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The Scale of Body Connection: A Multisample Study to Examine Sensitivity to Change Among Mind–Body and Bodywork Interventions

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Abstract

Purpose: The purpose of this measurement study was to examine the Scale of Body Connection (SBC) sensitivity to change among mind–body or bodywork interventions and to explore the concurrent validity in relation to emotion dysregulation and mindfulness skills.

Methods: This study was based on multiple clinical trials that had used the SBC to evaluate changes in body awareness (BA) and bodily dissociation (BD) in response to a mind–body or bodywork intervention. To test for sensitivity to change, *t* tests were used to examine change and estimate effect sizes. To explore convergent validity, Pearson's product–moment correlations between the SBC subscales and Five-Facet Mindfulness Questionnaire (FFMQ) and Difficulties in Emotion Regulation Scale (DERS) were calculated among a subset of the studies, which also included these measures.

Results: The BA and BD scales consistently detected significant positive responses to a range of intervention types (yoga, mindfulness meditation, BA, multimodal therapy, and bodywork), demonstrating SBC sensitivity to change. With a few exceptions, the effect sizes across studies for BA were above 0.35, indicating near moderate-to-large effect sizes. The effect sizes for BD, as a measure of responsiveness, were much smaller than for BA; however, four of the studies had effect sizes between 0.54 and 0.86. Concurrent validity with the DERS was supported by moderate-to-large correlations, and with the FFMQ, it was significant with the BA scale in one included study.

Conclusions: The results of this study further establish SBC validity and sensitivity to change across a range of mind–body therapies and confirm prior findings of moderate-to-strong internal consistency reliability. The findings support the use of this brief scale to assess key dimensions of BA and BD in practice and research.

Keywords: measurement, mind-body therapies, dimensional measurement accuracy, intervention research, interoception, body awareness, dissociation

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Introduction

To promote an understanding of interoceptive processes, one of the first scales so developed was the Scale of Body Connection (SBC).[1] Designed as a self-report measure for use in clinical research, the SBC has been used to examine change and test for mediation effects in mind–body interventions. The scale has been translated into more than 12 languages and validated in scale translation studies. A prior multistudy evaluation of the SBC showed acceptable distributional properties and reliability coefficients, confirmed the two-factor model, and demonstrated SBC construct validity.[2]

However, to examine how well the SBC performs, it is imperative to examine its sensitivity to change when used within the context of mind–body interventions. This is particularly important given that awareness of interoceptive signals is a posited mechanism underlying mind–body treatment approaches designed for a range of health-related conditions (e.g., chronic pain, mental health disorders, symptom management related to physical health conditions).[3]

Interoception is the sensory process of receiving, accessing, and appraising internal body signals that motivate behavior toward preferred physiological states.[4,5] While interoceptive awareness is sometimes defined as the representation of afferent body sensations,[6,7] broader definitions cast interoception as a dimensional construct that accounts for how people attend to, appraise, and respond to bodily sensations.[8]

Attentive and self-regulatory habits matter because body sensations are valenced to motivate behavior, as does the pleasure of socializing with friends or aversion to a sudden pain. Such ingrained affective components of interoceptive signals may have evolved to maintain homeostasis[9–11] and can influence cognitive responses and decision-making.[12] In addition, mental representations of selfhood are based on embodied sensory experiences, supporting a sense of the self that is crucial to human interaction.[13]

Thus, greater accuracy of interoceptive self-representation promotes moment-by-moment adjustment, whereas inaccurate representation can lead to emotion dysregulation. Difficulties with emotion regulation appear to be transdiagnostic.[14] Accordingly, many health problems may involve dysregulated interoceptive processes, including affective disorders,[15] addiction,[16] eating disorders,[17] chronic pain,[18] dissociative disorders,[19] post-traumatic stress disorder,[20] and somatoform disorders.[21,22]

Understanding how interoceptive processes influence representations of self and emotion regulation is critical for improving health and treatment models.[23] Such understanding will require assessment of interoceptive awareness in clinical practice and reproducible evidence of clinical benefits of intervention approaches that target the capacity for interoceptive awareness. This includes identification of the regulatory correlates of interoceptive awareness, which can be accomplished, for example, through measurement of both interoceptive awareness and emotion regulation.

