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Hypnosis and Meditation: Vehicles of Attention and Suggestion

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Although hypnosis and meditation represent distinct domains of practice, they appear to overlap in phenomenology, cognitive mechanisms, neural substrates, and potential therapeutic merits. Whereas numerous studies have documented the beneficial impact of these approaches, few have harnessed these distinctive phenomena together, either clinically or as a means of illuminating cognitive questions. This paper introduces the theme of the present issue and discusses the potential value of yoking empirical studies of hypnosis and meditation. The marriage of these seemingly disparate yet overlapping practices promises to improve our scientific understanding of each as well as unravel their underlying mechanisms. On the one hand, albeit largely overlooked by researchers studying meditation, the intimate relationship between attention and suggestion holds important implications for both theoretical models and therapeutic applications of contemplative practice. On the other hand, hypnosis and meditation serve as complementary vehicles for elucidating salient topics in cognitive neuroscience, including the neural underpinnings of perception and cognitive control, and the governing of deeply-ingrained processes. Binding these approaches to the science of attention and suggestion paves the road to a more nuanced appreciation of hypnosis and meditation while fostering novel therapeutic prospects and improving our understanding of consciousness and cognition.

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Introduction

Until recently, folk beliefs and popular misconceptions shrouded the empirical study of hypnosis and meditation and dimmed their promise as research instruments. Current investigative techniques, however, have done much to demystify these phenomena and dispel antiquated characterizations associating them with complete sensory withdrawal and mindless trance. Over the past decade, a surge of scientific research drawing on both hypnosis and meditation has documented their influence on a host of processes ranging from attention and emotion to brain function and physiology (Lutz, Slagter, Dunne, & Davidson, 2008; Oakley & Halligan, 2009). Methodological and theoretical advances in cognitive neuroscience have offered new prospects for elucidating these practices from an empirical perspective (Cahn & Polich, 2006; Raz & Shapiro, 2002). On the flip side, researchers have begun employing hypnosis and meditation as vehicles for investigating fundamental processes of mind and brain (Raz, 2011), including perception (Carter et al., 2005; Cohen Kadosh, Henik, Catena, Walsh, & Fuentes, 2009), self-regulation (Egner & Raz, 2007; Tang, Rothbart, & Posner, 2012), and neuroplasticity (Slagter, Davidson, & Lutz, 2011). In addition to such research-centred applications, mounting clinical evidence has underscored the potential therapeutic merits of these contemplative approaches and propelled a swelling wave of mindfulness- and suggestion-based treatments in medical practice (Baer, 2003; Lynn, Kirsch, Barabasz, Cardeña, & Patterson, 2000). These developments have allowed hypnosis and meditation to shake off many layers of misunderstanding and gain a solid footing in the realms of both cognitive research and therapeutic practice. The time is therefore ripe to explore the potential fruits of bridging these approaches.

Bridging the domains of hypnosis and meditation

Although hypnosis and meditation represent distinct domains of practice, they seem to overlap in phenomenology, and perhaps also in terms

of cognitive mechanisms, neural substrates, and potential therapeutic merits. And yet, researchers specializing in hypnosis and meditation hardly interact, perhaps because these practices originate from different cultural, philosophical and geographical traditions (Johnson, 1982; Pintar & Lynn, 2008). Indeed, the scientific literature contains only sparse scattered accounts addressing hypnosis and meditation side by side (e.g., Davidson & Goleman, 1977; Grant & Rainville, 2005; Halsband, Mueller, Hinterberger, & Strickner, 2009; Holroyd, 2003; Lynn, Das, Hallquist, & Williams, 2006; Spiegel, White, & Waelde, 2010). The present special issue brings together expert perspectives from the study of hypnosis and meditation to sketch recent empirical advances and explore the similarities and differences between these unique forms of self-regulation. In this introductory paper, I provide a cursory synthesis of the views presented in this issue and discuss the potential value of yoking the scientific studies of hypnosis and meditation. This crosstalk will likely bring about a more nuanced appreciation of the underlying mechanisms of these practices, while also fostering novel therapeutic prospects and elucidating prominent topics in cognitive research.

