https://doi.org/10.2352/EI.2023.35.10.HVEI-255


# Self-Regulation of Attentional Stance Facilitates Induction of Meditative States

Glenn Hartelius
Attention Strategies Institute

Lora Likova
Smith-Kettlewell Eye Research Institute

Christopher W. Tyler
Smith-Kettlewell Eye Research Institute

## Abstract

Attentional stances are particular ways in which *the location of the source or seat of attention* is situated within bodily experience. The goal of the study is to use this untapped cognitive resource to refine the construct of mindfulness by providing objective measurement and experimental control of these aspects of mindfulness. Location of the seat of attention, also described as *self-location* or *egocenter*, has been shown to have measurable impact on cognitive skill, emotional temperament, and self-construal, as well as social and moral attitudes. Our recent study has shown that the seat of attention can be volitionally self-regulated into various internal attentional stances that are stably associated with distinct patterns of cortical activation as measured with EEG. These results suggest that control of attentional stance should provide direct management of specific cognitive and emotional resources. Two specific global cognitive states associated with mindfulness are the positive emotional states of *vipaśyanā* and *śamatha*. The current study of the correlations of 11 attentional stances for with positive emotions reveal the association of *vipaśyanā* with a diffuse attentional stance centered on the abdomen, and *śamatha* with a focused attentional stance situated along the midline of the body. In addition to advancing denotation and differentiation of these two distinct elements of mindfulness, these results provide the opportunity for more efficient mindfulness training. Such opportunity would benefit anyone needing stress-reducing mindfulness training, and in particular, for underserved individuals in society who are most in need of stress management.

## Introduction

Meditative states such as mindfulness appear to be capable of description as specific, measurable *attentional stances*—particular ways in which *the source or seat of attention* is situated within bodily experience (Hartelius, Likova, & Tyler, 2022). Such descriptions make possible rapid methods for arriving at a target meditative state—a skill that otherwise may take weeks or months to master (e.g., Dobkin et al., 2017; Mastriano, 2012; Van Doren et al., 2022). Given that mindfulness is currently a poorly defined construct applied to what may be a variety of "fundamentally different states, experiences, skills, and practices" (Van Dam et al., 2018, p. 5), describing specific meditative states associated with mindfulness as distinct attentional stances will enable more precise definition, accurate objective measurement, and better control of mindfulness as an experimental variable.

The origin or seat of attention is the bodily location *from which* the attentional 'spotlight' is felt to emanate, and *at which* the attended information is felt to impinge. Existing research on the seat of attention, also described as *self-location* or *egocenter*, shows that it can be situated in various ways within the experienced body space (Hanley et al., 2020; Likova, 2012), and that differences in its location have measurable impact on cognitive skill, emotional temperament, and self-construal, as well as social and moral attitudes (Adam et al., 2015; Fetterman et al., 2020; Fetterman & Robinson, 2013).

A recent study by Hartelius et al. (2022) showed that this aspect of attention can be volitionally self-regulated into various internal *attentional stances*, and that these stances are relatively stable as demonstrated by robust within-subject inter-run correlations of EEG-measured patterns of brain activation for each stance; trials with 8 participants showed that most stances were associated with a unique cortical activation pattern in one or more frequency bands. This study also demonstrated that some attentional stances—that is, locations of the seat of attention—can be objectively associated with specific positive emotional states, suggesting that control of attentional stance should provide direct management of specific cognitive and emotional resources. This suggestion is supported by an earlier study with endurance athletes demonstrating that two different discrete attentional stances were associated with each of two tasks: a) reading a news story, and b) experiences of a flow state during athletic endurance practice (Hartelius, 2015; Marolt-Sender, 2014).

The capacity-modulating effect of changes in attentional stance suggests that this variable is key for regulation of global cognitive state (cf. McKilliam, 2020). This raises the possibility that meditative states such as *vipaśyanā* and *śamatha*, commonly associated with mindfulness, might reflect particular attentional stances. If so, then self-regulation of the seat of attention might facilitate improved definition, induction, maintenance, and validation of these meditative states. For example, *vipaśyanā* meditation—one of the practices associated with mindfulness—is associated with awareness in the abdomen (e.g., Bien & Didonna, 2009) and is sometimes categorized as a state of attentional diffusion (e.g., Dakwar & Levin, 2009); as such, the predicted *attentional stance* for *vipaśyanā* would be a diffuse attentional state centered on the abdomen. Conversely, since *śamatha* is achieved through practice of focused attention (e.g., Hickey, 2021) or the focusing of oneself (Stevens, 2021), it should be associated with focused attentional stances.

