAIA scores for study participants from Japan and the United States (Study 1).*

MAIA Dimension	Item Range	n	Construct definition and sample item	Japan (N = 407)			United States (N = 204)					
				Total (*SD*)	Cronbach's Alpha	McDonald's Omega (RML) [95% CI]	Total (*SD*)	Cronbach's Alpha	McDonald's Omega (RML) [95% CI]	*t*	*p*	*d*
Noticing	1-4	4	Awareness of uncomfortable, comfortable, and neutral body sensations (e.g., "I notice changes in my breathing, such as whether it slows down or speeds up")	2.15 (1.25)	0.72	0.73 [0.68, 0.79]	3.66 (1.13)	0.76	0.77 [0.70, 0.84]	19.83	< .001	1.68
Not-Distracting	5-7	3	Tendency not to ignore or distract oneself from sensations of pain or discomfort (e.g., "I distract myself from sensations of discomfort")	2.81 (1.21)	0.62	0.63 [0.54, 0.71]	3.14 (1.32)	0.56	0.56 [0.44, 0.0.69]	12.26	< .001	1.06
Not-Worrying	8-10	3	Tendency not to worry or experience emotional distress with sensations of pain or discomfort (e.g., "When I feel physical pain, I become upset")	2.28 (1.20)	0.51	0.55 [0.46, 0.64]	3.05 (1.30)	0.56	0.60 [0.50, 0.70]	9.82	< .001	0.86
Attention Regulation	11-17	7	Ability to sustain and control attention to body sensations (e.g., "I am able to consciously focus on my body as a whole")	2.06 (1.15)	0.89	0.89 [0.87, 0.91]	3.30 (1.20)	0.88	0.88 [0.85, 0.91]	15.96	< .001	1.38
Emotional Awareness	18-22	5	Awareness of the connection between body sensations and emotional states (e.g., "I notice how my body changes when I'm angry")	2.11 (1.22)	0.85	0.85 [0.82, 0.88]	3.74 (1.14)	0.84	0.84 [0.78, 0.89]	20.85	< .001	1.77
Self-Regulation	23-26	4	Ability to regulate distress by attention to body sensations (e.g., "When I bring awareness to my body, I can feel a sense of calm")	2.09 (1.19)	0.79	0.80 [0.75, 0.84]	3.33 (1.24)	0.84	0.84 [0.79, 0.88]	14.83	< .001	1.29
Body Listening	27-29	3	Active listening to the body for insight (e.g., "When I am upset, I take time to explore how my body feels")	1.89 (1.19)	0.87	0.87 [0.84, 0.90]	3.29 (1.21)	0.76	0.77 [0.71, 0.84]	16.35	< .001	1.38
Trusting	30-32	3	Experiencing one's body as safe and trustworthy (e.g., "I feel my body is a safe place")	2.18 (1.19)	0.79	0.79 [0.75, 0.84]	3.67 (1.16)	0.74	0.76 [0.69, 0.84]	18.27	< .001	1.55

Note. M = mean, SD = standard deviation. RML = robust maximum likelihood. 95% confidence interval using robust standard errors. Welch's t-test was performed to account for differences in sample sizes. d = Cohen's d for standardized effect size.