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Effects of Mindfulness Meditation on Self-Transcendent States: Perceived Body Boundaries and Spatial Frames of Reference

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Abstract

Objectives: Mindfulness training is believed to encourage self-transcendent states, but little research has examined this hypothesis. This study examined the effects of mindfulness training on two phenomenological features of self-transcendence: 1) perceived body boundary dissolution, and 2) more allocentric spatial frames of reference.

Methods: A sample of healthy, young adults (n=45) were randomized to five sessions of mindfulness training or an active listening control condition.

Results: Results indicated mindfulness training decreased perceived body boundaries ($F_{4,172}$=6.010, p<.001, η^2=.12) and encouraged more allocentric frames of reference ($F_{4,168}$=2.586, p=.039, η^2=.06). The expected inverse relationship was observed between perceived body boundaries and allocentric frames of reference ((β=−.58, p=.001)), and path analysis revealed the effect of mindfulness training on allocentric frames of reference was mediated by decreased perceived body boundaries (β=.24, *se*=.17, *CI*: 0.11 to 0.78).

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Author Contributions.

AWH: reviewed the literature and summarized previous, related work; conducted the analyses; and wrote the first draft of the manuscript. MD: collaborated with the design and writing of the final manuscript. ELG: collaborated with the design and writing of the final manuscript.

Conflict of Interest Statement

Adam Hanley, Michael Dambrun, and Eric Garland declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval.

The study was approved by the Institutional Review Board at the University of Utah in 2016 (IRB_00088540).

Informed Consent.

Informed consent was obtained from all individual participants included in this study.

Conclusions: Taken together, study results suggest that mindfulness training alters practitioners' experience of self, relaxing the boundaries of the self and extending the spatial frame of reference further beyond the physical body. Future studies are needed to explore the psychophysiological changes that co-occur with phenomenological reports of self-transcendence and the behavioral consequences following self-transcendent experiences.

Keywords

Self-transcendence; Mindfulness; Spatial Frame of Reference; Perceived Body Boundary; Egocentric Frame of Reference; Allocentric Frame of Reference

Although a definitive definition of mindfulness has not been established (Dreyfus, 2011; Grossman & Van Dam, 2011), mindful states are commonly characterized by the metacognitive capacity to intentionally and non-judgmentally attend to subjective experience (Bishop et al., 2004; Dahl, Lutz, & Davidson, 2015; Dorjee, 2016; Dreyfus, 2011; Kabat-Zinn, 1994). Accumulating evidence indicates that the cultivation of mindfulness improves psychological and physical functioning (Chiesa & Serretti, 2009; Demarzo et al., 2015; Goldberg et al., 2018; Gotink et al., 2015; Khoury et al., 2015). Theorists hypothesize that mindfulness confers these benefits by increasing 1) attentional control and 2) emotion regulation, and by 3) altering the practitioner's sense of self (Dahl, Lutz & Davidson, 2015; Hozel et al., 2011; Vago & Silbersweig, 2012). The development of attentional control and emotion regulation through mindfulness training is well-documented in a recent review paper (Tang et al., 2015). However, considerably less is known about how mindfulness training impacts the experience of self.

The self has been defined in many ways (e.g., Gallagher, 2013; Legrand & Ruby, 2009; Strawson, 1999), a thorough review of which is beyond the current paper's scope. Here, we adopt an understanding of the self that accords with cognitive science (Berkovich-Ohana & Glicksohn, 2014; Christoff et al., 2011; Gallagher, 2000; Legrand & Ruby, 2009) and Buddhist psychology (Austin, 2006; Gyamtso, 1994; Macy, 1991; Macy, 1979; Rahula, 2007), holding that the self is "an interdependent, self-organizing process shaped by [1] the flow of experience and [2] the choices that condition this flow" (Macy, 1979 p.42). As intimated by this definition, some theorists assert that the experience of self emerges from the interplay between two dependent, yet antagonistic "selves" (Berkovich-Ohana & Glicksohn, 2014; Gallagher, 2000; James, 1890): 1) the minimal self, "a consciousness of oneself as an immediate subject of experience, unextended in time" (Gallagher, 2000, p.15), and 2) the narrative self, "a more or less coherent self (or self-image) that is constituted with a past and a future" (Gallagher, 2000, p.15).

The minimal and narrative selves are presented as hierarchical, with the narrative self constructed from information from the minimal self (Berkovich-Ohana & Glicksohn, 2014). The minimal self, as the immediate subject of experience, provides an initial parsing of "self' (i.e., subject) from "not self" (i.e., object). This subject-object dichotomization is dependent on sensory processing. For example, locating an object in the visual field requires a perceptual point of origin, and this point of origin is often construed as the self (Austin, 2000; Christoff, Cosmelli, Legrand, & Thompson, 2011; Legrand & Ruby, 2009). While all

of the senses possess this self-specifying capability to a greater or lesser degree, vision is a particularly powerful self-specifier (Klatzky, 1998). Indeed, converging evidence indicates Westerners tend to locate their sense of self behind the eyes (Alsmith & Longo, 2014; Anglin, 2014; Bertossa et al., 2008; Limanowski & Hecht, 2011; Starmans & Bloom, 2012). Once subject-object dichotomies are created by the minimal self, they are often reified by the narrative self. By cognitively interpreting and organizing the minimal self's stream of immediate, sensory experience the narrative self generates a durable personal narrative that situates the embodied present in a remembered past and imagined future (Berkovich-Ohana & Glicksohn, 2014).