Given that experienced practitioners may combine *śamatha* with *vipaśyanā*, (e.g., Roychowdhury, 2021), one might expect the two types of stances to be contiguous in body space. Since these states are also associated with attainment of qualities such as bliss (e.g., Halkias, 2019) and serenity (e.g., Apple, 2015), they would likely have a robust association with positive emotions. The current study employed neuroimaging to investigate these hypotheses.

## Methods

Whole-head EEG was measured in eight participants (5F/3M) aged 32–71 (mean = 54) with facility in attentional self-regulation, using a high-density 128-lead EEG array while in either focused and diffuse stances centered in various locations in the head, chest, abdomen, and head+torso, covering the likely range of options (Fig. 1).

Our results of EEG measure of attentional stances were compared with brain activation patterns derived from an EEG study of positive emotional states (Hu et al., 2017; see Figs. 2), together with the separate variable of arousal(Fig. 3). The current analysis focused on identifying stances associated with multiple positive emotions, then distinguished attentional stances that included correlation with neural arousal from those that did not, in order to assess the predicted associations with either the *śamatha* or *vipaśyanā* forms of meditation.

## Results

The analysis showed that three of the eleven attentional stances were associated with more than one positive emotion, and each of these was strongly correlated in the beta and gamma bands with at least three positive emotions (see Figs. 3, 4). Two of these stances also correlated strongly with neural arousal: a stance focused in front of the spine in the core of the body, and one focused in the peripersonal space above the head. These two stances align with the expected characteristics of *śamatha* meditation, a practice that likely employs a stance extending to include both the spine and the peripersonal space above the head. These two stances align with the expected characteristics of śamatha meditation, a practice that likely employs a stance extending to include both the spine and the peripersonal region above the head (see Fig. 5A).