Relatedly, recent studies[24,25] show evidence of concurrent validity of the SBC and measures of emotion regulation and mindfulness, and results from these studies highlight the mediating role that interoceptive awareness processes can play in emotion regulation.

This study was based on multiple clinical trials that had used the SBC to evaluate changes in body awareness (BA) and bodily dissociation (BD) in response to a mind–body or bodywork intervention. Among the data from the 13 studies used in this overall project, three studies included the Difficulties in Emotion Regulation Scale (DERS)[26] and/or the Five-Facet Mindfulness Questionnaire (FFMQ), offering the opportunity to build evidence of concurrent validity between the SBC and these two well-established scales.

Thus, the aims of this study were to verify SBC reliability, assess SBC sensitivity to change across studies and types of intervention approaches, and explore concurrent validity of the SBC.

Materials and Methods

Procedures

Before initiating this study, the University of Washington Institutional Review Board approved this research. Deidentified datasets were requested from individual investigators who had previously contacted the authors to use the SBC in their intervention studies. Thirteen studies and 14 datasets were located, which addressed mental and/or physical health concerns and examined the effects of complementary or integrative health interventions.

Among these studies (Table 1), five different intervention approaches were utilized: (1) yoga,[27,28] (2) multimodal (including yoga, mindfulness meditation, progressive relaxation, and psychoeducation) therapy[29] (Lauche RD, Southern Cross University, Australia), (3) mindfulness meditation[30] (Shankland, R., Université Grenoble Alpes, France), (4) BA (involving manual, mindfulness, and psychoeducation components),[31–36] and (5) bodywork (manual therapy).[32,37]

The interventions had been conducted in four languages: English,[28,30,32–34] Dutch,[35,36] German[27,29,31,37] (Lauche RD, Southern Cross University, Australia), and French (Shankland, R., Université Grenoble Alpes, France). Nine datasets were from other researchers[27–30,35–37] (Lauche RD, Southern Cross University, Australia; Shankland, R., Université Grenoble Alpes, France) and four were from the authors' own studies.[32–34]

The datasets were categorized based on demographics, intervention type, population, single intervention group versus multiple groups (which included control groups), and availability of data at both pre- and postintervention time points.

Measures

Interoceptive awareness. The SBC[1] has 20 items representing two distinct dimensions: BA and BD. Response options are based on a 5-point frequency scale ranging from 0, meaning not at all, to 4, meaning all of the time (see Supplementary Material: Scale of Body Connection). Across time, a positive change on the BA subscale represents an *increase* in BA, a positive result.

Slightly different, a negative change on the BD subscale represents a *decrease* in BD, also a positive result. In this study, internal consistency (Cronbach's α) ranged from 0.53 to 0.93 for BA (averaging 0.87) and 0.55 to 0.87 for BD (averaging 0.75).

Emotion regulation. Specific to exploring convergent validity, the authors used the DERS,[26] a 36-item self-report

Table 1. Summary of Scale of Body Connection Intervention Studies, Samples, and Scale Internal Reliability Coefficients

Intervention	*Primary author (language)*	*Population sample*	*Delivery mode*	*Sample size*	*Gender % female*	α *BA*	α *BD*
Yoga	Cramer (German)[27]	Colorectal cancer	Group	27	79	0.79	0.68
	Center for Trauma and Resilience (English)[28]	Trauma	Group	152	100	0.85	0.81
Multimodal	Lauche (German)[a]	Chronic pain	Group	202	91	0.80	0.79
	Cramer (German)[29]	Chronic pain	Group	310	93	0.73	0.71
Mindfulness meditation	Daubenmier (English)[30]	Overweight/obese	Group	24	100	0.81	0.76
	Shankland (French)[b]	Eating disorder	Group	12	100	0.53	0.70
BA	Danielson (German)[31]	Major depression	Individual and group	21	76	0.81	—
	van der Maas (Dutch)[35]	Chronic pain	Individual	50	82	0.80	0.69
	van der Maas (Dutch)[36]	Mood disorders	Individual	164	78	0.82	0.55
	Price (English)[34]	Substance use	Individual	31	100	0.78	0.74
	Price (English)[33]	Substance use	Individual	68	100	—	0.85
	Price (English)[32]	Trauma	Individual	12	100	0.93	0.87
Bodywork	Haller (German)[37]	Neck pain	Individual	22	81	0.84	0.76
	Price (English)[32]	Trauma	Individual	12	100	0.89	0.84

