

Neuroplasticity, Meditation Training, and The New Mind
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Abstract

There is growing consensus in cognitive neuroscience and psychology that the brain and mind are plastic, but the limits of neuroplasticity are unknown. It is time for a new mind-brain science supported by rigorous inter-disciplinary empirical investigation to determine how training the mind changes the brain. The growing field of meditation research has yielded promising findings, but several questions remain concerning the underlying processes and the limits of observed benefits of meditation training. To address those issues, we propose a paradigm shift from an almost exclusive use of third-person assessments (by outside observers using physical measures) to a more synergistic approach integrating first- and third-person assessments of meditation training in experimental contexts. The challenge is to document, rigorously and systematically, what people actually “do” during meditation, given the instructions they receive, and then relate first-person assessments to previously validated objective measures. We explain why this challenge question is important while framing the longstanding issues of meditation research in a more scientifically tractable manner. The synergistic approach we advocate here will benefit both basic and applied science by illuminating the mechanisms of mind-brain plasticity and guiding development of practical tools for use in clinical and secular educational, workplace, and community contexts.

Neuroplasticity, Meditation Training, and The New Mind

Millions of years of evolution have shaped the biology of the human brain and mind. Culture and individual learning tune this biology throughout a person's life. We intuitively understand, and science now supports, that we are born with certain abilities, and then learn, through our interests and efforts, to achieve diverse goals. The brain is plastic; learning modifies connections among neurons, changes brain structure, and alters the cortical systems devoted to particular tasks. But the limits of brain plasticity are unknown and currently represent humankind's greatest frontier. It is time for a new science of brain-mind plasticity, backed by rigorous, inter-disciplinary empirical science, which can help us understand how training yields new capabilities. The implications of such research are wide-ranging, running from the ethics of science through changes in educational policy to society's appreciation of the human capacity to flourish within an increasingly interdependent and stressful world.

The new perspective on mind science implies that almost any activity in any domain (e.g., athletics, academics, music, visual arts, parenthood, politics), if pursued to a sufficient degree, can significantly alter the brain and mind. We focus on one domain that has attracted growing attention from the scientific community: The field of meditation research has yielded many promising findings about the benefits of mental training. Still, there are many unknowns with respect to the underlying processes and the nature and limits of the benefits. Here we frame those issues in scientifically tractable terms and contend that they can be addressed in a new research paradigm integrating first- and third-person assessments of meditation training.

1. The challenge question

What do people actually *do* when they meditate, and how does that relate to the transformation they experience as a result of their meditation practice? In other words, how does the nuanced phenomenology of subjective experience during meditation relate to the changes we can measure in psychological, physiological, neurological, and biological processes as a result of meditation practice?

More specifically, our challenge question can be broken down into simpler questions: What kinds of conscious experiences do meditators engage in while meditating? What kinds of other subjective experiences occur in meditation without any intention or conscious effort on the part of the individual "doing" the meditation? Which processes (with or without conscious effort or intention) are common across meditators within a certain tradition, which ones are common across different traditions, and which ones are idiosyncratic? Can we relate the diverse subjective experiences in meditation, assessed with novel first-person

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measures, to the known objective benefits of meditation assessed with previously validated third-person measures? What novel third-person measures can be developed based on considering the first-person accounts?

2. Explanation, research context, and significance of the challenge question

Documented benefits of meditation include improvements in attention and well-being, as well as clinical improvements in hypertension, depression, anxiety and eating disorders, substance abuse, and quality of life for people with neurodegenerative diseases. Yet meditation research has thus far not addressed the challenge question we have raised. For example, the finding that certain patterns of brain activity are associated with certain kinds of meditation practice cannot directly illuminate the observations and learning that occur in the meditator's mind. Granted, many experiments are designed to illuminate the neuro-cognitive underpinnings of meditation, not the subjective experience of meditators. But such scientific studies of meditation are of limited pedagogical and educational value if we do not understand the emotional and cognitive processes that occur during meditation. We propose to use meditators' first-person perspectives to better understand training-related changes in performance in cognitive and socioemotional domains.