Just as the minimal and narrative selves are constructed, they can also be momentarily altered or more permanently reorganized through both intentional (e.g., mindfulness practice, substance use) and unintentional (e.g., injury, trauma exposure) means. Alterations in the narrative self tend to occur when self-referential thought decreases and/or autobiographical memories and self-related beliefs become inaccessible (Millière et al., 2018). Erasure of the self reified in personal narrative reduces the sense of self to the domain of immediate sensory experience (Berkovich-Ohana & Glicksohn, 2017). Alterations to the minimal self tend to occur during instances of diminished sensory, such as when the eyes are closed and attention is directed inward (Austin, 2009). By turning attention inward, sensory modalities with more diffuse points of origin (e.g., interoception) become prioritized over those sensory modalities with more highly defined points of origin (e.g., vision). As such, less self-specifying sensory information is available and the sensory information that is available less definitively differentiates subject from object. Thus, both the narrative and minimal selves can be altered; and, these alterations likely impact the subject-object dichotomies that organize daily life at both the narrative and minimal levels of self. In these altered states, the distinction between subject and object is sometimes transcended, experienced phenomenolgically as a merging of perceiver and perceived (Gyamtso, 1994; Macy, 1991; Vago & Silbersweig, 2012; Yaden et al., 2017). Altered states of self in which subject and object merge are often described as self-transcendent experiences.

Self-transcendence can be defined as a transient mental state characterized by two, core phenomenological components: 1) annihilational unity (i.e., "the subjective experience of self-loss"), and 2) relational unity (i.e., "connection to other people and things in the environment beyond the self") (Yaden et al., 2017, p.8). These core components of self-transcendence are clearly articulated by multiple theorists (Hood, 1975; Wahbeh, Sagher, Back, Pundhir, & Travis, 2018; Yaden et al., 2017) and described in many contemplative traditions (e.g., Buddhist, Christian, Judaic, Islamic). In fact, the realization of self-transcendence is recognized as the aspirational aim of many contemplative practices (Berman & Stevens, 2015; Dreyfus & Thompson, 2007; Hopkins, Napper, & Lama, 1984). Yet, relations between the annihilational and relational components of self-transcendence remain empirically untested due to an historical lack of validated self-report measures. Fortunately, recent psychometric advances have resulted in valid tools capable of measuring both core, phenomenological components of self-transcendent states.

The Perceived Body Boundaries Scale (PBBS; Dambrun, 2016) was developed to measure a central aspect of annihilational unity: the perceived salience of body boundaries. Perceived

body boundary salience is the degree to which the self is experienced as a discrete, body-encapsulated entity, separate and isolated from the surrounding world (Dambrun, 2016). A higher score on the PBBS signifies the perception of a strong boundary between self and world. Comparatively, a lower PBBS score signifies the perception that little to no distinction exists between self and world, a dissolution of bodily boundaries in which the normal sense of self is lost or "annihilated" (for a review, see Dambrun, 2016). It is important to emphasize that the perceived body boundary is not necessarily equivalent to the physical body boundary. While the physical body boundary defines the boundary of the body as a physical object, the perceived body boundary defines the sense of being more or less separated from the world (see for example Ataria et al., 2015).

The Spatial Frame of Reference Continuum (SFoRC; Hanley & Garland, 2019) was developed to measure a central aspect of relational unity: the degree of connection between the self, others, and the environment. A spatial frame of reference can be defined as the area within the field of awareness experienced as self-constituent (Austin, 2006, James, 1890), with emerging evidence suggesting that spatial frames can vary both inter- and intra-personally (Hanley & Garland, 2019). Fixed at either pole of this spatial frame of reference continuum are the egocentric frame of reference and the allocentric frame of reference. An egocentric frame of reference denotes a self-centered preoccupation with internal, private events, constraining the sense of self within the physical body's boundary (Austin, 2006). Comparatively, a sense of selflessness characterizes the allocentric frame of reference, which denotes a broadly distributed feelings of unity and interdependence with the social and natural worlds (Austin, 2006).

As core phenomenological features of self-transcendence, perceived body boundaries and spatial frames of reference are likely to be complementary. However, the directionality of this relationship has not been clearly specified. It may be that the perceived body boundary operates like a container that constrains the spatial frame of reference's scope. Considering this relationship via a metaphor of osmotic diffusion may be illustrative. Just as a gas can be highly concentrated in a small, closed container, once that container is opened the gas will evenly distribute throughout the environment. In much the same way, the skin may be thought to encapsulate and contain the self (Watts, 1957). If the skin is experienced as a strong phenomenological boundary between the sense of self and the world, feelings of relational unity are unlikely. Thus, a strong perceived body boundary would be expected to confine the spatial frame of reference to within the physical body. In contrast, little to no perceived body boundary would likely permit expanded spatial frames (i.e., allocentric), supporting a highly diffuse sense of self that is "one" with the world.