[a]Lauche RD, Southern Cross University, Australia. https://clinicaltrials.gov/ct2/show/NCT01805947?term=lauche
[b]Shankland, R., Université Grenoble Alpes, France.
BA, body awareness; BD, bodily dissociation.

designed to assess multiple aspects of emotional dysregulation, which includes six subscales: degree of awareness, emotional clarity, impulsivity, goal-directed behaviors, acceptance, and behavioral regulation strategies.

Items are rated using 5-point response options, with higher scores indicating greater problems with emotion regulation. Reported internal consistency (Cronbach's α) for the six subscales ranges from 0.73 to 0.88.[38]

Mindfulness skills. The FFMQ,[39] a 39-item self-report measure, captures five dimensions of skills associated with the practice of mindfulness. Scale items are rated using a 5-point Likert scale to assess the following dimensions: observing, acting with awareness, nonjudging, describing, and nonreactivity. In this study, internal consistency of the FFMQ subscales ranged from 0.75 to 0.91.

Data analyses

The analyses were conducted using data from mind–body or bodywork intervention groups (no control group data were included) within the 13 studies. For consistency among the studies, the authors used only the most immediate postintervention data for studies with multiple follow-ups. As a preliminary step in the analyses, the authors calculated the internal consistency (Cronbach's α) of the scales, using the standard of $\alpha \geq 0.70$[40] to interpret results. Cronbach's α ranged from 0.53 to 0.93 for BA (averaging 0.87) and 0.55 to 0.87 for BD (averaging 0.75).

The only study with Cronbach's α value below 0.70 for BA was a pilot mindfulness study for patients with eating disorders ($N = 12$) (Shankland, R., Université Grenoble Alpes, France). The BD scale had Cronbach's α values below 0.70 in three studies, with only one value substantially below 0.70 from a BA study for people with mood disorders[35] (Table 1).

To test SBC sensitivity to change, the authors first calculated BA and BD means and standard deviations to examine the scale score distribution features. They then used two-tailed paired *t* tests to examine changes in scores from pre- to postintervention. Changes exceeding the 95% confidence interval of the baseline were considered significant ($p < 0.05$).

The authors also calculated effect sizes (Cohen's *d*)[41] for the pre- and post-test SBC subscales. In addition, to explore convergent validity, correlations between the SBC and FFMQ and DERS were calculated using Pearson's product–moment correlation coefficients. Convergent validity was defined by moderate-to-large correlations (≥0.45) among instruments used to measure theoretically related concepts. Analyses were conducted using SPSS, version 19,[42] with statistical significance set at $p < 0.05$.

Results

The analyses were based on a total of 1193 patients representing 7 populations with different health conditions, including cancer,[27] pain (Lauche RD, Southern Cross University, Australia),[29,36,37] obesity,[30] eating disorders (Shankland, R., Université Grenoble Alpes, France), depression,[31] trauma,[28,32] and substance use disorders.[33,34] Most of the samples were primarily (76%–100%) female.