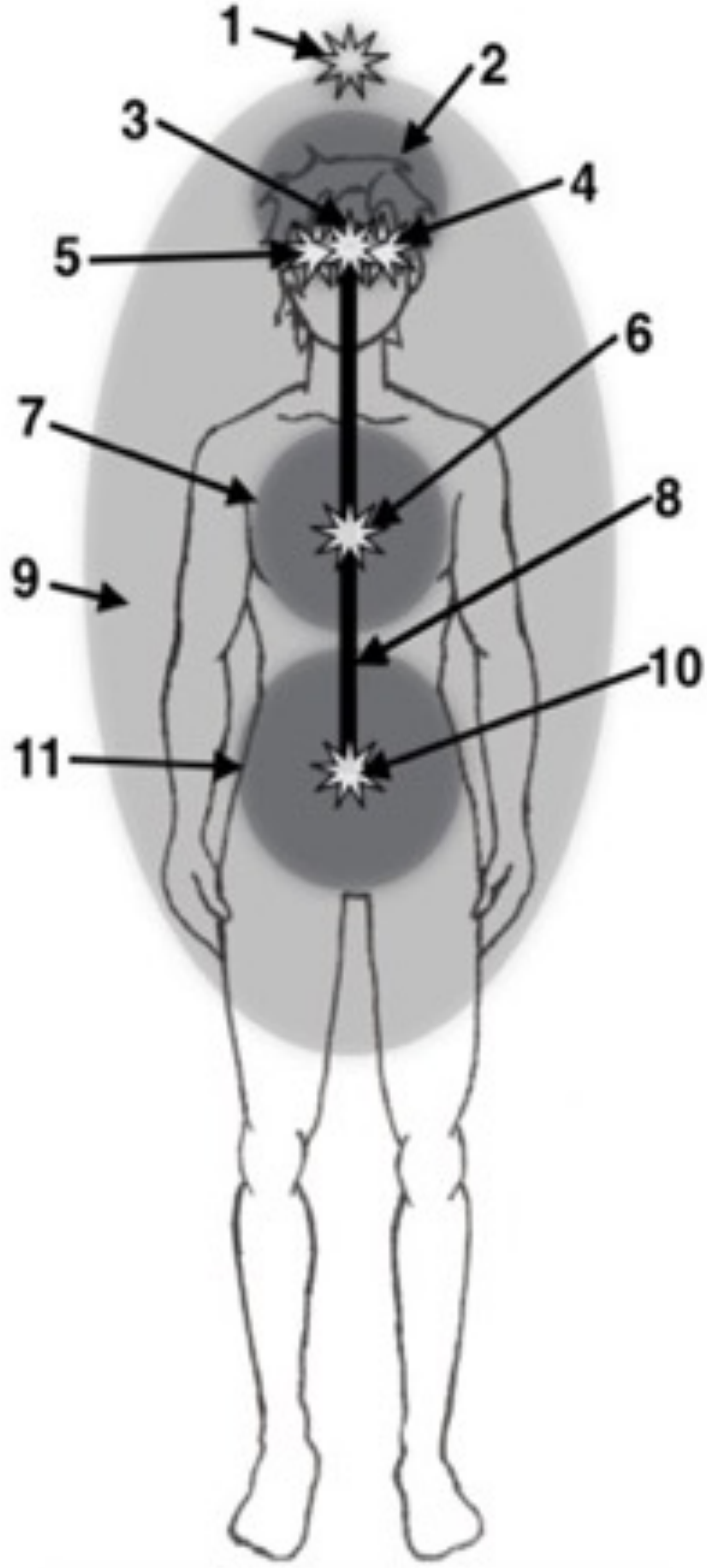


Fig. 1. Attentional stances measured for correlation with positive emotions and comparison with traditional characteristics of *vipaśyanā* and

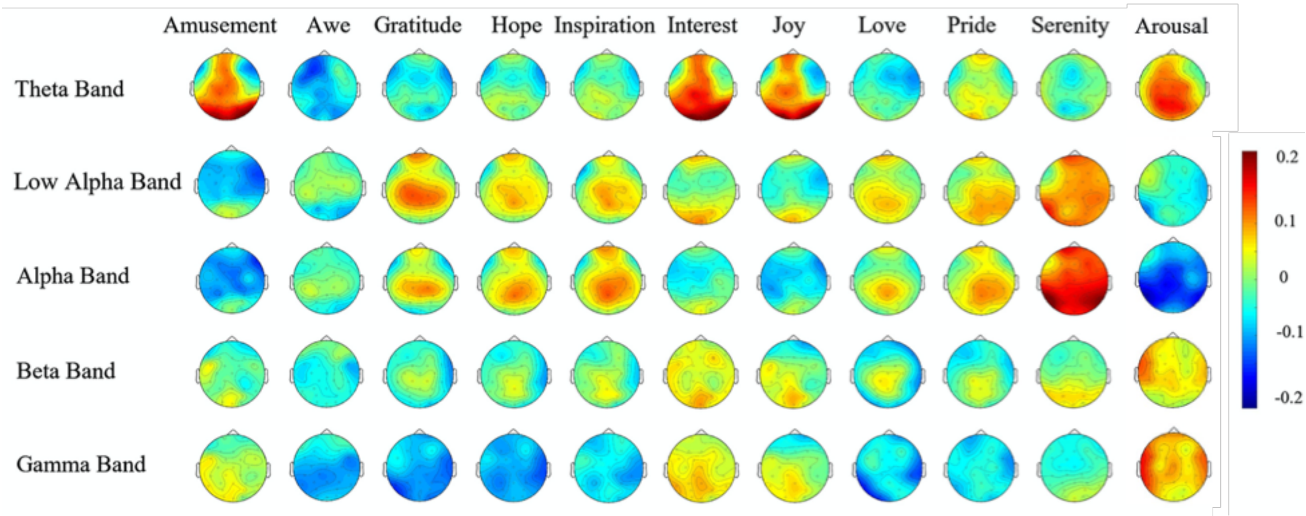


Fig. 2. EEG spatial patterns for 10 positive emotions, plus arousal. Note that these emotions are a mostly highly distinct from each other in one or more frequency bands (from Hu et al., 2017; reproduced with permission).