Multiple explanations exist for why mindfulness may encourage self-transcendent experiences. From a cognitive science perspective, mindfulness practices, such as focused attention or open-monitoring practices, appear capable of altering, or even dissolving, both the narrative and minimal selves. With respect to the narrative self, mindfully attending to a specific object (e.g., the breath, a body part, the field of awareness) decreases the self-referential thoughts and autobiographical storylines that instantiate the narrative self (Berkovich-Ohana & Glicksohn, 2014; Gallagher, 2000). Neural activity during mindful states appears to support the phenomenology of narrative selflessness. Activity in brain

regions implicated in narrative self-construction, such as the cortical midline structures and default mode network (DMN), is regularly altered during mindful states achieved through mindfulness practice (e.g., Berkovich-Ohana, Glicksohn, & Goldstein, 2012; Brewer et al., 2011; Farb et al., 2007; Lin, Callahan & Moser, 2018; Milliere et al., 2018). With respect to the minimal self, as the object of mindfulness is often internal (e.g., the breath, a body part), engagement with this internal object limits the exteroceptive sensory input that most sharply distinguishes the self as a distinct entity in space. Losing access to self-specifying sensory information during mindfulness practice is likely to feel like “selflessness”, making allocentric frames of reference more accessible. Again, neural activity during mindful states appears to support the phenomenology of minimal selflessness. Mindfulness practice can alter neural activity in a major node of the DMN, the inferior parietal lobe and temporoparietal junction (IPL/TPJ; Lin, Callahan, & Moser, 2018; Millière, Carhart-Harris, Roseman, Trautwein, & Berkovich-Ohana, 2018), implicated in the integration of “internal and external inputs into a coherent perception of oneself” (Igelström & Graziano, 2017). As such, the phenomenological experience of relational unity may co-occur with deactivation in the IPL/TPJ. From a Buddhist perspective, mindfulness training orients the practitioner to the fundamental impermanence of all things (Pali: *anattā*), rendering the self an ultimately, empty construct (Pali: *anattā*). Through observation, meditation practices deconstruct reified objects (Dahl et al., 2015), such as the self, into their constituent percepts (i.e., thoughts, emotions, sensations). Realizing the self to be impermanent, challenges its status as a thing and suggests the self may be better conceived of as a multifaceted system with both internal and external elements (Dambrun & Ricard, 2011; Gyamtso, 1994; J. Macy, 1991).

Regardless of the explanatory means, it is clear that theory has greatly outpaced empirical research on mindful self-transcendence. Nevertheless, emerging evidence indicates mindfulness training can impact both perceived body boundaries and spatial frames of reference. To date, one study has directly examined the impact of mindfulness training on perceived body boundaries and another on spatial frames of reference. In the first study, Dambrun (2016) found that a single, mindfulness training session decreased perceived body boundary strength in a sample of healthy young adults. In this study, a body scan meditation was used to dissolve body boundaries, and perceived body boundary dissolution was associated with greater happiness and less anxiety (Dambrun, 2016). In the second study, Hanley and Garland (2019) found a single mindfulness training session expanded spatial frames of reference. In this study, a standardized mindfulness meditation practice (e.g., Garland, 2013) was used to encourage more allocentric frames of reference, and the realization of more allocentric frames were associated with increased positive affect and decreased negative affect (Hanley & Garland, 2019). Thus, mindfulness practice appears capable of 1) dissolving perceived body boundaries and 2) encouraging allocentric frames of reference, and both experiences were linked with more positive affective states. However, it remains unclear whether an empirical relationship exists between perceived body boundary dissolution and allocentric frames of reference, and whether mindfulness training can strengthen that relationship over time.

The purpose of this study was to test the long-standing belief that mindfulness encourages self-transcendent states by examining the effects of mindfulness training on two phenomenological features of self-transcendence: 1) perceived body boundary and 2) spatial

frame of reference. No study to date has examined both aspects of self-transcendence in combination, explored the impact of multiple mindfulness training sessions on perceived body boundaries and spatial frames of reference, or investigated the directionality of the relationship between perceived body boundaries and spatial frames of reference. It was hypothesized that mindfulness training would encourage a) body boundary dissolution, and b) allocentric frames of reference. It was further hypothesized that the relationship between mindfulness training and more allocentric frames of reference would be mediated by perceived body boundary dissolution.

Method

Participants

Participants (n=45) were recruited from a large, Western University. All English speaking adults (18+ years old) were eligible to participate. The majority of participants were female (82%) and Caucasian (80%). The mean participant age was 26.9 (6.3). Participants' demographics and baseline did not statistically differ by group (Table 1).

Procedures

This study was presented to prospective participants as an attention training study and no mention of mindfulness was made in any study recruitment materials to minimize self-selection bias. Study procedures took place over the course of five, individually scheduled study sessions spanning three weeks. After providing written informed consent in the first session, participants completed the perceived body boundary and spatial frame of reference measures before and after a five-minute resting baseline assessment in which they remained still and did not speak. At the beginning of the second session, participants were infomed whether they had been randomized (1:1) to either a mindfulness training (n=24) or active listening (n=21) condition, determined by random number generation. Participants in the mindfulness training condition were guided though scripted, basic mindful breathing and body scanning techniques (Garland, 2013) by a researcher with 5+ years of meditation experience. The same research assistant read participants in the active listening condition selections from *The Natural History of Selborne*, a validated control condition for research on brief mindfulness training (Zeidan, Johnson, Diamond, et al., 2010). Participants came to the same university-based lab room for each study session and remained seated during the exerimental induction. The mindfulness and active listening conditions were equivalent in length. In study sessions 2–4, participants completed the perceived body boundary and spatial frame of reference measures before and after their respective 11-minute experimental induction (mindfulness vs. active listening) to assess state induction effects on these indices of self-transcendence. All study procedures were approved by the local Institutional Review Board.