Hypnosis and meditation each refer to a broad range of practices that emanate from diverse cultural and historical traditions, invoke various cognitive and behavioural stances, and aim at a plethora of therapeutic and soteriological outcomes—from analgesia to enlightenment. The heterogeneity among goals and techniques within these domains poses a significant challenge to developing inclusive definitions of such practices. Beyond the sheer diversity of activities falling under the labels of hypnosis and meditation, inconsistent interpretations of key terms—e.g, "hypnosis" (Kirsch et al., 2011) and "mindfulness" (Williams & Kabat-Zinn, 2011)—may further obfuscate central concepts and impede the progress of research on these topics. Developing a rigorous science of atypical cognition, therefore, would involve relinquishing reliance on the terms of tradition in favour of precise operational definitions founded upon robust phenomenological, behavioural, and physiological data. In his commentary, Grant (this issue) describes several potential pitfalls associated with glazing over the particularities of individual practices and conflating different stages of those practices. His contribution provides an important reminder to remain vigilant of these caveats when investigating hypnosis and meditation, especially in a comparative context. Moving forward in this way—exploring overlaps while remaining mindful of distinctions and shades of meaning—would likely lead to a more scientific understanding of these phenomena (cf Manna et al., 2010; Raz, 2007).

Binding the study of attention to the science of suggestion

Considering hypnosis and meditation together may force us to take a more critical glance at how we construe these practices, and could potentially highlight mechanisms that researchers have largely overlooked to date. Most forms of meditation share the essential feature of attention regulation. Drawing on traditional Buddhist perspectives, scientists generally classify meditation practices into two non-exhaustive categories: focused attention and open monitoring (Lutz, et al., 2008). Focused attention involves single-pointed concentration on an experiential object such as the breath or a mantra. Open monitoring, on the other hand, involves broadening attention to include the whole field of moment-to-moment experience. Although such conceptual bifurcations are useful, many meditative practices do not fall neatly within this dichotomous schema (e.g., compassion, visualization, and analytic practices; Lutz, Dunne, & Davidson, 2006). Typically, however, most of the meditative techniques gaining prominence in cognitive science and clinical practice employ some combination of focused attention and open monitoring to cultivate a non-reactive, receptive awareness of present-moment experience.

Similarly to scientists studying meditation, researchers interested in hypnosis often place attention at the center of their theoretical models and empirical accounts. Historically, hypnosis was associated with a special state of consciousness sometimes known as "trance". To this day, however, scholars and practitioners have reached little consensus regarding the psychological characteristics of this putative hypnotic state, let alone identified reliable neurophysiological indices supporting its existence (Oakley & Halligan, 2009, 2010). Nevertheless, despite the paucity of data demonstrating a distinct neurocognitive state of hypnosis, studies have reported substantial, albeit at times inconsistent, links between attention and hypnotic capacities (Dienes et al., 2009). In addition, numerous cognitive and neuroimaging reports have documented the power of suggestion over attention functions and their associated brain networks (Egner, Jamieson, & Gruzelier, 2005; Iani, Ricci, Baroni, & Rubichi, 2009; Iani, Ricci, Gherri, & Rubichi, 2006; Priftis et al., 2011; Raz & Campbell, 2011; Raz, Fan, & Posner, 2005;

Terhune, Cardeña, & Lindgren, 2011). More prevalently, brief verbal suggestions comprising only a few words can lead to profound alterations in perception, cognition, and behaviour among responsive—i.e., highly suggestible—individuals (Kihlstrom, 2008). Suggestion and attention, therefore, reflect two central thematic intersections for exploring the convergence between hypnosis and meditation.