Sensitivity to change

The authors examined the distributions of means and standard deviations for the BA and BD scales pre- and postintervention, and then to assess sensitivity to change, they tested for pre–post changes in each of the scales. At pretest, BA mean scores ranged from 1.61 to 2.86 and increased from 1.89 to 3.11 post-test. Of the 13 studies with pre–post BA data, 9 demonstrated significant increases in BA (Table 2). For BD, mean scores at pretest ranged from 0.79 to 2.40, and at post-test, the range decreased to

Table 2. *t* Test Results for Pre–Post Intervention Changes in Body Awareness and Bodily Dissociation by Intervention Type

Intervention type	*Study author population*	*Sample size*	*Time point*	*BA pre–post scores (SD)*	p	*Cohen's* d	*BD pre–post scores (SD)*	p	*Cohen's* d
Yoga	Cramer[27]	27	Pre	2.86 (0.48)			0.81 (0.44)		
	Cancer		Post	3.07 (0.52)	0.004	0.42	0.82 (0.66)	0.96	0.02
	Center for Trauma	152	Pre	2.33 (0.72)			1.07 (0.71)		
	and Resilience[28]		Post	2.64 (0.60)	<0.001	0.47	0.90 (0.66)	<0.001	0.25
	Trauma								
Multimodal	Lauche[a]	202	Pre	2.45 (0.54)			1.34 (0.59)		
	Chronic pain		Post	2.70 (0.53)	<0.001	0.47	1.28 (0.61)	0.47	0.10
	Cramer[29]	310	Pre	2.35 (0.57)			1.30 (0.60)		
	Chronic pain		Post	2.48 (0.57)	<0.001	0.23	1.23 (0.57)	0.02	0.12
Mindfulness	Daubenmier[30]	24	Pre	2.10 (0.54)			1.62 (0.65)		
meditation	*Obesity*		Post	2.18 (0.59)	0.66	0.14	1.13 (0.47)	0.02	0.86
	Shankland[b]		Pre	1.83 (0.56)			2.40 (0.82)		
	Eating disorder	12	Post	2.52 (0.56)	0.001	1.23	1.71 (0.92)	0.01	0.79
BA	Danielson[31]	21	Pre	2.11 (0.66)	0.58	0.12	—	—	
	Depression		Post	2.22 (1.08)					
	van der Maas[35]	50	Pre	2.28 (0.60)			1.88 (0.49)		
	Chronic pain		Post	3.11 (1.65)	0.002	0.67	1.62 (0.47)	<0.001	0.54
	van der Maas[36]	164	Pre	2.41 (0.59)			1.59 (0.74)		
	Mood disorders		Post	2.79 (0.48)	<0.001	0.71	1.19 (0.64)	0.02	0.58
	Price[34]	31	Pre	2.37 (0.59)			0.87 (0.62)		
	Substance use		Post	2.57 (0.65)	0.106	0.39	0.79 (0.61)	0.22	0.13
	Price[33]	68	Pre	—		—	0.91 (0.61)	0.01	
	Substance use		Post				0.86 (0.68)		0.08
	Price[32]	12	Pre	1.73 (0.73)	0.086	0.26	1.83 (0.83)	0.31	0.13
	Trauma		Post	1.93 (0.78)			1.72 (0.85)		
Bodywork	Haller[37]	22	Pre	2.86 (0.48)	0.003	0.38	0.79 (0.43)	0.958	0.05
	Neck pain		Post	3.07 (0.52)			0.82 (0.66)		
	Price[32]	12	Pre	1.61 (0.77)	0.012	0.40	1.67 (0.68)	0.36	0.27
	Trauma		Post	1.89 (0.62)			1.55 (0.42)		

[a]Lauche RD, Southern Cross University, Australia. https://clinicaltrials.gov/ct2/show/NCT01805947?term=lauche
[b]Shankland, R., Université Grenoble Alpes, France.
BA, body awareness; BD, bodily dissociation; SD, standard deviation.

0.82–1.72. Of the 13 studies with BD pre–post data, 7 demonstrated significant decreases in BD (Table 2).

Effect sizes were also calculated and ranged from 0.14 to 1.23. Nine of the 13 studies demonstrated effect sizes above 0.35, indicating near moderate-to-large effect sizes for majority of the studies involved. The BD effect sizes ranged from 0.02 to 0.86, with 4 of the 13 studies showing effect sizes between 0.54 and 0.86, demonstrating moderate-to-large effects. The authors also explored sensitivity to change by therapeutic modality: yoga, multimodal therapy, mindfulness meditation, BA, and bodywork.