Measures.

Perceived Body Boundaries was measured with the Perceived Body Boundaries Scale (PBBS; Dambrun, 2016). The PBBS is a visual item (Figure 1) used to assess the strength of the boundary between the self and the world using a 7-point Likert type scale (1=Weak boundary, 7=Strong boundary). Participant instructions for the PBBS read: "How strong is

the boundary between your self and the world, right now? Please find below several bodies that are more or less salient. A body high in salience is a body in which one feels enclosed, that is highly distinct from the bodies of others, and that sets a marked boundary between you and the rest of the world. Conversely, a body low in salience is strongly connected to its surroundings; it is a kind of permeable envelope, without any marked boundaries. Please indicate which of the bodies presented below best represents your current body state. If the boundaries of your body are extremely salient you should circle the image on the extreme right. If the boundaries of your body are almost imperceptible you should circle the image on the extreme left. You can indicate an intermediate state by circling an image somewhere between the two poles."

Spatial frame of reference was measured with the Spatial Frame of Reference Continuum (SFoRC; Hanley & Garland, 2019). The SFoRC is (Figure 2) a visual item used to represent degree to which the field of awareness is felt to extend beyond the physical body using a 6-point Likert type scale (1=Egocentric frame of reference, 6=Allocentric frame of reference). Participant instructions for the SFoRC read: "How far does your self extend into the world, right now? Using the letters and images below, please indicate how much you feel that your SELF extends beyond your physical body RIGHT NOW. "A" represents your self stopping at your physical body. "F" represents your self extending into everything (for example, the entire Universe). The letters in-between "A" and "F" represent different levels of self-extension. The rings are symbolic, and do not represent actual distances. Please circle one letter."

Analytic Strategy

First, repeated measures ANOVAs were used to examine Condition (Mindfulness vs. Active Listening) by Time (Session 1–5) interactions for the post-induction perceived body boundary and spatial frame of reference scores, adjusting for pre-induction scores. Lower perceived body boundary scores indicated less of a boundary between the self and the world. Higher spatial frame of reference scores indicated more allocentric frames of reference. Second, change scores were calculated for perceived body boundary and spatial frame of reference by subtracting the pre-induction score from the post-induction score at each of the five study sessions to ascertain the state effects of the experimental condition. Repeated measures ANOVAs were then used to examine Condition (Mindfulness vs. Active Listening) by Time (Session 1–5) interactions for the perceived body boundary and spatial frame of reference change scores. Finally, path analysis was used to determine whether perceived body boundary dissolution mediated the effect of mindfulness training on more spacious frames of reference.

Results

Perceived Body Boundaries

Repeated measures ANOVA revealed a significant Condition (Mindfulness vs. Active Listening) x Time (Session 1 – 5) interaction for post-induction perceived body boundaries ($F_{4,152}$=7.89, p<.001, η^2=.17), adjusting for pre-induction perceived body boundary scores. Thus, mindfulness training (Session 1: $\bar{x}$ =4.44, S.E.=.21; Session 5 = $\bar{x}$ =3.55, S.E.=.24)

decreased the strength of perceived body boundaries, relative to active listening (Session 1: $\bar{x}$ =3.87, S.E.=.22; Session 5 = $\bar{x}$ =4.61, S.E.=.25). Repeated measures ANOVA also revealed a significant Condition (Mindfulness vs. Active Listening) x Time (Session 1 – 5) interaction for state changes in perceived body boundaries ($F_{4,172}$=6.010, p<.001, η^2=.12), indicating that mindfulness training resulted in larger induction-dependent decreases in perceived body boundaries relative to active listening (Figure 3). We decomposed the change score interaction using the repeated contrast function to determine at which successive time points a significant between groups difference was observed. From session 1 to session 2, a significant between groups difference emerged ($F_{1,43}$=19.46, p<.001, η^2=.31), but not between any other two successive time points. Thus, mindfulness had the greatest impact on change in perceived body boundaries from session 1 to session 2.