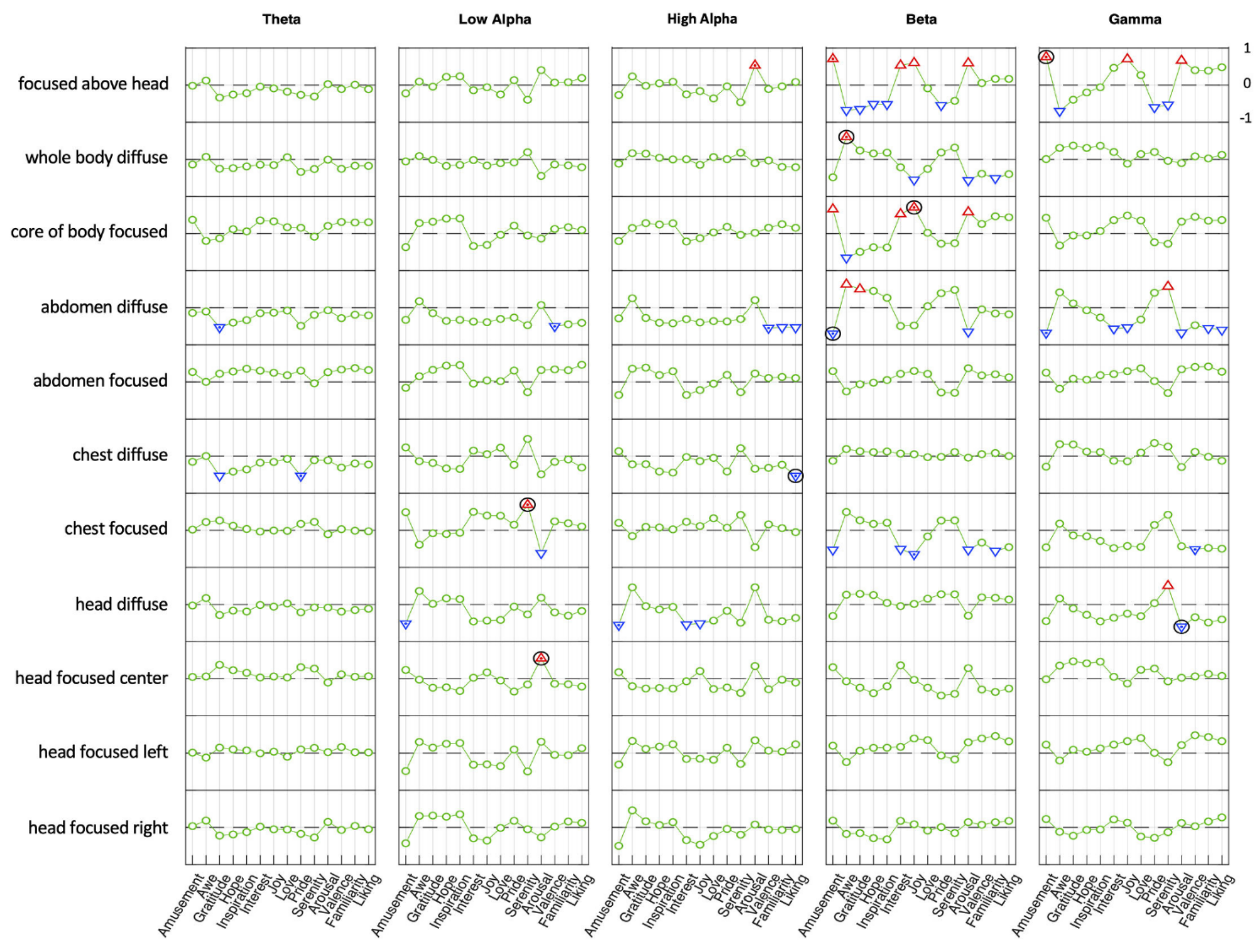


Fig. 3. Correlation between average power spectra (differences from non-Null mean) we have measured (Hartelius et al., 2022) and emotional correlation topography in Hu et al. (2017) in five frequency bands. The abs[correlation] ≥ 0.5 are indicated by triangles. Across 32 scalp locations, correlations ≥ 0.5 are significant at $p \leq 0.002$. The maximum within-band abs[correlation] above this threshold is marked with a dot. The frequency band with maximum correlation for each state is marked with a black circle.

The third stance correlated with multiple positive emotions but not with neural arousal: it being a diffuse attentional stance centered on the abdomen, which matches well with the predicted stance for vipaśyanā meditation (Fig. 5B). Thus, the two predicted associations for the śamatha and the vipaśyanā forms of meditation were borne out in the EEG analysis of the attentional stances, and aligned along the central body axis.

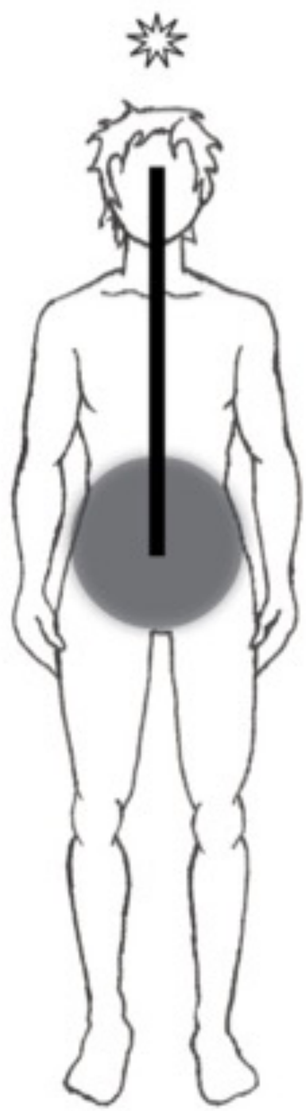

Fig. 4. The "abdomen diffuse" attentional stance (gray disk) correlated with awe and gratitude in the beta band and with serenity in the gamma band; the "core focused" stance (tick black line) correlated with amusement, interest, joy, and arousal in the beta band; the "above head focused" stance (star) correlated with amusement, interest, joy, and arousal in the beta band and amusement, joy, and arousal in the gamma band; all correlations ≥ 0.5 (i.e., significant at $p \leq 0.002$).