Why does this matter? The scientifically documented effects of meditation are currently understood in terms of the instructions participants receive in their training. For example, in Mindfulness Based Stress Reduction (MBSR) programs, participants are told to "gently attend to the breath without grasping or pushing away any thoughts" while remaining "non-judgmental" and as "accepting" of their experiences as possible. Such instructions are fairly general, and even the teachers of such programs acknowledge that it is generally not possible to follow the instructions perfectly during a meditation session. Also, we know from psychological research that people do not always do what they are told, not necessarily because they do not wish to comply but because some of their mental processes operate outside of awareness and beyond personal control.

There is a wide range of meditation methods taught in various traditions, including practices designed to arouse benevolent states of minds such as compassion and loving-kindness; practices designed to hone focused attention; and devotional practices such as prayers and chanting. It is likely that people who receive different instructions "do" different things during meditation. Further, since many contemplative training programs provide instruction in multiple methods, it is important to understand interactions among techniques (i.e. "cross-training" effects). It is currently difficult to know how well students follow instructions and what else they do while meditating. We have no systematic account of their detailed subjective experiences of meditation, something not provided by the methods used in the scientific study of meditation thus far.

The traditional meditation literature contains first-person accounts of advanced meditators' experiences. Such accounts are pedagogically important in inspiring others to meditate, but their conclusions cannot be generalized beyond the context of a particular text because there is no way to know how relevant the accounts are to other people, and no way to infer how various methods and experiences are related to objectively measurable

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processes. *Therefore, a major challenge for future meditation research, as we see it, is to create methods to document the phenomenology of meditation with as much detail and veracity as researchers typically apply to third-person measures of physiology and behavior. We can then investigate relations between first- and third-person assessments of training.* Critical to this approach is an appreciation of the developmental nature of meditative training. A given individual's experiences during meditation may change greatly over the course of practice as changes in skill and goals develop.

In sum, to “unlock a new cycle of research” in the area of neuroplasticity and mental training, we envision a synergistic scientific study of meditation that includes assessments of detailed phenomenological accounts of various forms of meditation (with an eye toward the meditation techniques, such as “mindfulness” and “focused attention” that have been most often used in published research) and state-of-the-art psychological, physiological and behavioral measures. Such an approach would deepen our understanding of what happens when people meditate, both in terms of their subjective experiences and more objective outcomes of training.

3. Unanswered questions in the field

The coordinated first- and third-person investigation we are advocating will help address longstanding issues in the burgeoning field of meditation research, concerns which have been neglected in studies focused on the interface between current neuroscientific knowledge and meditation training:

- What are the “active ingredients” in meditation that drive the observed benefits of meditation practice?
- What is the optimal “dosage” of meditation training? Would 20 minutes of daily practice over the course of many years yield the same benefits as an intensive 3-month training?
- How variable is the phenomenology of meditating? What do people actually do when they meditate, in contrast to the instructions they receive? How does the nuance of phenomenological reports change with meditative experience?
- What is the relation between the phenomenology of meditating and the physiological and psychological variables assessed with previously validated measures? Are there qualities of subjective experience that are related to measureable changes in perception and attention? To improved emotion regulation? To the expression of compassion?
- What is the role of motivation and worldview (defined as a matrix of beliefs that support a larger sense of meaning in life) in determining the effects of meditation? Would those who endorse religious worldviews derive different benefits in third-person terms from meditation than those who hold a secular worldview? In first-person terms?
- Do people with different psychological dispositions or different worldviews benefit differentially from one form of meditation rather than another?
- How can meditation best be taught in a secular context? Can traditional teachings be stripped of their cultural context, cosmology or worldview rooted in religious beliefs and practices?