Spatial Frame of Reference

Repeated measures ANOVA revealed a significant Condition (Mindfulness vs. Active Listening) x Time (Session 1 – 5) interaction for post-induction spatial frame of reference ($F_{4,148}$=3.59, p=.008, η^2=.09), adjusting for pre-induction spatial frame of reference scores. Thus, mindfulness training (Session 1: $\bar{x}$ =3.02, S.E.=.16; Session 5 = $\bar{x}$ =3.38, S.E.=.19) encouraged more allocentric frames of reference, relative to active listening (Session 1: $\bar{x}$ =3.28, S.E.=.17; Session 5 = $\bar{x}$ =2.84, S.E.=.20). Repeated measures ANOVA also revealed a significant Condition (Mindfulness vs. Active Listening) x Time (Session 1 – 5) interaction for state change in spatial frame of reference ($F_{4,168}$=2.586, p=.039, η^2=.06), indicating that mindfulness training resulted in larger induction-dependent increases in spatial frame of reference relative to active listening (Figure 4). We again decomposed this interaction using the repeated contrast function to determine at which successive time points a significant between groups difference was observed. From session 1 to session 2, a significant between groups difference emerged ($F_{1,42}$=8.45, p=.006, η^2=.17), but not between any other two successive time points. Thus, mindfulness had the greatest impact on change in spatial frame of reference from session 1 to session 2.

Path Modeling

Path analysis was conducted to examine whether experimentally induced changes in perceived body boundaries (i.e., changes in perceived body boundaries at session 5 adjusting for changes in perceived body boundaries at session 1) were associated with changes in spatial frame of reference (i.e., changes in spatial frame of reference at session 5 adjusting for changes in spatial frame of reference at session 1). A significant positive association was observed (β=−.58, p=.001), suggesting that as perceived body boundaries dissolved in response to mindfulness training, spatial frames of reference expanded.

To further examine these findings, two mediation analyses investigated the causal relation between perceived body boundaries and spatial frame of reference, testing the hypothesis that decreases in perceived body boundaries would encourage more spacious frames of reference (Figure 5). The contrast of greatest change revealed by the repeated measures ANOVA results (session 2) was selected as the mediator of experimental condition and the outcome (session 5). In our hypothesized model (model 1), residualized change in perceived body boundaries at session 2 (change in perceived body boundaries at session 2 adjusting for

change in perceived body boundaries at session1) was examined as a mediator of the relationship between condition and residualized change in spatial frame of reference at session 5 (change in spatial frame of reference at session 5 adjusting for change in spatial frame of reference at session1). Because alternative model specifications were possible, as an alternative model (model 2), we examined residualized change in spatial frame of reference at session 2 as a mediator of the relationship between condition and residualized change in perceived body boundaries at session 5.

In model 1, experimental condition had a significant direct effect on change in perceived body boundaries during session 2 (β=−.51, *se*=.36, *CI*: −0.82 to −2.23), and change in perceived body boundaries during session 2 had a significant direct effect on change in spatial frame of reference during session 5 (β=−.47, *se*=.09, *CI*: −0.46 to −0.12). Additionally, experimental condition demonstrated a significant indirect effect (β=.24, *se*=.17, *CI*: 0.11 to 0.78) on change in spatial frame of reference during session 5 via change in perceived body boundaries during session 2 (Figure 4). The model explained 42% of the variance in residualized change in spatial frame of reference.

In model 2, experimental condition had significant, direct effects on change in spatial frame of reference during session 2 (β=.45, *se*=.27, *CI*: 0.40 to 1.47), and change in perceived body boundaries during session 5 (β=−.47, *se*=.36, *CI*: −1.95 to −0.56). However, change in spatial frame of reference during session 2 did not directly effect change in perceived body boundaries during session 5 (β=−.16, *se*=.17, *CI*: −0.54 to 0.14).

Discussion

In this study, we examined the impact of mindfulness training on perceived body boundaries and spatial frames of reference in a sample of healthy, young adults randomized to mindfulness training or an active listening control condition. This study is the first to examine these two, core phenomenological features of self-transcendence together, and to examine their relationship across time. Results indicated that mindfulness training was associated with large effect size decreases in perceived body boundaries and medium effect size increases in spatial frames of reference over five training sessions. Furthermore, the expected relationship between perceived body boundaries and spatial frames of reference was observed, with mindfulness-induced perceived body boundary dissolution being associated with more allocentric frames of reference. Path analysis revealed that the effect of mindfulness training on spatial frames of reference was significantly mediated by perceived body boundary dissolution. Taken together, study results suggest that mindfulness training alters practitioners' experience of self, relaxing the boundaries of the self and extending the spatial frame of reference beyond the physical body.

Evidence from this study converges with previous reports suggesting mindfulness encourages self-transcendence (Ataria et al., 2015; Berkovich-Ohana & Glicksohn, 2017; Dambrun, 2016; Dor-Ziderman et al., 2013; A. W. Hanley et al., 2018; Adam W. Hanley & Garland, 2019). Specifically, these results confirm Dambrun's (2016) finding that only one mindfulness training session was sufficient to change body boundary perception in novice meditators. Thus, the experience of self appears to be highly malleable, despite the self

being popularly characterized in the West as a durable, trait-like entity. Results from this study also extends previous findings, indicating that mindfulness can continue to dissolve perceived body boundaries and expand spatial frames of reference over multiple, mindfulness training sessions.

