

Dartmouth College

Dartmouth Digital Commons

Dartmouth Scholarship

Faculty Work

4-14-2014

Movement-Based Embodied Contemplative Practices: Definitions and Paradigms

Laura Schmalzl

University of California - San Diego

Mardi A. Crane-Godreau

Dartmouth College

Peter Payne

Dartmouth College

Follow this and additional works at: <https://digitalcommons.dartmouth.edu/facoa>



Part of the [Cognitive Neuroscience Commons](#), [Kinesiotherapy Commons](#), and the [Movement and Mind-Body Therapies Commons](#)

Dartmouth Digital Commons Citation

Schmalzl, Laura; Crane-Godreau, Mardi A.; and Payne, Peter, "Movement-Based Embodied Contemplative Practices: Definitions and Paradigms" (2014). *Dartmouth Scholarship*. 855.

<https://digitalcommons.dartmouth.edu/facoa/855>

This Article is brought to you for free and open access by the Faculty Work at Dartmouth Digital Commons. It has been accepted for inclusion in Dartmouth Scholarship by an authorized administrator of Dartmouth Digital Commons. For more information, please contact dartmouthdigitalcommons@groups.dartmouth.edu.



Movement-based embodied contemplative practices: definitions and paradigms

Laura Schmalzl^{1,2*†}, Mardi A. Crane-Godreau^{3,4†} and Peter Payne^{3†}

¹ Department of Family and Preventive Medicine, University of California San Diego, La Jolla, CA, USA

² VA San Diego Healthcare System, La Jolla, CA, USA

³ Department of Microbiology and Immunology, Geisel School of Medicine at Dartmouth, Lebanon, NH, USA

⁴ Research and Development Service, Veteran's Administration Medical Center, White River Junction, VT, USA

Edited by:

Catherine Kerr, Brown University, USA

Reviewed by:

Evan Thompson, University of British Columbia, Canada
Michael Lifshitz, McGill University, Canada
Catherine Kerr, Brown University, USA

*Correspondence:

Laura Schmalzl, Department of Family and Preventive Medicine, School of Medicine, University of California San Diego, 9500 Gilman Drive, La Jolla, CA 92093, USA
e-mail: lschmalzl@ucsd.edu

[†] These authors have contributed equally to this work.

Over the past decades, cognitive neuroscience has witnessed a shift from predominantly disembodied and computational views of the mind, to more embodied and situated views of the mind. These postulate that mental functions cannot be fully understood without reference to the physical body and the environment in which they are experienced. Within the field of contemplative science, the directing of attention to bodily sensations has so far mainly been studied in the context of seated meditation and mindfulness practices. However, the cultivation of interoceptive, proprioceptive and kinesthetic awareness is also said to lie at the core of many movement-based contemplative practices such as Yoga, Qigong, and Tai Chi. In addition, it likely plays a key role in the efficacy of modern somatic therapeutic techniques such as the Feldenkrais Method and the Alexander Technique. In the current paper we examine how these practices are grounded in the concepts of embodiment, movement and contemplation, as we look at them primarily through the lens of an enactive approach to cognition. Throughout, we point to a series of challenges that arise when Western scientists study practices that are based on a non-dualistic view of mind and body.

Keywords: Yoga, Qigong, Somatics, embodiment, movement, contemplation, proprioception, mindfulness

INTRODUCTION

Compared to the extensive body of work on mindfulness-based practices, far fewer scientific studies have examined the mechanisms underlying movement-based embodied contemplative practices such as Yoga or Qigong. One likely reason is the inherent challenge of dealing with their multifaceted nature, typically involving specific movement sequences, specialized use of the breath, and modulation of attention (Wayne and Kaptchuk, 2008). Movement-based practices have, however, been shown to alleviate the symptoms of various clinical conditions (Jahnke et al., 2010; Wren et al., 2011), and elicit measurable changes in physiological stress markers (Lee et al., 2004; West et al., 2004), cognitive functioning (Manjunath and Telles, 2001; Silva et al., 2007), sensorimotor acuity (Kerr et al., 2008), as well as emotional states in healthy populations (Chattha et al., 2008). An important challenge for contemplative scientists is therefore to advance our understanding of the mechanisms underlying these complex practices. But what exactly constitutes a movement-based embodied contemplative practice (MECP)? Contemplative movement systems exist in almost all cultures of the world—from shamanistic dances, Christian liturgical gestures, and Eastern spiritual practices, to modern Western somatic practices. The initial challenge in looking at these systems is one of providing a taxonomy that is appropriate both to the systems themselves and to thorough scientific investigation. Whether a system is embodied or not, whether it is movement-based or not, and whether it is contemplative or not, are all relevant distinctions, so let us look at each of these aspects separately.