Numerous scientific accounts leveraging behavioural, genetic, and neuroimaging methods have documented the association between suggestion and attention (Raz, 2004, 2005; Raz & Buhle, 2006). Hardly a unitary concept, attention refers broadly to the allocation of cognitive processing resources. Most current models break down the process of attention into distinct brain areas and networks that mediate different subprocesses (e.g., monitoring, control, and orienting functions; Petersen & Posner, 2012). The preponderance of the evidence indicates that attention and suggestion draw on overlapping functional neuroanatomy, neural circuitry, chemical modulators, and cellular structures (Fernandez-Duque & Posner, 2001; Posner & Fan, 2004; Raz & Buhle, 2006). Guided by such brain findings, researchers have related specific genetic polymorphisms to well-defined neurocognitive phenotypes, including those associated with different styles of attention and responses to hypnotic suggestion (Lichtenberg, Bachner-Melman, Gritsenko, & Ebstein, 2000; Raz, 2005; Szekely et al., 2010). Such multipronged approaches combining genetic and neuroimaging assays of both attention and hypnotic response pave the way to answering questions such as how highly suggestible individuals differ from less-suggestible persons. Similar methods could be used to elucidate individual differences among practitioners of meditation and may provide an avenue for beginning to custom-tailor mindfulness-based approaches to specific individuals. Future work probing hypnosis and meditation, therefore, would help shed light on the relationship between attention and suggestion in both typical and atypical cognition.

Several papers in the current special issue integrate the themes of attention and suggestion to explore the similarities and differences between hypnosis and meditation. Semmens-Wheeler and Dienes (this issue) argue that whereas both hypnosis and meditation are potent modulators of attention, they differ fundamentally in terms of metacognition—i.e., explicit knowledge of the contents of one's own experience. Mindfulness meditation, they assert, aims at cultivating awareness of one's experience, whereas hypnosis relies on a failure of metacognition, especially concerning knowledge of one's own intentions. In his commentary, Terhune et al. (this issue) prompts a lively theoretical exchange concerning future possibilities for testing such metacognitive theories of hypnosis (see also the reply by Dienes and Semmens-Wheeler (this issue)). Lynn, Malakataris, Maxwell, Mellinger, & van der Kloet (this issue) propose a broader model of attention in hypnosis and meditation. They outline a popular conception of mindfulness—i.e., purposeful, nonjudgmental attention to the unfolding of experience on a moment-to-moment basis—as the central feature of many meditative techniques. Unlike most mindfulness-based approaches, hypnosis typically involves suggestions emphasizing specific, and often unusual, behaviours or perceptual experiences (e.g., hallucinations) rather than targeting attention or meta-cognition per se. Lynn et al. (this issue) argue, however, that mindfulness-based practices do fall within the broad domain of suggestion, albeit harnessing suggestion specifically to cultivate sustained attention and moment-to-moment monitoring of experience. They construe the defining feature of hypnosis as the flexibility it affords for modulating features of consciousness, rather than as one particular or special state of attention. In line with this view, hypnotic phenomena typically follow even in the absence of an induction ritual or explicit mention of the context of hypnosis (Mazzoni et al., 2009; McGeown et al., 2012; Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006). Furthermore, responses to suggestions in a hypnotic context correlate strongly with responses to the same suggestions outside of hypnosis (Kirsch & Braffman, 2001). Thus, the intimate relationship between suggestion and attention appears to extend beyond the specific context of hypnosis and may hold significant implications for the empirical understanding and therapeutic applications of contemplative practice.