As evidence accumulates demonstrating the self-transcendent effects of mindfulness meditation, future studies should explore the psychophysiological changes that co-occur with phenomenological reports of self-transcendence. Self-transcendent experiences may modulate autonomic arousal, given the observed relationship between self-transcendence and positive emotionality (Dambrun & Ricard, 2011; Hanley & Garland, 2019). It may also be that self-transcendence is associated with deactivation in the default mode network, given the relationship between activity in these brain regions and self-referential processing (Berkovich-Ohana et al., 2012; Brewer et al., 2011). Finally, self-transcendence might be mediated by changes in functional connectivity between the frontoparietal network and the inferior temporal nodes of the DMN observed during meditation (Froeliger et al., 2012). The inferior temporal lobe mediates the ventral allocentric stream of visuospatial reference and is therefore involved in object processing in relation to the environment (Medina et al., 2009). Allocentric processing is in contradistinction to the dorsal egocentric stream of attention which processes perceptual objects in relation to the embodied self (Volcic & Kappers, 2008). Increased functional connectivity in these networks may correspond with phenomenological accounts of mindfulness-induced changes in perceived body boundaries and spatial frames of reference (Austin, 2009). As meditative practice deepens over time, these self-transcendent phenomena may result in experiential emptiness (sunyata) and the nonduality of “the inner space of the mind and the outer space of objective phenomena” (Wallace & Hodel, 2008).

Future studies may also want to pursue the behavioral impacts of self-transcendent experiences. Self-transcendence is hypothesized to be closely linked with prosocial behavior (e.g., Macy, 1991). It may be that a shift in perspective from a “me” to a “we” orientation could evoke compassion, which may manifest as altruism. The relationship between selflessness and prosociality is echoed in many contemplative traditions, and results from this study may provide an initial step towards empirically grounding these long-standing claims. Furthermore, just as self-transcendence has clear implications for social relations, it may also have implications for individual relationships with the natural world. For instance, environmental stewardship may be an expected consequence of believing the self to be extended into nature. Thus, while findings from this study set the stage for continued exploration of self-transcendence -- specifically exploring the emotional and behavioral consequences of self-transcendent states and experiences -- a great deal of work remains to be done.

Limitations and Future Research Directions

Despite findings from this study representing valuable contributions to the nascent study of self-transcendence, limitations should also be noted. First, the sample was comprised primarily of young, college-educated females, which potentially limits the generalizability of results. Second, expectancy effects may have influenced these findings, despite efforts

being made in the recruitment process to minimize self-selection bias. Using a sham meditation control condition (e.g., Zeidan, Johnson, Gordon, & Goolkasian, 2010) may help address this potential confound in future studies. Third, psychometrically sound methods of measuring self-transcendence are just beginning to be developed. While preliminary evidence indicates the both the Perceived Body Boundaries Scale (PBBS; Dambrun, 2016) and the Spatial Frame of Reference Continuum (SFoRC; Hanley & Garland, 2019) are valid and useful measures of self-transcendence, continued psychometric work is needed. Additionally, future investigations of self-transcendence using the PBBS and the SFoRC may also benefit from including the Inclusion of Other in Self scale (Aron et al., 1992) as a complementary, visual measure designed to capture a conceptually related dimension of self-transcendence, or the state version of the Nondual Awareness Dimensional Assessment (Hanley, Nakamura, & Garland, 2018). Third, given the limited study of self-transcendence, qualitative interviews using the neurophenomenological method (Depraz et al., 2003) to elicit participant descriptions of self-transcendent experiences would have provided a more complete characterization of idiographic experiences. Relatedly, in rare instances, altered states of self can also be unpleasant (e.g., the dark night of the soul), and even pathologized in Western psychology (e.g., dissociative states). Although participants did not report any adverse events in this study, qualitative descriptions would have allowed us to more comprehensively represent the range of self-transcendent experiences evoked in this study.

The study of self-transcendence is a burgeoning area of inquiry that has a long historical lineage, but has received little attention in Western psychology. Self-transcendence is celebrated in many contemplative traditions as a means of achieving a durable sense of well-being (e.g., Dambrun & Ricard, 2011) and creating a better world (e.g., Macy, 1991). As such, the aim of many contemplative practices is the realization of self-transcendent states (Berman & Stevens, 2015; G. Dreyfus & Thompson, 2007; Hopkins et al., 1984). The Buddhist tradition, in particular, has developed an advanced technology of mindfulness practices designed to cultivate self-transcendence. Results from this study provide preliminary, empirical evidence that mindfulness can, indeed, induce self-transcendent states. This study suggests that self-transcendence can be arrived at through two complementary experiences, the dissolution of the boundaries of the self and the extension of the sense of self beyond the physical frame. Continued examination of these self-transcendent states will further refine our understanding of the relationship between perceived body boundaries and spatial frames of reference as well as identify the behavioral consequences self-transcendent experiences.