**Discussion & Conclusions**

While further testing is needed, this promising analysis suggests that quantitative data, graphic experiential descriptors, and traditional accounts are capable of resolution into a simplified and measurable operational description for specific meditative states associated with mindfulness. If confirmed in larger-scale future research, such results would greatly simplify teaching, induction, maintenance, and control for such states in experimental settings, thereby advancing their scientific study.

In addition to utility for meditation research, these results have more immediate pragmatic value for efficient dissemination of stress management based on mindfulness practice, especially to underserved populations who may not have time or resources to invest in lengthy trainings, as well as overloaded time-deficient executives Mindfulness-based stress reduction (MBSR) trainings typically require several hours of training per week for eight weeks (e.g., Dobkin et al., 2017), and may cost many hundreds of dollars, placing them out of reach for many individuals under high financial stress or heavy caretaking responsibilities.

Given that mindfulness training often includes visualized cues, while attentional stance for self-regulation of global cognitive state relies instead on interoceptive capabilities that tend to be well developed in blind individuals (Radziun et al., 2022), such an approach to mindfulness practices may be particularly well adapted to this population. Vision loss is a highly stressful event (Bittner et al., 2010; Sabel, 2018) that has a substantial negative impact on well-being (Nyman et al., 2012) and quality of life (Rai et al., 2019), requiring the adoption of novel coping strategies for improved adaptational outcomes rather than reliance on existing strategies (Brennan & Cardinali, 2000). Personal practice of mindfulness among blind and low vision individuals has been associated with increased social, emotional, and physical health (Marquès-Brocksopp, 2014), and mindfulness meditation has been shown to reduce stress biomarkers (Dada et al., 2018) and both increase optic perfusion and decrease interocular pressure in

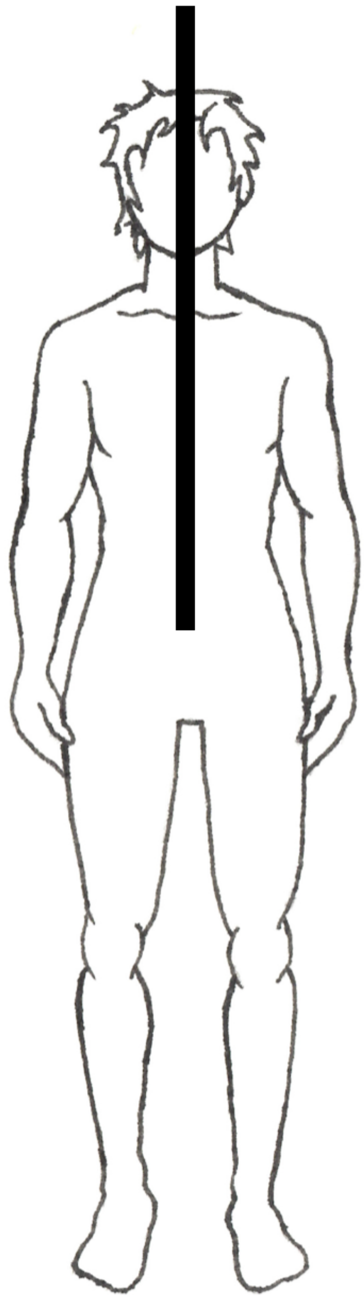

Fig. 5A. **The attentional stance of *śamatha*.** The two attentional stances strongly correlated with positive emotions and with neural arousal accord with traditional characterizations of the *śamatha* state, suggesting that these neural functions reflect the attentional stance of *śamatha*.

glaucoma (Dada et al., 2021a, 2021b), but an initial review of literature has found no studies focused on adapting mindfulness practices to blind populations. Future studies should extend evidence for enhanced interceptive mindfulness