Results in Table 3 support the premise that the SBC is a sensitive measure across multiple intervention approaches. With the exception of BD across two bodywork studies ($N=34$), intervention approaches showed significant improvements in both BA and BD.

Concurrent validity

Concurrent validity (Table 4) was examined using bivariate correlations between the two SBC subscales and the DERS[26] and FFMQ.[39] In the studies using the DERS, the BA and BD scales showed moderate-to-large correlations with the DERS in the predicted direction ($r \geq 0.45$, $p < 0.01$).

For the FFMQ, correlation with BA was statistically significant in one sample ($r=0.48$, $p<0.001$). The BD scale correlation with FFMQ in both samples was strong, although not statistically significant ($r=-0.63$; -0.64).

Limitations

The majority of studies included in this were from the United States and European countries and participants were primarily female. The addition of measurement studies across other diverse countries and cultures (e.g., Asia, Africa), and including equivalent numbers of males and females, will strengthen support for SBC use to assess domains of interoceptive awareness essential for regulating emotions and achieving optimal well-being. There was large variation in sample sizes across the included studies.

While effect sizes are not dependent on sample size and thus allow for comparisons across studies, they are influenced by sample heterogeneity and tend to attenuate effect size.[43] For this study, the authors were precluded from studying the influence of heterogeneity on intervention effects beyond those of the intervention approaches. The design of future studies will need to incorporate known subgroupings to refine understanding of responsiveness to

Table 3. Pre–Post Changes in Body Awareness and Bodily Dissociation for Combined Studies Within Intervention Type

Subscale	*Intervention type (*N*)*	*Assessment time point*	*Average score (SD)*	p	*Cohen's* d
BA	Yoga (179)	Pre	2.42 (0.71)	<0.001	0.43
		Post	2.70 (0.60)		
	Multimodal (512)	Pre	2.39 (0.56)	<0.001	0.32
		Post	2.57 (0.57)		
	Mindfulness meditation (36)	Pre	2.10 (0.57)	0.006	0.44
		Post	2.36 (0.60)		
	BA (278)	Pre	2.34 (0.62)	<0.001	0.55
		Post	2.68 (0.61)		
	Bodywork (34)	Pre	2.49 (0.82)	<0.001	0.32
		Post	2.69 (0.79)		
BD	Yoga (179)	Pre	1.02 (0.68)	0.001	0.21
		Post	0.88 (0.66)		
	Multimodal (512)	Pre	1.32 (0.59)	0.02	0.12
		Post	1.25 (0.58)		
	Mindfulness meditation (36)	Pre	1.76 (0.85)	0.001	0.38
		Post	1.45 (0.79)		
	BA (325)	Pre	1.61 (0.71)	<0.001	0.24
		Post	1.45 (0.64)		
	Bodywork (34)	Pre	1.07 (0.67)	0.95	0.36
		Post	1.05 (0.68)		

BA, body awareness; BD, bodily dissociation; SD, standard deviation.

interventions, as measured by the SBC and other common measures in the field. The findings, however, provide information essential for the design of future studies to examine variations in intervention responsiveness.

Discussion

This study is the second part of a multistep process to evaluate the psychometric properties of the SBC, a two-dimensional, 20-item self-administered tool. The findings show acceptable SBC reliability with strong Cronbach α coefficients (mean $\alpha = 0.87$ for BA; mean $\alpha = 0.75$ for BD) congruent with findings from a prior larger multisample study of the SBC.[24] Importantly, both the BA and BD scales consistently detected significant positive responses to a range of interventions, demonstrating SBC sensitivity to change.

With a few exceptions, the effect sizes across studies for BA were near moderate to large, indicating that the instrument detected positive and meaningful effects of interventions on BA. Effect sizes for positive well-being outcomes (such as interoceptive awareness) in mind–body interventions typically range from small to moderate in size.[44]

Based on an *a priori* power calculation for pre–post tests, a minimum of 36 subjects would be needed to detect moderate effect sizes (power = 0.90, $p = 0.05$, two-tailed). Table 1 shows that 8 of the 14 studies had fewer than 36 cases; statistically significant effects were thus evident only for those with larger intervention effects, such as the Shankland study ($N = 12$, $d = 1.23$).