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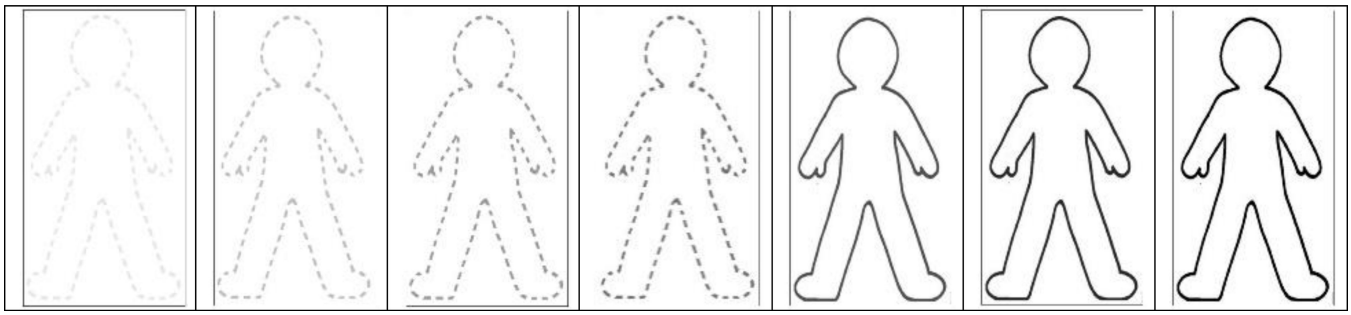

Figure 1.
Image used for the Perceived Body Boundaries Scale.

Figure 2.
Image used for the Spatial Frame of Reference Continuum.

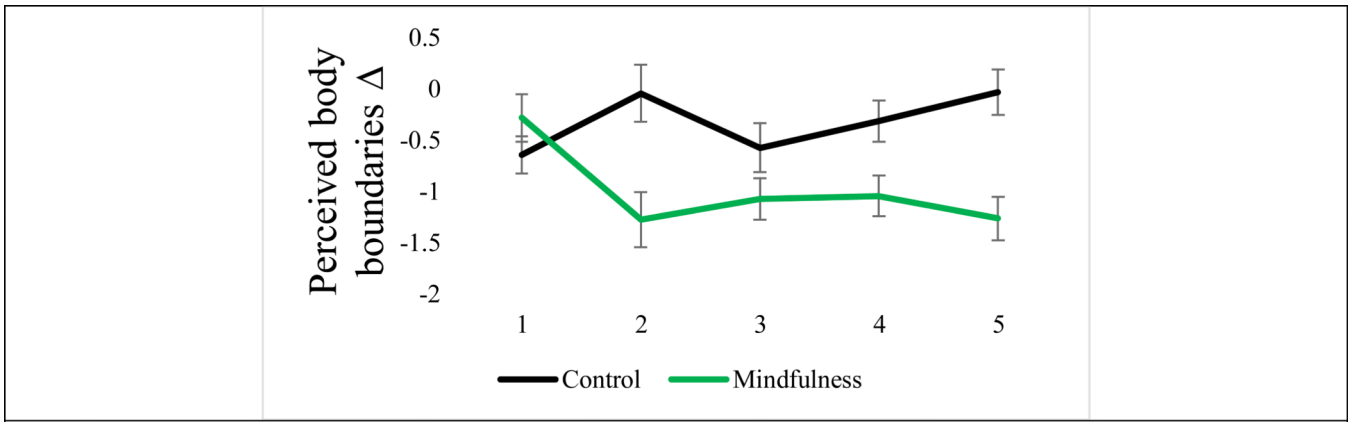

Figure 3.

Effect of mindfulness training on in-session change in perceived body boundaries (±1 standard error) from study session 1 to session 5. In-session change calculated by subtracting post-induction perceived body boundary score from pre-induction perceived body boundary score.

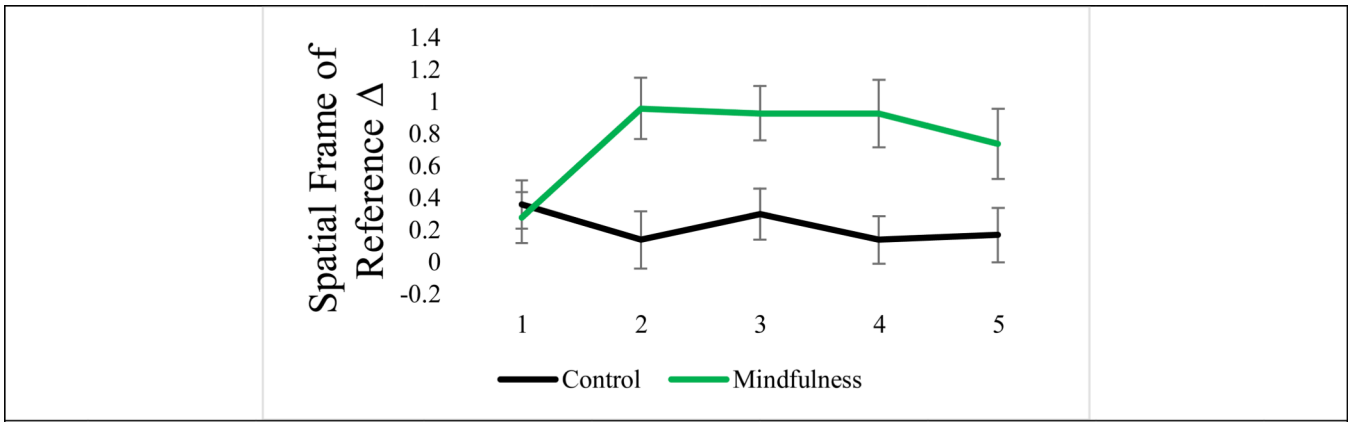

Figure 4.

Effect of mindfulness training on in-session change in spatial frame of reference (±1 standard error) from study session 1 to session 5. In-session change calculated by subtracting post-induction spatial frame of reference score from pre-induction spatial frame of reference score.