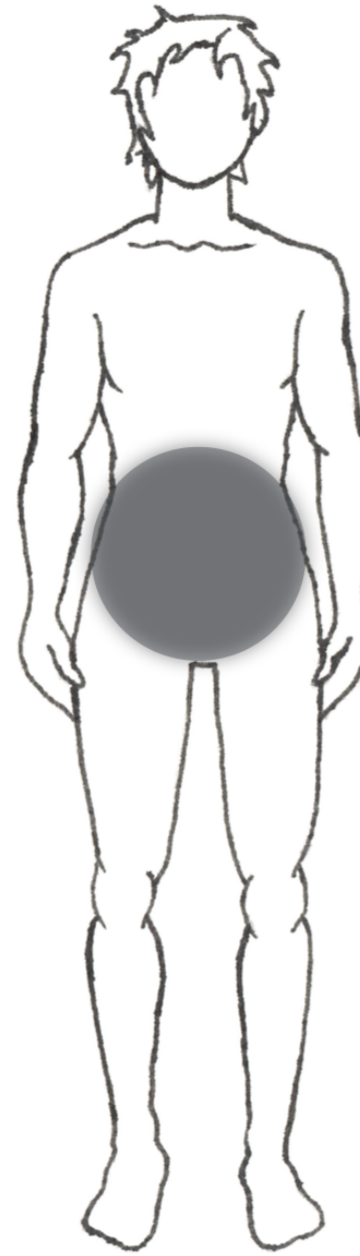

Fig. 5B. **The attentional stance of *vipaśyanā*.** That the single attentional stance strongly correlated with positive emotions and associated with the abdomen accords with traditional characterizations of the *vipaśyanā* state, suggesting this is the attentional stance of *vipaśyanā*.

mechanisms in diverse populations such as the blind, preliminary to scientifically informing its incorporation in future vision rehabilitation protocols.

This approach to conceptualization and measurement of two specific global cognitive states associated with mindfulness offers advancement toward increased accuracy in denotation and differentiation of distinct elements now encompassed under the broad umbrella of states associated with mindfulness offers advancement toward increased specificity in denotation and differentiation of distinct elements now encompassed under the broad umbrella of mindfulness. It can also provide a pragmatic way forward for streamlining mindfulness training for individuals in society who are most in need of simplified stress management strategies.

**Acknowledgments**
NIH/NEI ROI EY024056 & NSF/SL-CN 1640914 to LTL.

**References**

Adam, H., Obodaru, O., & Galinsky, A. D. (2015). Who you are is where you are: Antecedents and consequences of locating the self in the brain or the heart. *Organizational Behavior and Human Decision Processes*, *128*, 74–83. https://doi.org/10.1016/j.obhdp.2015.03.004

Apple, J. B. (2015). Mindfulness and vigilance in Tsong-kha-pa's great treatise on the stages of the path to enlightenment. In *Buddhist Foundations of Mindfulness* (pp. 245–266). Springer, Cham. https://doi.org/10.1007/ 978-3-319-18591-0_12

Bien, T., & Didonna, F. (2009). Appendix A: Mindfulness practice. In F. Didonna (Ed.), *Handbook of mindfulness* (pp. 477–488). Springer. https://doi.org/10.1007/978-0-387-09593-6

Bittner, A. K., Edwards, L., & George, M. (2010). Coping strategies to manage stress related to vision loss and fluctuations in retinitis pigmentosa. *Optometry—Journal of the American Optometric Association*, *81*(9), 461–468. https://doi.org/10.1016/j.optm.2010.03.006

Brennan, M., & Cardinali, G. (2000). The use of preexisting and novel coping strategies in adapting to age-related vision loss. *The Gerontologist*, *40*(3), 327–334. https://doi.org/10.10 93/geront/40.3.327

Dada, T., Mittal, D., Mohanty, K., Faiq, M. A., Bhat, M. A., Yadav, R. K., Sihota, R., Talvir, S., Velpandian, T., Kalaivani, M., Pandey, R. M., Gao, Y., Sabel, B. A., & Dada, R. (2018). Mindfulness meditation reduces intraocular pressure, lowers stress biomarkers and modulates gene expression in glaucoma: A randomized controlled trial. *Journal of Glaucoma*, *27*(12), 1061–1067. https://doi.org/ 10.1097/IJG.0000000000001088

Dada, T., Lahri, B., Mahalingam, K., Shakrawal, J., Kumar, A., Sihota, R., & Yadav, R. K. (2021a). Beneficial effect of mindfulness-based stress reduction on optic disc perfusion in primary open angle glaucoma: A randomized controlled trial. *Journal of Traditional and Complementary Medicine*, *11*(6), 581-586. https://doi.org/10.1016/j.jtcme.2021.06.006

Dada, T., Bhai, N., Midha, N., Shakrawal, J., Kumar, M., Chaurasia, P., Gupta, S., Angmo, D., Yadav, R., Dada, R., & Sihota, R. (2021b). Effect of mindfulness meditation on intraocular pressure and trabecular meshwork gene expression: A randomized controlled trial. *American Journal of Ophthalmology*, *223*, 308–321. https://doi.org/ 10.1016/ j.ajo.2020.10.012