EMBODIED

Over the past decades, cognitive neuroscience has witnessed a shift from predominantly abstract and computational views of the mind, to more embodied and situated views of the mind.

Francisco Varela (Varela et al., 1991) was one of the first to introduce the term “embodied mind” into cognitive neuroscience as a counter to the concept of a “disembodied mind,” a mental entity considered independently of its relationship to a body and the environment (for further perspectives see (Wilson, 2002), and (Ziemke, 2003)). According to the “enactive approach” to cognition (Thompson and Varela, 2001; Thompson, 2005; Di Paolo and Thompson, 2014), living beings are autonomous agents that actively generate and maintain their physical and psychological identities, and that enact their cognitive domains through their activities. As such, the enactive approach postulates that human beings exists intrinsically as embodied beings, and that mental functions such as perception, cognition and motivation, cannot be fully understood without reference to the physical body as well as the environment in which they are experienced (Varela et al., 1991; Thompson, 2007).

The closely related “grounded theory” of cognition (Barsalou, 2008) posits that cognition (including abstract thought, conceptual knowledge and semantic memory) is grounded in the brain’s modal sensory systems, rather than being merely based on abstract computations. Similarly, the dynamical systems approach to developmental theory (Camras and Witherington, 2005), psychoanalysis (Krueger, 2002) as well as the newly emerging body-oriented methods of psychotherapy (Heller, 2012), all emphasize

that bodily sensory systems are the first to develop and that they play a fundamental role in the formation of the sense of self (Sheets-Johnstone, 1999). In sum, all these schools of thought converge on the fact that the experience of one's self in the world as a cognizant being does not solely emerge from neural activity within the brain. Instead, it involves a complex interplay of brain, body and environment, and the seamless integration of interoceptive, proprioceptive (including vestibular), kinesthetic, tactile, and spatial information (Ehrsson, 2007; Haselager et al., 2012; Ionta et al., 2011).

Within the field of contemplative science, the process of becoming reflectively attentive to bodily sensations and sensory experiences has so far been primarily studied in the context of seated meditation and mindfulness-based practices (Didonna, 2009). However, it is certainly at the core of many movement-based practices as well. In fact, systems such as Hatha Yoga, Qigong, Tai Chi, the Alexander Technique, and the Feldenkrais Method (see Supplementary Material for a brief description of these systems), all involve an explicit emphasis on attending to interoceptive, proprioceptive and kinesthetic qualities of experience. They also use concepts such as “being in one's body” to encourage an embodied experience of the self.

MOVEMENT-BASED

One of the central motivations of examining movement within the context of contemplative practices can be related to the enactive approach described above. Movement is a fundamental characteristic of the embodied state, and the enactive as well as the grounded cognition approaches propose that the individual's capacity for self-movement and its underlying sensorimotor substrates are a constitutive part of all cognitive processes (Thompson and Varela, 2001; Barsalou, 2008). In addition, they propose that any embodied activity, including cognitive processes, takes the form of sensorimotor coupling with the environment. What a living organism senses and perceives is a function of how it moves, and how a living organism moves is a function of what it senses and perceives (Maturana and Varela, 1987). Along similar lines, Llinás (2002) echoes Sperry's earlier assertion (Sperry, 1952) that movement is the principal function of the nervous system, and that most advanced functions of the cortex can be seen as elaborations of the basic need to move toward or away from environmental stimuli. The word “emotion” is derived from the Old French “*emouvoir*” (“to stir up or agitate”), and from the Latin roots “*ex-*” (out) and “*-movere*” (to move). Similarly, the word “attention” is derived from the root “*ten*” (“to stretch out toward”) (Partridge, 1966). In that sense, feeling attracted or repulsed from something, or even directing or withdrawing ones attention from something, can be seen as subtle forms of movement (Day, 1964; Sheets-Johnstone, 1999).

