

Editorial Special Topic: Enhancing Brain and Cognition Through Meditation

Cristiano Crescentini¹ · Franco Fabbro^{2,3} · Barbara Tomasino⁴

Published online: 1 June 2017
© Springer International Publishing 2017

Keywords Cognitive enhancement · Meditation · Mindfulness · Attention · Brain imaging

In recent years, meditation has become increasingly popular as a topic of scientific research because of its suggested enhancing effects on brain and cognition. Several research lines have indeed demonstrated that meditation practice, and in particular mindfulness meditation (MM), can promote changes in the brain structure and improvements in cognitive processing, such as executive functions and attention regulation abilities. The practice of meditation has also been shown to lead to a variety of positive clinical outcomes, such as, for example, in anxiety, depression, stress, and substance abuse problems. Furthermore, more recently, meditation has been proposed to be helpful in delaying cognitive decline in the elderly and in speeding up the education of children so to potentially reduce the risk of behavioral deviance and pathology.

This special issue aims to be a forum for the exchange of novel hypotheses and empirical data about how different practices of meditation may promote enhancement of human neurocognitive processes. The issue comprises 16 articles with 12 research articles, 2 hypothesis and theory articles, 1

review, and 1 opinion elaborated by 52 authors from various countries. These contributions present state-of-the-art, theory-driven approaches to the study of meditation and its effects in enhancing brain and cognition.

Tarrasch (2017) tested the effects of MM on attention and emotion regulatory functions of a large sample of elementary school children, who practiced mindfulness as part of their curriculum. This investigation is thus a rare example of study conducted in a “mindful school” in which a longstanding MM practice is included.

Malinowski and Shalamanova (2017) presented a conceptual and theoretical framework for the posited neuroprotective effects of MM in cognitive aging. In particular, they discuss how MM may contribute to enhance cognitive reserve capacity and to preserve cognitive functions in older age.

In a related review article, Kurth et al. (2017) discussed how the regular and constant practice of meditation over long periods of time may be a means to counteract the normal effects of aging on cognition. Authors review the existing literature on cognitive changes due to aging as well as those induced by meditation. Moreover, they identify critical aspects that future studies may address in order to unambiguously ascertain whether meditation can significantly contribute to delaying brain aging.

In a hypothesis and theory article, Hommel and Colzato (2017) discussed the importance of having a theoretical framework that can be used to guide the selection of the best-suited meditation technique. They argue that different cognitive-control styles towards more versus less top-down control can be obtained by practicing focused attention meditation (FAM) and open monitoring meditation (OMM). The knowledge of this theoretical framework is very important for achieving more effective meditation-based interventions.

✉ Cristiano Crescentini
cristiano.crescentini@uniud.it

¹ Department of Languages and Literatures, Communication, Education and Society, University of Udine, Via Margreth 3, 33100 Udine, Italy

² Department of Medicine, University of Udine, Udine, Italy

³ Perceptual Robotics (PERCRO) Laboratory, Scuola Superiore Sant’Anna, Pisa, Italy

⁴ IRCCS E. Medea, San Vito al Tagliamento, Italy

In a related opinion article, Colzato and Kibele (2017) discussed how FAM and OMM could enhance athletic performance differentially, depending on the specific sport skills. Because of the distinct metacontrol states established by these two types of meditation, it is proposed that FAM would promote performance in closed skill sports (e.g., archery), while OMM would enhance performance in open skill sports (e.g., soccer).

In a research article by Immink et al. (2017), single sessions of FAM and OMM were employed to investigate the instantaneous effects on subsequent sequence performance and learning (examined through a serial reaction time task, SRT). It was found that both types of meditation enhanced sequence performance, while the level of effort experienced during FAM and OMM was particularly associated with sequence learning.

Rooks et al. (2017) revealed the positive effects of short-form mindfulness training (MT) vs. relaxation training (RT) on sustained attention and emotional well-being in 100 college football players. Authors found that greater engagement in MT, but not RT, predicted greater benefits on the sustained attention to response task (SART), and that greater engagement in both training programs predicted negative change in anxiety and positive change in positive affect over a high-demand pre-season training interval.

Jha et al. (2017) investigated whether mindfulness training (MT) may mitigate working memory (WM) decline and decrease susceptibility to distraction that may be due to periods of persistent and intensive demands. Authors compared the effects on WM performance of two 8-week, 8-h variants of MT (versus a non-training group), in military cohorts enduring a high-demand interval of military training and in a civilian cohort. Results showed that the MT variant including in-class mindfulness training (vs. didactic content) was particularly effective in protecting the military cohorts against WM degradation over high-demand intervals.

In a randomized controlled design, Bennike et al. (2017) compared the effects of two short-term (i.e., 30 days) online-based interventions, focused on MM and brain training, on behavioral (and indirect) markers of mind-wandering (using the SART) in two groups of healthy participants. An increased ability to withhold a prepotent response during a monotonous task such as the SART, observed specifically after the MM training, led the authors to suggest that short online mindfulness-based interventions may be effective in reducing mind-wandering.

Hartkamp and Thornton (2017) studied 41 individuals before and after a 6-day intensive Vipassana (mindfulness) retreat. Of interest, a series of behavioral measures assessing cognitive flexibility (e.g., Stroop, Task Switching) revealed no change in the retreat group vs. a group of control participants who did not take part to the retreat. Nevertheless, retreat participants reported increased mindfulness and well-being scores after the 6-day period. The authors discussed possible

study limitations and gave a series of important suggestions for future studies on mindfulness and cognition.