Dakwar, E., & Levin, F. R. (2009). The emerging role of meditation in addressing psychiatric illness, with a focus on substance use disorders. *Harvard Review of Psychiatry*, *17*(4), 254–267. https://doi.org/10.1080/10673220903149135

Dobkin, P. L., Zhao, Q., & Monshat, K. (2017). Who experiences depressive symptoms following mindfulness-based stress reduction and why? *The International Journal of Whole Person Care*, *4*(1), 13–31. https://doi.org/10.26 443/ijwpc.v4i1.123

Fetterman, A. K., Juhl, J., Meier, B. P., Abeyta, A., Routledge, C., & Robinson, M. D. (2020). The path to God is through the heart: Metaphoric self-location as a predictor of religiosity. *Self Identity*, *19*, 650–672. https://doi.org/10.10 80/15298868.2019.1651389

Fetterman, A. K., & Robinson, M. D. (2013). Do you use your head or follow your heart? Self-location predicts personality, emotion, decision making, and performance. *Journal of Personality and Social Psychology*, *105*, 316–334. https://doi.org/10.1037/a0033374

Halkias, G. T. (2019). Buddhist meditation in Tibet: Exoteric and esoteric orientations. In M. Farias, D., Brazier, & M. Lalljee (Eds.), *The Oxford Handbook of Meditation*. Oxford University Press. https://doi.org/10.1093/oxford hb/97801 98808640.013.52

Hanley, A. W., Lecy, N., & Hanley, R. (2021). Locating the embodied sense of self and examining its relationship with psychological well-being. *International Journal of Transpersonal Studies*, *40*(1), 84–95. https://doi.org/10.2 4972/ijts.2021.40.1.84

Hartelius, G. (2015). Body maps of attention: Phenomenal markers for two varieties of mindfulness. *Mindfulness*, *6*, 1271–1281. https://doi.org/10.1007/s12671-015-0391-x

Hartelius, G., Likova, L. T., & Tyler, C. W. (2022). Self-regulation of seat of attention into various attentional stances facilitates access to cognitive and emotional resources: An EEG study. *Frontiers in Psychology*, *13*, 810780. https://doi.org/10.3389/fpsyg.2022.810780

Hickey, W. S. (2021). "Mind cure" and mindfulness-based interventions (MBIs). In D. Lüddeckens, P. Hetmanczyk, P. E. Klassen, & J. B. Stein (Eds.), *The Routledge handbook of religion, medicine, and health* (pp. 83–97). Routledge. https://doi.org/10.4324/9781315207964-8

Hu, X., Yu, J., Song, M., Yu, C., Wang, F., Sun, P., Wang, D., & Zhang, D. (2017) EEG correlates of ten positive emotions. *Frontiers in Human Neuroscience*, *11*, 26. https://doi.org/ 10.3389/fnhum.2017.00026

Likova, L. T. (2012) The spatiotopic 'visual' cortex of the blind. *IS&T/SPIE Electronic Imaging*. http://doi.org/10.11 17/12.912257

Marolt-Sender, M. A. (2014). A phenomenological inquiry into the attention postures of flow-like states [Doctoral dissertation, Sofia University]. ProQuest Dissertations and