For the most part, MECPs are based on internally generated self-willed movement (Krieghoff et al., 2011), and practitioners guide and adjust their movement based on subtle feedback from joints and muscles (Scott, 2012). Such voluntary and actively initiated movement, as opposed to externally evoked or purely passively imposed motion, is intrinsic to the sense of agency (Kalckert and Ehrsson, 2012), which in turn is central to the

development of the sense of self (Thelen and Fogel, 1989). Given their emphasis on carefully executed intentional movements, we speculate that MECPs can be a tool for restructuring an individual's sense of agency, and consequently impact the exploration and transformation their sense of self. There are, however, also forms of MECPs that involve spontaneous movement that is not controlled voluntarily (e.g., Spontaneous Qigong, Tandava, Shaktipat, Katsugen-Kai, Latihan, and Kundalini (Louchakova and Warner, 2003)). Such practices involve putting oneself into a state of receptivity and surrendering to the spontaneous movement that arises. Overtly, these movements may resemble animal movements, Taijiquan forms, or Yoga asanas and mudras. In other cases however, the “movement” is purely internal, involving vivid interior sensations of heat, vibration, “energy” currents, and even changes in experienced bodily shape and spatial extension. During infant development, spontaneous involuntary movement precedes controlled voluntary movement and the development of a sense of agency (Sheets-Johnstone, 1999). That is, an infant's experience of “movement occurs” precedes the experience of “I move” (Haselager et al., 2012). We suggest that MECPs involving spontaneous movement may therefore allow a constructive regression to early stages of development of voluntary motor control, and a consequent re-modeling of the sense of agency.

Asian movement-based practices such as Ashtanga Vinyasa Yoga (Jois, 1999) or Taijiquan (Jou and Shapiro, 1983) obviously involve overt voluntary physical motion, and strongly emphasize specific forms and qualities of movement. However, let us consider this quote from Yiquan master Wang Xiangzhai: “One should know that a big movement is not as good as a small movement, a small movement is not as good as stillness, one must know that only stillness is the endless movement.” (Wang, 2005). In Qigong practice, as in the internal martial arts, there is often a progression from an overt large motion, to a very small and subtle motion, to a purely internal or imagined movement—and this last is regarded as the most effective (as well as the most difficult) way of moving the “Qi” (life energy). So what needs to move, and to what extent does the movement need to be overtly evident, in order for a practice to qualify as movement-based? Here we propose the idea of extending the concept of “movement-based” so as to include very subtle, and even imagined, movement. This idea is supported by our knowledge of the neural mechanisms underlying motor control (Scott, 2012) and motor imagery (Schuster et al., 2011). Every execution of an overt movement controlled by the primary motor cortex is preceded by activations in premotor and supplementary motor areas. This preparatory phase has the purpose of organizing the movement by setting the appropriate posture, muscle tone and autonomic tone, and allow for integration of information from other cortical regions (e.g., visual, somatosensory, executive, affective and motivational) into the intended motor action (Wolpert et al., 2011). Moreover, premotor, supplementary motor as well as cerebellar areas are strongly activated during motor imagery without any actual physical movement (Gerardin et al., 2000), which in itself can improve motor skills and even physical strength (Yue and Cole, 1992; Sharma et al., 2006; Schuster et al., 2011). Qigong uses a technique very similar to motor imagery

referred to as “moving the Qi.” It consists of moving one’s attention through the body so as to create a sensation of a flowing current of energy (Johnson et al., 2000). This form of practice is regarded by most practitioners as essential to the benefits of Qigong. We postulate that such subtle movement may have the effect of re-programming counterproductive patterns of intention and action by bringing the process of initiating action up to full consciousness.

At this point it might appear that every contemplative practice involves movement to some extent, and in fact we would argue that this is the case. Even in the most static forms of seated meditation the whole body is in constant subtle motion with the rhythm of the breath. That said however, we propose to define a movement-based practice as one in which the principal focus is on the intentional induction, or the intentional disinhibition, of overt movement or subtle internal sensations of movement. This definition excludes simply watching the breath while seated, unless specific emphasis is put on cultivating attention to the subtle movement that accompanies the breath.

CONTEMPLATIVE

In recent scientific explorations of contemplative practices, the terms “contemplation” and “meditation” have often been used interchangeably. The dictionary definition of contemplation includes both secular and religious meanings, referring to sustained attention and deep consideration of an object of interest that is often used in the context of religious or spiritual experience. The root of the word is the same as that of “temple”—“tem” or “to cut”—implying the concept of “carving out” a special time and place apart from daily preoccupations (Partridge, 1966). The word meditation has its origins in the Indo-European root “med,” implying the concepts “to measure,” “to consider,” or “to think about.” In Western Christian tradition “contemplation” refers to non-conceptual awareness of the Divine, whereas “meditation” carries the implication of conceptual, thought-based consideration of religious ideas. In the encounter between Western thought and Asian religions however, the English word meditation has come to be used to denote a wide range of diverse practices (for a discussion of this issue in relation to early Buddhist writings see Brooks, 2004).