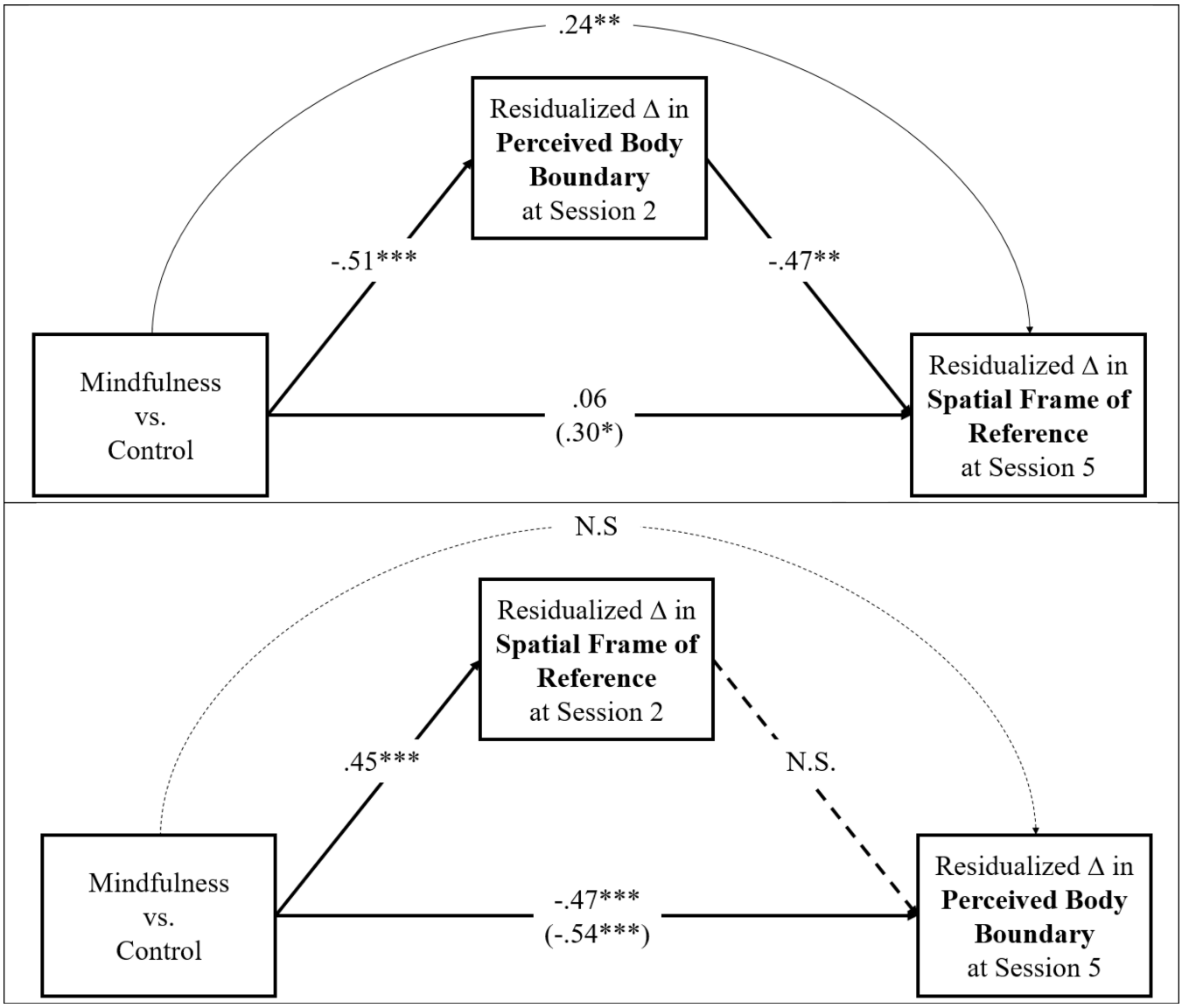

Figure 5.

Mediation models tesing the effects of mindfulness training on resdiualized changes in perceived body boundaries and residulaized changes in spatial frame of reference at sessions 2 and 5, adjusting for change scores during session 1. Parenthetic values re the direct effect of experimental condition on distal outcome with the mediator removed from the model. N.S. = non-significant path. The curved line represents the indirect effect of the endogenous variable on the distal outcome via the mediator.

Table 1.

Participant Demographics

Measure	Mindfulness	Active Listening	
Female, N (%)	21 (88%)	16 (76%)	χ^2=0.98, *p*=.32
Age, $\bar{x} \pm SD$	26.9 ± 6.5	27.0 ± 6.4	*t*=0.02, *p*=.98
Race, N (%)			χ^2=2.14, *p*=.54
Asian or South Asian	1 (4%)	2 (10%)	
Caucasian	21 (88%)	15 (71%)	
Multiracial	1 (4%)	1 (5%)	
Latino	1 (4%)	3 (14%)	
Perceived Body Boundary at Baseline	4.79 (1.35)	4.43 (1.03)	*t*=1.00, *p*=.32
Spatial Frame of Reference at Baseline	2.67 (1.17)	3.10 (1.26)	*t*=1.18, *p*=.24