Theses. https://www.proquest.com/docview/16844 25934/2 0934ABA0C674060PQ/1?accountid=25260
Marquès-Brocksopp, L. (2014). Mindfulness, spiritual well-being, and visual impairment: An exploratory study. *British Journal of Visual Impairment*, *32*(2), 108–123. https://doi.org/10.1177/0264619614528343
Mastriano, H. A. (2012). The impact of Zen meditation on security and satisfaction in monogamous relationships. *Mental Health, Religion & Culture*, *15*(5), 495–510. https://doi.org/10.1080/13674676.2011.587402
McKilliam, A. (2020). What is a global state of consciousness? *Philosophy and the Mind Sciences*, *1*(II), 7. https://doi.org/10.33735/phimisci.2020.II.58
Nyman, S. R., Dibb, B., Victor, C. R., & Gosney, M. A. (2012). Emotional well-being and adjustment to vision loss in later life: A meta-synthesis of qualitative studies. *Disability and rehabilitation*, *34*(12), 971–981. https://doi.org/10.3109/096 38288.2011.626487
Radziun, D., Korczyk, M., Crucianelli, L., Szwed, M., & Ehrsson, H. H. (2022). Cardiac interoception is enhanced in blind individuals. *bioRxiv*. https://doi.org/10.1101/2022.0 5.02.490293
Rai, P., Rohatgi, J., & Dhaliwal, U. (2019). Coping strategy in persons with low vision or blindness—An exploratory study. *Indian Journal of Ophthalmology*, *67*(5), 669–676. https://doi.org/10.4103/ijo.IJO_1655_18
Roychowdhury, D. (2021). Mindfulness practice during COVID-19 crisis: Implications for confinement, physical inactivity, and sedentarism. *Asian Journal of Sport and Exercise Psychology*, *1*(2), 108–115. https://doi.org/10.10 16/ j.ajsep.2021.09.004
Sabel, B. A., Wang, J., Cárdenas-Morales, L., Faiq, M., & Heim, C. (2018). Mental stress as consequence and cause of vision loss: The dawn of psychosomatic ophthalmology for preventive and personalized medicine. *EPMA Journal*, *9*(2), 133–160. https://doi.org/10.1007/s13167-018-0136-8
Stevens, J. (2021). *The marathon monks of Mount Hiei*. Echo Point Books & Media.
Van Dam, N. T., van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., Meissner, T., Lazar, S. W., Kerr, C. E., Gorchov, J., Fox, K. C. R., Field, B. A., Britton, W. B., Brefczynski-Lewis, & Meyer, D. E. (2018). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science*, *13*(1), 36–61. https://doi.org/10.11 77/1745691617709 589
Van Doren, N., Oravecz, Z., Soto, J. A., & Roeser, R. W. (2022). Examining the cultural consensus on beliefs about mindfulness among US college-attending young adults. *Mindfulness*, *13*(10), 2420–2433. https://doi. org/10.1007/ s12671-022-01956-x

## Author Biographies

***Glenn Hartelius, Ph.D.,*** *serves as Director of Attention Strategies Institute in Berkeley, CA, which specializes in attention and global cognitive states. His research focuses on cognitive processes associated with global cognitive state regulation, operational definition of meditative states, resolution of dissociated ego states, therapeutic effects of ketamine-induced states, consciousness theory and research, and contributions to the definition and development of whole person approaches to psychology. He has built and chaired a doctoral program in psychology, taught at universities in the United States and the UK, and worked closely with scholars from Fudan University, Shanghai, in support of the founding and development of the Chinese Association of Integral Psychology.*

***Lora Likova, Ph.D.,*** *has a multidisciplinary background that encompasses studies in cognitive neuroscience and computer science, with patents in the field of magnetic physics and many years of experience in brain imaging, brain plasticity, human vision, and neurorehabilitation research. Her work was the first to identify the cortical mechanism of dynamic depth perception using fMRI, a discovery that has been instrumental in opening a new field in binocular motion research. In the field of enhancing memory, learning and spatiomotor abilities, Dr. Likova has developed a paradigmatically novel training technique – The Cognitive-Kinesthetic Training, based on (non-visual) drawing from memory, which has shown dramatic behavioral and causal brain reorganization effects in a wide range of cognitive and spatio-motor domains. It is highly effective in enhancing brain plasticity even in late adulthood and has shown tremendous potential as a rehabilitative intervention across blind, low vision and normally sighted populations. She is the Director of "Brain Plasticity, Learning & Neurorehabilitation Lab" at Smith-Kettlewell Eye Research Institute in San Francisco. Dr. Likova is a long-standing member of the Organizing Committee of HVEI.*

***Christopher W. Tyler, Ph.D., D.Sci.,*** *is currently Head of the Brain Imaging Center of the Smith-Kettlewell Eye Research Institute in San Francisco, which specializes in visual, cognitive and rehabilitation research. His research career is in visual neuroscience and computational vision with emphasis on form, symmetry, flicker, motion, color, and stereoscopic depth perception in adults and tests for the diagnosis of eye diseases in infants and of retinal and optic nerve diseases in adults. An area of particular interest is the cortical mechanisms involved in the stereoscopic processing of 3D images to extract the depth signal from the binocular disparity between the two images, including his origination of the algorithm for the random-dot autostereogram, a method of presenting 3D information in a single image rather than a stereopair. He developed a rapid method of recording brain responses across a wide range of conditions (the "sweep VEP") in as little as 10 seconds. He has recently been developing advanced non-invasive methods for estimating the neural signal dynamics underlying the BOLD fMRI signal and bringing these capabilities to bear on evaluating deficits of the electroretinogram and motor control of eye movements in individuals with Traumatic Brain Injury. He has received support for his research on functional vision through many federal agencies, and is involved in international research collaborations as far afield as the UK, France, Australia, Germany, Israel, India and Taiwan.*