A theoretical approach that is fundamental to the investigation of contemplative and meditative practices is neurophenomenology (Varela, 1996; Lutz and Thompson, 2003), an offshoot of the enactive approach described above. Neurophenomenology emerged out of the need to make systematic use of first-person methods and introspective phenomenological reports in the study of subjective conscious experience, and to relate the information gathered through those methods to complex dynamical systems analysis of brain activity. First-person methods, whether phenomenological, meditative or psychotherapeutic, are specifically aimed at increasing an individual’s sensitivity to the quality of their experience from moment to moment. As a result, they have the potential to enable tacit, pre-verbal and pre-reflective aspects of the experience that typically remain merely “lived through,” to become subjectively accessible. First-person methods exist within several contemplative practices and traditions that systematically

cultivate the capacity for attentive self-awareness. While the individual practices differ in terms of specifically adopted techniques, they typically involve a disciplined process of becoming reflectively attentive to experience. In phenomenology this process is known as “epoché” (Husserl, 2012), and is described as three intertwining phases that form a dynamic cycle. In a nutshell, the three phases consist of suspension of habitual thoughts, redirection of attention to the experience itself, and receptivity to whatever arises from it (Depraz et al., 2000). In the context of MECPs, the redirection of attention predominantly entails cultivating awareness of bodily sensations and proprioceptive feedback related to the specifically employed movement and breathing techniques.

In recent years there has been an increasing interest in trying to understand the neural mechanisms underlying contemplative states. In fact, mindfulness-based meditation practices are now known to engage selective brain areas and neural networks involved in attention, body awareness, emotion regulation and the sense of self (Hölzel et al., 2011; Kerr et al., 2013). In addition, meditative practices have also been found to be typically associated with altered activation of the so-called default mode network (DMN) (Raichle et al., 2001), and enhanced connectivity between cortical regions implicated in self-monitoring and cognitive control (Brewer et al., 2011). The DMN is known to be involved in the construction of the “autobiographical self,” and the assessment of stimuli for their relevance to the mentally sustained image of oneself. The altered activity of the DMN during meditative states has therefore been proposed to underlie a shift to less self-centered and more objective awareness of interoceptive as well as exteroceptive sensory events (Brewer et al., 2011). To which extent these findings also relate to MECPs remains an open question. Yoga and Qigong are broad and multifaceted categories, both including a range of “meditative movement” practices (Larkey et al., 2009), which are typically complemented by seated meditation techniques. Hence, while many of the already formulated theories about the mechanisms underlying traditional mindfulness-based practices might also apply to MECPs, it can also be assumed that MECPs may involve additional distinct mechanisms. Specifically, since movement increases the intensity of proprioceptive stimuli (Prochazka, 2011), it is possible that MECPs may offer a more efficient form of practice than seated meditation when it comes to cultivating bodily awareness and the sense of self.

Regardless of the specific underlying mechanisms, for most practitioners of MECPs contemplation represents the cultivation of sustained attention and equanimity (Desbordes et al., 2014), that for some has the ultimate aim of transforming habitual self-identity (akin to most seated meditation practices). However, MECPs can also be practiced without specific reference to altered self-identity as such. For example, Hatha Yoga can be practiced as a form of physical therapy, or Taijiquan purely as a martial art. Whether in such cases these types of practices can still be defined as contemplative remains subject to interpretation. In any case, the wide spectrum of potential applications of MECPs underlines the importance of documenting precisely which of their component parts are emphasized within a specific intervention—not only for the sake of scientific clarity, but out of respect to the systems themselves.

ADDITIONAL CONSIDERATIONS

So far we have referred to MECPs as performed by an individual person. However, there are also forms of MECPs involving two people. The relationship between these two may be that of master and disciple, teacher and student, therapist and client, or co-practitioners. Together, they enter a state of enhanced connectivity referred to as “resonance” (Siegel, 2007; Nummenmaa et al., 2012). In this state there is a largely automatically occurring sharing of affective and somatosensory experience, said to also involve a simultaneous activation of affective and sensory brain structures in both individuals. These phenomena have been documented in recent research in social neuroscience (Singer and Lamm, 2009). This form of dyadic contemplation is at the core of many Eastern movement-based systems (Wallace, 2001), as well as Western systems such as the Feldenkrais Method, the Alexander Technique, and body-oriented psychotherapy.

A further example of a novel therapeutic system that might fall into the category of MECPs is Somatic Experiencing (SE). Based on observations of how animals in the wild recover from trauma, its principal method is based on attention to bodily (interoceptive, proprioceptive, kinesthetic, tactile and spatial) sensations (Levine, 1997). According to SE theory, it is proposed that the practitioner is guided by the resonant relationship and verbally leads the client into internal and external movement, enabling a rebalancing of the autonomic nervous system (Levine, 2010).