The effect sizes for the BD scale, as a measure of responsiveness, were much smaller than for the BA scale, perhaps due to the attenuated reliability of the scale, variation in intervention approaches, and/or sample heterogeneity.[43] The four studies showing moderate-to-large BD effect sizes were for mindfulness meditation[30] (Shankland, R., Université Grenoble Alpes, France) or BA intervention.[35,36] It is difficult, however, to attribute the larger effect sizes among these four studies to the intervention type as there were other studies of the same intervention type that did not show a similarly larger effect.

Of note, three of these four studies had sample populations that were uniquely represented overall: two study samples were people with eating disorders (eating disorders; obesity) and one was specific to the treatment of mood disorders. The fourth study, focused on treatment of chronic pain, had two distinct features compared with other studies serving a chronic pain population: the intervention was delivered individually and targeted BA (vs. being multimodal). These overall findings suggest the need for future study that evaluates whether the BD scale is particularly suitable for certain types of interventions and populations.

Overall, the findings highlight the applicability of the SBC to a range of intervention types, with significant improvements in BA and BD across mind–body interventions—those

Table 4. Concurrent Validity of Scale of Body Connection Subscales Based on Measures of Emotion Regulation and Mindfulness

	Shankland[a] *(*N = *12)*		*Price*[34] *(*N = *31)*		*Price*[33] *(*N = *68)*	
	BA	*BD*	*BA*	*BD*	*BA*	*BD*
DERS			−0.45**	0.46**		0.64***
FFMQ	0.45	−0.63	0.48***	−0.64		

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.
[a]Shankland, R., Université Grenoble Alpes, France.
BA, body awareness; BD, bodily dissociation; DERS, Difficulties in Emotion Regulation Scale (total score); FFMQ, Five-Facet Mindfulness Questionnaire (total score).

delivered in groups (yoga, multimodal therapy, and mindfulness) as well as individually (BA and bodywork). Notably, the populations within this group of 14 intervention studies included a broad range of patients experiencing both mental and physical health disorders (e.g., depression, trauma, cancer, chronic pain, substance use).

The demonstrated sensitivity to change in the SBC across these studies suggests that this measure can be reliably used across a wide range of health conditions. Future research is needed to examine and establish clinically meaningful change on the SBC.

The moderate-to-strong concurrent associations between the SBC and emotion dysregulation, measured by the DERS, contribute to establishing measurement validity. In contrast, associations with mindfulness, measured with the FFMQ, were inconsistent. Associations between the constructs of emotion dysregulation and mindfulness are important to examine because interoceptive awareness is fundamentally linked to mindfulness skills[39,40] and emotion regulation.[41]

The concurrent validity analyses, however, were based on limited data, and not all of the observed associations were statistically significant, possibly due to the small sample size ($N = 12$) in one study (Shankland, R., Université Grenoble Alpes, France). Nonetheless, the overall findings are congruent with prior research that examined the relationship between the SBC and emotion dysregulation[42,43] and SBC and mindfulness[43] and contribute to establishing concurrent validity of the SBC.

Conclusions

This study establishes the SBC sensitivity to change. In addition, the results strengthen the evidence of concurrent validity between the SBC and measures of emotion regulation and mindfulness. A major strength of this study was inclusion of diverse datasets from multiple countries (and languages), intervention types, and health conditions.

The apparent breadth of SBC applicability evidenced in this study, strong SBC measurement properties,[1,2] and brevity of the measure make it a useful tool to assess key dimensions of interoceptive awareness and improvement in response to a variety of therapeutic approaches in mind–body and bodywork practice and research.

Authors' Contributions

This project was conceived by C.J.P. and E.A.T.; S.C.C. managed the data collection and analyses; and S.C.C., E.A.T., and C.J.P. participated in interpretation of the findings and writing for publication.

Author Disclosure Statement

No competing financial interests exist.

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Supplementary Material

Supplementary Data

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