The scientific literature on hypnosis offers a rich storehouse of knowledge concerning the power of suggestion to influence mind, brain, and behaviour. Conversely, scholarly discussions regarding the mechanisms of meditation rarely address the potential impact of suggestion. Although expectation and suggestion constitute explicit defining features of hypnosis, they may also play an important, albeit more tacit, role in meditation. For example, many practice-oriented accounts of contemplative training emphasize the importance of a relationship with a qualified teacher (McLeod, 2005), both in one-on-one encounters and through the tradition of dharma talks (i.e., oral presentations that a teacher offers a congregation of practitioners during formal meditation practice). Although largely overlooked in the scientific literature on meditation, such

psychosocial interactions likely involve a wealth of suggestive prompts and expectancy cues that may contribute to the development and outcomes of contemplative practices. As a case in point, a recent study demonstrated that motivation and effort may account for much of the improvement in attention usually ascribed to mindfulness practice (Jensen, Vangkilde, Frokjaer, & Hasselbalch, 2012). To explore such issues, Farb (this issue) offers a proposal for considering how intentions and expectations may help drive the benefits of standard mindfulness practices beyond the influence of attention training as such. His contribution illustrates how a comparative perspective can guide the development of theoretical models of meditation and aid in refining mindfulness-based approaches. Of importance, Farb's proposed role for expectation in meditation hardly discredits the specific effects of attention training in these practices. The hypnosis literature may be instructive in this regard. Studies investigating the role of expectation in hypnosis indicate that attitudinal factors such as expectation and intention typically interact with aptitudinal factors such as attentional efficiency in shaping hypnotic responsiveness (Benham, Woody, Wilson, & Nash, 2006; Lifshitz, Howells, & Raz, 2012). Further research would be necessary to explore whether a similar relationship holds in the meditative practices. This special issue aims to lay the groundwork for such future endeavours.

Elucidating fundamental processes of consciousness and cognition

Gaining control over undesirable patterns of behaviour and cognition is a central aim common to many forms of hypnosis and meditation. This notion maps closely onto the conceptual distinction typical within the cognitive sciences between mental processes that are controlled and those that are automatic. Whereas controlled processes are voluntary, slow, and effortful, automatic processes are involuntary, fast, and effortless (Shiffrin & Schneider, 1977). Achieving literacy, for example, is a controlled and deliberate process requiring attention. Once learned and sufficiently practiced, however, reading becomes an automatic process, proceeding quickly and without effort (MacLeod, 1992). A common view posits that extensive practice can render effortful processes more automatic (MacLeod & Dunbar, 1988). Once automatized, moreover, these processes appear resistant to control and largely imperturbable. Such overlearned habits form the backbone of many mental disorders; consider, for example, the centrality of ruminative thinking in depression (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008) and the significance of impulsive behaviour among disorders of self-regulation such as Tourrette's Syndrome (Wright, Rickards, & Cavanna, 2011). Thus, in addition to advancing our understanding of volitional control, gaining control over deeply-ingrained processes would hold important implications for clinical interventions (Kuyken et al., 2008; Raz et al., 2009). Yet, while many studies have investigated how controlled processes become automatic, only a few recent reports have examined how automatic processes can de-automatize and return into the purview of control.

Hypnosis and meditation provide complementary prospects for investigating the modulation of automatic processes (Lifshitz, Campbell, & Raz, in press). A growing body of research shows that various forms of suggestion can derail processes previously considered ballistic and impervious to willful intervention (Campbell, Blinderman, Lifshitz, & Raz, in press). One study, for example, demonstrated the influence of hypnotic suggestion on colour processing in the brain (Kosslyn, Thompson, Costantini-Ferrando, Alpert, & Spiegel, 2000). Highly suggestible individuals were able to see grayscale images in colour and perceive only shades of gray when viewing colourful displays upon suggestion. These phenomenological changes manifested alongside alterations in low-level neural processes associated with colour perception. An independent group, moreover, recently replicated these findings using nonhypnotic suggestion in the absence of a formal induction procedure (McGeown, et al., 2012). Another example of how suggestion governs deeply ingrained processes employs the gold standard of visual attention—the Stroop task (Stroop, 1935). This classic experimental paradigm shows that skilled readers seem unable to withhold accessing word meaning despite explicit instructions to attend to ink colour only. Although most cognitive scientists consider processing printed linguistic stimuli inevitable for skilled readers (MacLeod, 1992), multiple reports demonstrate that a specific suggestion to see word stimuli as meaningless symbols can override the automaticity of reading in a classic Stroop paradigm (Raz & Campbell, 2011; Raz et al., 2003; Raz, Moreno-Iniguez, Martin, & Zhu, 2007; Raz, Shapiro, Fan, & Posner, 2002). Recent neuroimaging assays have begun to unravel the mechanisms of de-automatization as a function of suggestion (Casiglia et al., 2010; Raz, et al., 2005; Terhune, Cardeña, & Lindgren, 2010), while behavioural accounts have extended these effects to related cognitive processes (Iani, et al., 2009; Iani, et al., 2006) and alternative forms of suggestion (Augustinova & Ferrand, 2012; Parris, Dienes, & Hodgson, 2012; Raz, et al., 2006).