CONCLUSION

As pointed out in a seminal article by Kerr (2002) and more recently by Payne and Crane-Godreau (2013), several challenges arise when Western scientists study practices that stem from ancient Eastern traditions. These authors underline the importance of having a thorough understanding of a system in its own terms before attempting to interpret it from a modern scientific perspective. They point out the risk of attempting to shoehorn a system into an already existing conceptual framework, which often eliminates the possibility of genuinely new discovery.

So what does it mean to look for the mechanisms underlying MECPs? Most of these practices have their own intrinsic complex bodies of theory. As both scientists and practitioners of MECPs, we are naturally drawn to wanting to operationalize them and understand them in our own “language.” In doing so however, our aim is not to replace their already existing frameworks with new scientific explanations (Smolin, 2013). Rather, our task is one of translation—the translation of phenomena and theories emerging from one world-view into a language based on a very different world-view. Neither of these languages is right or wrong, but each of them has advantages and disadvantages. If neuroscience will remain open to encountering phenomena not previously recognized, this will undoubtedly improve our scientific understanding of human functioning and of how ancient practices can enhance human wellbeing in our modern times.

ACKNOWLEDGMENTS

We would like to thank our reviewers for providing us with invaluable constructive feedback. Many thanks also to James L. Bernat, Steven N. Fiering, Eva Henje Blom, James C. Leiter, Chivon Powers and Elizaveta Solomonova for their comments

on an earlier version of this manuscript. Laura Schmalzl is supported by funding from the U.S. Department of Veteran Affairs Rehabilitation Research and Development (VA RR and D). Mardi A. Crane-Godreau and Peter Payne are supported by funding from the Flight Attendant Medical Research Institute (FAMRI). Mardi A. Crane-Godreau is also supported by funding from the American Academy of Pediatrics.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <http://www.frontiersin.org/journal/10.3389/fnhum.2014.00205/abstract>

REFERENCES

- Akers, B. D. (2002). *The Hatha Yoga Pradipika: The Original Sanskrit (Swami Svatmarama) – An English translation (Brian Dana Akers)*. New York, NY: Woodstock.
- Alexander, F. M., and Maisel, E. (1989). *The Alexander Technique: The Essential Writings of F. M. Alexander*. New York, NY: Carol Communications.
- Barlow, W. (1973). *The Alexander Technique*. New York, NY: Alfred A. Knopf, Inc.
- Barsalou, L. W. (2008). Grounded cognition. *Ann. Rev. Psychol.* 59, 617–645. doi: 10.1146/annurev.psych.59.103006.093639
- Brewer, J. A., Worhunsky, P. D., Gray, J. R., Tang, Y. Y., Weber, J., and Kober, H. (2011). Meditation experience is associated with differences in default mode network activity and connectivity. *Proc. Natl. Acad. Sci. U.S.A.* 108, 20254–20259. doi: 10.1073/pnas.1112029108
- Brooks, J. S. (2004). *Exposing Translator Bias in the Translation of the Pali Canon and Other Asian Literature*. Available online at: <http://www.greatwesternvehicle.org/criticism/translation.htm> (Accessed on: January 3, 2014).
- Camras, L. A., and Witherington, D. C. (2005). Dynamical systems approaches to emotional development. *Dev. Rev.* 25, 328–350. doi: 10.1016/j.dr.2005.10.002
- Chattha, R., Raghuram, N., Venkatram, P., and Hongasandra, N. R. (2008). Treating the climacteric symptoms in Indian women with an integrated approach to yoga therapy: a randomized control study. *Menopause* 15, 862–870. doi: 10.1097/gme.0b013e318167b902
- Cohen, K. (1999). *The Way of Qigong*. Los Angeles, CA: Ballantine Wellspring.
- Day, M. E. (1964). An eye movement phenomenon relating to attention, thought and anxiety. *Percept. Mot. Skills* 19, 443–446. doi: 10.2466/pms.1964.19.2.443
- Depraz, N., Varela, F. J., and Vermersch, P. (2000). “The gesture of awareness: an account of its structural dynamics,” in *Investigating Phenomenal Consciousness: New Methodologies and Maps*, ed M. Velmans (Philadelphia, PA: John Benjamins), 121–136. doi: 10.1075/aicr.13.10dep
- Desbordes, G., Gard, T., Hoge, E. A., Hölzel, B. K., Kerr, C., Lazar, S. W., et al. (2014). Moving beyond mindfulness: defining equanimity as an outcome measure in meditation and contemplative research. *Mindfulness*. doi: 10.1007/s12671-013-0269-8. [Epub ahead of print].
- Didonna, F. (2009). *Clinical Handbook of Mindfulness*. New York, NY: Springer. doi: 10.1007/978-0-387-09593-6
- Di Paolo, E., and Thompson, E. (2014). “The enactive approach,” in *The Routledge Handbook of Embodied Cognition*, ed L. Shapiro (London: Routledge Press). (in press). Available online at: <http://www.routledge.com/books/details/9780415623612/>
- Ehrsson, H. H. (2007). The experimental induction of out-of-body experiences. *Science* 317, 1048–1048. doi: 10.1126/science.1142175
- Feldenkrais, M. (1990). *Awareness Through Movement: Health Exercises for Personal Growth*. San Francisco, CA: Harper Collins.
- Gerardin, E., Sirigu, A., Lehericy, S., Poline, J. B., Gaymard, B., Marsault, C., et al. (2000). Partially overlapping neural networks for real and imagined hand movements. *Cereb. Cortex* 10, 1093–1104. doi: 10.1093/cercor/10.11.1093
- Haselager, W. F. G., Broens, M., and Gonzalez, M. E. Q. (2012). The importance of sensing one’s movements in the world for the sense of personal identity. *Rivista Internazionale di Filosofia e Psicologia* 3, 1–11. doi: 10.4453/rifp.2012.0001
- Heller, M. C. (2012). *Body Psychotherapy: History, Concepts and Methods*. New York, NY: W. W. Norton and Company, Inc.
- Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., and Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms

- of action from a conceptual and neural perspective. *Perspect. Psychol. Sci.* 6, 537–559. doi: 10.1177/1745691611419671
- Husserl, E. (2012). *Ideas: General Introduction to Pure Phenomenology* (Trans: W. R. B. Gibson). New York, NY: Routledge Press.
- Ionta, S., Gassert, R., and Blanke, O. (2011). Multi-sensory and sensorimotor foundation of bodily self-consciousness – an interdisciplinary approach. *Front. Psychol.* 2:383. doi: 10.3389/fpsyg.2011.00383
- Jahnke, R., Larkey, L., Rogers, C., Etnier, J., and Lin, F. (2010). A comprehensive review of health benefits of Qigong and Tai Chi. *Am. J. Health Promot.* 24, 1–25. doi: 10.4278/ajhp.081013-LIT-248
- Johnson, J. A., Stewart, J. M., and Howell, M. H. (2000). *Chinese Medical Qigong Therapy: A Comprehensive Clinical Guide*. Pacific Grove, CA: International Institute of Medical Qigong.
- Jois, S. K. P. (1999). *Yoga Mala*. New York, NY: North Point Press.
- Jou, T. H., and Shapiro, S. (1983). *The Tao of Tai Chi Chuan: Way to Rejuvenation*. Rutland, VT: C.E. Tuttle Company.
- Kalckert, A., and Ehrsson, H. H. (2012). Moving a rubber hand that feels like your own: a dissociation of ownership and agency. *Front. Hum. Neurosci.* 6:40. doi: 10.3389/fnhum.2012.00040
- Kerr, C. E. (2002). Translating “mind-in-body”: two models of patient experience underlying a randomized controlled trial of Qigong. *Cult. Med. Psychiatry* 26, 419–447. doi: 10.1023/A:1021772324119
- Kerr, C. E., Sacchet, M. D., Lazar, S. W., Moore, C. I., and Jones, S. R. (2013). Mindfulness starts with the body: somatosensory attention and cortical alpha modulation in mindfulness meditation. *Front. Hum. Neurosci.* 7:12. doi: 10.3389/fnhum.2013.00012
- Kerr, C. E., Shaw, J. R., Wasserman, R. H., Chen, V. W., Kanojia, A., Bayer, T., et al. (2008). Tactile acuity in experienced Tai Chi practitioners: Evidence for use dependent plasticity as an effect of sensory-attentional training. *Exp. Brain Res.* 188, 317–322. doi: 10.1007/s00221-008-1409-6
- Kriehoff, V., Waszak, F., Prinz, W., and Brass, M. (2011). Neural and behavioral correlates of intentional actions. *Neuropsychologia* 49, 767–776. doi: 10.1016/j.neuropsychologia.2011.01.025
- Krueger, D. W. (2002). *Integrating Body Self and Psychological Self: Creating a New Story in Psychoanalysis and Psychotherapy*. New York, NY: Routledge Press.
- Larkey, L., Jahnke, R., Etnier, J., and Gonzalez, J. (2009). Meditative movement as a category of exercise: Implications for research. *J. Phys. Activ. Health* 6, 230–238.
- Lee, M. S., Kang, C. W., Lim, H. J., and Lee, M. S. (2004). Effects of Qi-training on anxiety and plasma concentrations of cortisol, ACTH, and aldosterone: a randomized placebo-controlled pilot study. *Stress Health* 20, 243–248. doi: 10.1002/smi.1023
- Levine, P. A. (1997). *Waking the Tiger – Healing Trauma: The Innate Capacity to Transform Overwhelming Experiences*. Berkeley, CA: North Atlantic Books.
- Levine, P. A. (2010). *In an Unspoken Voice: How the Body Releases Trauma and Restores Goodness*. Berkeley, CA: North Atlantic Books.
- Llinás, R. R. (2002). *I of the Vortex: From Neurons to Self*. Cambridge, MA: MIT Press.
- Louchakova, O., and Warner, A. S. (2003). Via Kundalini: psychosomatic excursions in transpersonal psychology. *Human. Psychol.* 31, 115–158. doi: 10.1080/08873267.2003.9986928