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- How can the results of the scientific study of meditation be applied to meditation training in various educational and health-promoting contexts?
- What is the role of ethics in meditation? How can we “measure” ethical thinking and conduct? What are the tenants of secular ethics that might affect meditation practice in a secular setting – e.g., the pursuit of “life, liberty, and the pursuit of happiness”?
- What is the role of the teacher-student relationship in meditation training? How can we systematically understand the interpersonal processes (e.g., transference-countertransference) that occur between students and teachers of meditation, and how do these affect the students’ outcomes?
- What is the role of social support (beyond the teacher) in facilitating a person’s meditation practice? What is the modern secular equivalent of the “sangha” or community of practitioners, which has traditionally provided social support to meditators?
- Does meditation practice always lead to prosocial behaviors, compassion and emotional balance, as expected? What are the boundary conditions of the positive effects that meditation practice is thought to yield? Under what circumstances and for whom might meditation fail to yield positive effects?
- What are the adverse effects of meditation? Can meditation be harmful, and if so, under what circumstances and for whom?
- What is the relation between this informed phenomenological approach and extant self-report psychological measures of constructs such as “mindfulness”?

4. Range of disciplines, and implications in advancing the domain and capacity

The synergistic approach we envision will be interdisciplinary, involving theoretical frameworks and methods from cognitive and affective neuroscience, social psychology, anthropology, philosophy, religious studies, and contemplative scholarship. It will advance the basic science by illuminating the conscious mechanisms associated with training-induced benefits of meditation. It may also identify other kinds of changes that are not easily measured through the available instruments of science. For instance, it can help to identify the thought processes underlying the growth of ethical thinking through training. On the most fundamental level this synergistic approach will help cross-validate qualitative first-person accounts of meditation and quantitative third-person markers of concomitant objective changes.

This kind of research program would be like any other scientific research in a university setting, involving the training of graduate students and undergraduate research assistants, and development of the research careers of faculty members. The data from such studies will be rich, multi-level, and qualitative as well as quantitative. To conduct long-term longitudinal research projects involving dedicated meditators, it may be important to build partnerships with meditation centers that regularly host meditation retreats, so that we can enlist research participants from these facilities and collect data there.

5. Who is doing provocative research?

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To our knowledge, there is no published research that has addressed the core issue of the relation between rigorous first- and third-person measures of the effects of meditation training, although Francisco Varela first called for this approach in the mid-1990s and its essential importance is recognized in cross-cultural and interdisciplinary dialogues sponsored by organizations such as the Mind and Life Institute, the Emory University-Tibet Partnership and Science Initiative and the Stanford University Center for Compassion and Altruism Research and Education. Three ongoing studies that are relevant to our challenge question are:

- Lutz and Davidson et al. (UW Madison) have been investigating, among other studies, the correlation between self-reported online “clarity of mind” during meditation with fluctuations in brain electrophysiology of highly trained meditation adepts.
- Rosenberg et al. (UC Davis) are examining the concordance of first-person accounts of changes in emotional reactions to scenes of human suffering to dynamic changes in facial expressions of emotions.
- Sahdra et al. (UC Davis) are conducting extensive “grounded-theory” thematic codes of in-depth interviews of participants undergoing intensive training, which can be related to third-person measures of sustained attention and response inhibition, brain electrophysiology, biomarkers of stress and cellular aging, and trait physiology.

6. For further reading:

Lutz, A., Lachaux, J. P., Martinerie, J., & Varela, F. J. (2002). Guiding the study of brain dynamics by using first-person data: synchrony patterns correlate with ongoing conscious states during a simple visual task. *Proceedings of the National Academy of Sciences*, 99(3), 1586-91.

Thompson, E. (2007). *Mind in Life: Biology, Phenomenology, and the Sciences of Mind*, Cambridge, MA: Harvard University Press. 543pp.

Varela, F. J. (1996). Neurophenomenology: a methodological remedy for the hard problem, *Journal of Consciousness Studies*, 3(4), 330-349.

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