Böckler et al. (2017) tested the effects of a 3-month contemplative training, which focused on observing-thought meditation and perspective taking and allowed healthy adult participants to practice the ability to understand their own and others' mental states. The data showed that the degree to which participants improved their understanding of themselves predicted their improvements in understanding others' mental states, namely, theory of mind (TOM) performance.

Kohler et al. (2017) investigated the effects of a concentrative form of yoga nidra meditation on attention performance in a sample of ten young healthy participants before and after restricted sleep and again after a session of meditation or rest. Following meditation, but not rest, sustained attention improved and sleepiness decreased, a finding that could indicate a role for meditation in improving attention deficits associated with sleep loss.

With regard to brain imaging studies, Simon et al. (2017) investigated whether a specific practice of mantra meditation, supposed to increase concentration, induces deactivations within the default mode network (DMN), as previous studies on mantra meditation have reported only activations within the DMN. Authors found that a 2-week period of Kundalini yoga/meditation decreased activations within subregions of the DMN, showing that training in mantra meditation, like focused attention and open monitoring, has a suppressive effect on activity within the DMN.

In another brain imaging study, Kozasa et al. (2017) investigated the differences in DMN connectivity between regular meditators and non-meditators during an attention Stroop word-color paradigm. Results indicated that the connectivity between the precuneus/posterior cingulate cortex and the right and left parietal cortices helps to differentiate regular meditators from non-meditators, suggesting that the two populations have different connectivity patterns in the DMN reflecting different degree of interference in attention processes.

Mooneyham and colleagues (2017) revealed that a 6-week mindfulness-based health and wellness intervention led to a significant increase in cortical thickness in the left posterior insula and to a significant increased functional connectivity of this area with the right ventrolateral prefrontal cortex and with the left middle and superior temporal gyri, areas which are related to interoception and attention mechanisms.

Last, Sato et al. (2017) investigated structural and functional brain changes in a single meditator before and after a 5.5-week retreat. The findings observed after the retreat of decreased regional homogeneity in the precuneus and decreased cortical thickness in visual cortices, Brodmann area 8 and anterior cingulate, together with increased amplitude of low-frequency fluctuations in dorsolateral prefrontal cortex, were tentatively held to reflect the development of a focused and calm mind and decreased mind-wandering.

The articles included in the present special issue cover several aspects of the current research in the field of meditation and contribute to delineate how its practice can also result in enhanced brain, cognitive, and social functions.

References

- Bennike, I. H., Wieghorst, A., & Kirk, U. (2017). Online-based mindfulness training reduces behavioral markers of mind wandering. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0020-9.
- Böckler, A., Herrmann, L., Trautwein, F.M., Holmes, T., Singer, T. (2017). Know thy selves: learning to understand oneself increases the ability to understand others. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0023-6.
- Colzato, L. S., & Kibele, A. (2017). How different types of meditation can enhance athletic performance depending on the specific sport skills. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0018-3.
- Hartkamp, M. & Thornton, I.M. (2017). Meditation, cognitive flexibility and well-being. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0026-3.
- Hommel, B., & Colzato, L. S. (2017). Meditation and metacontrol. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0017-4.
- Immink, M. A., Colzato, L. S., Stolte, M., & Hommel, B. (2017). Sequence learning enhancement following single-session meditation is dependent on metacontrol mode and experienced effort. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0019-2.
- Jha, A.P., Witkin, J.E., Morrison, A.B., Rostrup, N., Stanley, E. (2017). Short-form mindfulness training protects against working memory degradation over high-demand intervals. *Journal of Cognitive Enhancement*, in press.
- Kohler, M., Rawlings, M., Kaeding, A., Banks, S., Immink, M.A. (2017). Meditation is effective in reducing sleepiness and improving sustained attention following acute sleep restriction. *Journal of Cognitive Enhancement*, in press.
- Kozasa, E. H., Sato, J. R., Russell, T. A., Barreiros, M. A., Lacerda, S. S., Radvany, J., et al. (2017). Differences in default mode network connectivity in meditators and non-meditators during an attention task. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0031-6.
- Kurth, F., Cherbuin, N., Luders, E. (2017). Aging mindfully to minimize cognitive decline. *Journal of Cognitive Enhancement*, in press.
- Malinowski, P., & Shalamanova, L. (2017). Meditation and cognitive ageing: the role of mindfulness meditation in building cognitive reserve. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0022-7.
- Mooneyham, B. W., Mrazek, M. D., Mrazek, A. J., Mrazek, K. L., Ihm, E. D. & Schooler, J. W. (2017). An integrated assessment of changes in brain structure and function of the insula resulting from an intensive mindfulness-based intervention. *Journal of Cognitive Enhancement*, in press.
- Rooks, J. D., Morrison, A. B., Goolsarran, M., Rogers, S. L., & Jha, A. P. (2017). “We are talking about practice”: the influence of mindfulness vs. relaxation training on athletes’ attention and well-being over high demand intervals. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0016-5.
- Sato, J. R., Kozasa, E. H., Wallace, B. A., & Amaro Jr., E. (2017). Neuroimaging data from a single participant before and after a meditation retreat: a proof of concept study. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0025-4.
- Simon, R., Pihlsgård, J., Berglind, U., Söderfeldt, B. & Engström, M. (2017). Mantra meditation suppression of default mode beyond an active task: a pilot study. *Journal of Cognitive Enhancement*, in press.
- Tarrasch, R. (2017). Mindful schooling: better attention regulation among elementary school children who practice mindfulness as part of their school policy. *Journal of Cognitive Enhancement*. doi:10.1007/s41465-017-0024-5.