- Lutz, A., and Thompson, E. (2003). Neurophenomenology: integrating subjective experience and brain dynamics in the neuroscience of consciousness. *J. Conscious. Stud.* 10, 31–52.
- Manjunath, N., and Telles, S. (2001). Improved performance in the Tower of London test following Yoga. *Indian J. Physiol. Pharmacol.* 45, 351–354.
- Maturana, H. R., and Varela, F. J. (1987). *The Tree of Knowledge: The Biological Roots of Human Understanding*. Boston, MA: New Science Library.
- Nummenmaa, L., Glerean, E., Viinikainen, M., Jaaskelainen, I. P., Hari, R., and Sams, M. (2012). Emotions promote social interaction by synchronizing brain activity across individuals. *Proc. Natl. Acad. Sci. U.S.A.* 109, 9599–9604. doi: 10.1073/pnas.1206095109
- Palmer, D. A. (2007). *Qigong Fever: Body, Science and Utopia in China*. New York, NY: Columbia University Press.
- Partridge, E. (1966). *Origins: A Short Etymological Dictionary of Modern English*. New York, NY: Macmillan.
- Payne, P., and Crane-Godreau, M. A. (2013). Meditative movement for depression and anxiety. *Front. Psychiatry* 4:71. doi: 10.3389/fpsyg.2013.00071
- Prochazka, A. (2011). “Proprioceptive feedback and movement regulation,” in *Comprehensive Physiology* (Wiley Online Library), 89–127. doi: 10.1002/cphy.cp120103
- Raichle, M. E., Macleod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., and Shulman, G. L. (2001). A default mode of brain function. *Proc. Natl. Acad. Sci. U.S.A.* 98, 676–682. doi: 10.1073/pnas.98.2.676
- Rywerant, Y., and Feldenkrais, M. (2003). *The Feldenkrais Method: Teaching by Handling*. North Bergen, NJ: Basic Health Publications.
- Satchidananda, S. S. (1978). *The Yoga Sutras of Patanjali: Translation and Commentary by Sri Swami Satchidananda*. Buckingham, VA: Integral Yoga Publications.
- Schuster, C., Hilfiker, R., Amft, O., Scheidhauer, A., Andrews, B., Butler, J., et al. (2011). Best practice for motor imagery: a systematic literature review on motor imagery training elements in five different disciplines. *BMC Med.* 9:75. doi: 10.1186/1741-7015-9-75
- Scott, S. H. (2012). The computational and neural basis of voluntary motor control and planning. *Trends Cogn. Sci.* 16, 541–549. doi: 10.1016/j.tics.2012.09.008
- Sharma, N., Pomeroy, V. M., and Baron, J. C. (2006). Motor imagery: a backdoor to the motor system after stroke. *Stroke* 37, 1941–1952. doi: 10.1161/01.STR.0000226902.43357.fc
- Sheets-Johnstone, M. (1999). Emotion and movement: a beginning empirical-phenomenological analysis of their relationship. *J. Conscious. Stud.* 6, 259–277.
- Siegel, D. J. (2007). *The Mindful Brain: Reflection and Attunement in the Cultivation of Well-being*. New York, NY: W. W. Norton and Company.
- Silva, L. M., Cignolini, A., Warren, R., Budden, S., and Skowron-Gooch, A. (2007). Improvement in sensory impairment and social interaction in young children with autism following treatment with an original Qigong massage methodology. *Am. J. Chin. Med.* 35, 393–406. doi: 10.1142/S0192415X07004916
- Singer, T., and Lamm, C. (2009). The social neuroscience of empathy. *Ann. N.Y. Acad. Sci.* 1156, 81–96. doi: 10.1111/j.1749-6632.2009.04418.x
- Singleton, M. (2010). *Yoga Body: The Origins of Modern Posture Practice*. New York, NY: Oxford University Press. doi: 10.1093/acprof:oso/9780195395358.001.0001
- Smolin, L. (2013). *Time Reborn: From the Crisis in Physics to the Future of the Universe*. Boston, MA: Houghton Mifflin Harcourt.
- Sperry, R. W. (1952). Neurology and the mind-brain problem. *Am. Sci.* 40, 291–312.
- Thelen, E., and Fogel, A. (1989). “Toward an action-based theory of infant development,” in *Action in Social Context: Perspectives on Early Development*, eds J. J. Lockman and N. L. Hazen (New York, NY: Plenum Press), 23–63.
- Thompson, E. (2005). Sensorimotor subjectivity and the enactive approach to experience. *Phenomenol. Cogn. Sci.* 4, 407–427. doi: 10.1007/s11097-005-9003-x
- Thompson, E. (2007). *Mind in Life: Biology, Phenomenology, and the Sciences of Mind*. Cambridge, MA: Belknap Press of Harvard University Press.
- Thompson, E., and Varela, F. J. (2001). Radical embodiment: neural dynamics and consciousness. *Trends Cogn. Sci.* 5, 418–425. doi: 10.1016/S1364-6613(00)01750-2
- Varela, F. J. (1996). Neurophenomenology: a methodological remedy for the hard problem. *J. Conscious. Stud.* 3, 330–349.
- Varela, F. J., Thompson, E., and Rosch, E. (1991). *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: MIT Press.
- Wallace, B. A. (2001). Intersubjectivity in Indo-Tibetan Buddhism. *J. Conscious. Stud.* 8, 209–230.
- Wang, X. (2005). *An Interview with Mr. Wang Xiang Zhai about the Essence of Combat Science*. Available online at: <http://gong-fu.eu/wp-content/uploads/pdf/wxzessenz.pdf> (Accessed on: September 9, 2013).
- Wayne, P. M., and Kaptchuk, T. J. (2008). Challenges inherent to T'ai Chi research: Part I – T'ai Chi as a complex multicomponent intervention. *J. Alter. Complement. Med.* 14, 95–102. doi: 10.1089/acm.2007.7170A
- West, J., Otte, C., Geher, K., Johnson, J., and Mohr, D. C. (2004). Effects of Hatha Yoga and African dance on perceived stress, affect, and salivary cortisol. *Ann. Behav. Med.* 28, 114–118. doi: 10.1207/s15324796abm2802_6
- Wile, D. (1996). *Lost T'ai-chi Classics From the Late Ch'ing Dynasty*. Albany, NY: State University of New York Press.
- Wilson, M. (2002). Six views of embodied cognition. *Psychon. Bull. Rev.* 9, 625–636. doi: 10.3758/BF03196322
- Wolpert, D. M., Diedrichsen, J., and Flanagan, J. R. (2011). Principles of sensorimotor learning. *Nat. Rev. Neurosci.* 12, 739–751. doi: 10.1038/nrn3112
- Wren, A. A., Wright, M. A., Carson, J. W., and Keefe, F. J. (2011). Yoga for persistent pain: new findings and directions for an ancient practice. *Pain* 152, 477–480. doi: 10.1016/j.pain.2010.11.017

- Yue, G., and Cole, K. J. (1992). Strength increases from the motor program: comparison of training with maximal voluntary and imagined muscle contractions. *J. Neurophysiol.* 67, 1114–1123.
- Ziemke, T. (2003). “What’s that thing called embodiment?” in *Proceedings of the 25th Annual Conference of the Cognitive Science Society*, eds R. Alterman and E. Kirsh (Mahwah, NJ: Lawrence Erlbaum), 1134–1139.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 14 February 2014; accepted: 24 March 2014; published online: 14 April 2014.
Citation: Schmalzl L, Crane-Godreau MA and Payne P (2014) Movement-based embodied contemplative practices: definitions and paradigms. Front. Hum. Neurosci. 8:205. doi: 10.3389/fnhum.2014.00205

This article was submitted to the journal Frontiers in Human Neuroscience.

Copyright © 2014 Schmalzl, Crane-Godreau and Payne. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) or licensor are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.