In addition to suggestion-based approaches, meditative practices provide a powerful means of gaining control over automatic processes. For example, specific forms of meditation appear to override habitual responses associated with spontaneous thought (Mrazek, Smallwood, & Schooler, 2012; Pagnoni, Cekic, & Guo, 2008), involuntary emotional reactivity (Farb et al., 2010; Taylor et al., 2011), and pain processing (Zeidan, Grant, Brown, McHaffie, & Coghill, 2012). In contrast to the rapid and transient alterations induced by hypnotic suggestion, moreover, the cognitive changes brought about through meditative training appear in some cases to reflect enduring transformations (see Slagter et al., 2011). Independent neuroimaging studies drawing separately on hypnosis and meditation have investigated the de-automatization of word reading using a classic Stroop paradigm (Kozasa et al., 2012; Raz, et al., 2005; Teper & Inzlicht, 2012). Comparing these autonomous reports reveals notable albeit preliminary overlaps among the functional neural correlates of these distinct strategies of self-regulation (Lifshitz, et al., in press). Future work would be necessary to elucidate these apparent intersections and further explore the mechanisms supporting the modulation of automaticity as a function of hypnosis and meditation. The results of these efforts would help pave the road to a more scientific understanding of volitional control in health as well as in pathology.

Over the past decade, approaches to studying brain function have shifted dramatically from purely task-based paradigms toward methods of investigating the subject at rest, in the absence of external stimulation (Raichle, 2010). Today, the concepts of the "resting state" and the "default mode" of brain function may seem inexorably bound and in some circles even synonymous. A closer look at the history of research on these topics, however, reveals that the notion of a unified default mode resting state network emerged through an integration of what were initially two isolated research trajectories harnessing distinct methodological and theoretical frameworks to address different physiological and cognitive questions (for a historical review, see Callard & Margulies, 2011). On the one hand, in the early 2000s, Marcus Raichle and colleagues at Washington University forged a cognitive neuroscience of internal experience through linking the functional roles of brain regions that are more active during rest—i.e., the default mode—to the psychology of spontaneous thought or mind-wandering (Raichle et al., 2001; Raichle & Snyder, 2007). On the other hand, an independent group of researchers led by Bharat Biswal at the University of Wisconsin in Milwaukee explored the possibility that baseline physiological activity—i.e., the resting state—might hold important clues for elucidating the functional architecture of the brain (Biswal, Zerrin Yetkin, Haughton, & Hyde, 1995). The associations between the fields of spontaneous *psychological* activity and spontaneous *physiological* activity in the resting brain were less obvious than they may appear to us today. Indeed, no cross citations existed between these two research trajectories until 2003, when Michael Greicius, a young researcher at Stanford University, integrated these perspectives to introduce the notion of a "default mode network" (DMN; Greicius, Krasnow, Reiss, & Menon, 2003). This creative synthesis launched a mutually productive exchange of theories and methods and heralded the burgeoning field of resting-state neuroimaging as we know it today. The above glimpse into the history of the concept of the DMN provides a crude analogy for the prospect of binding the domains of hypnosis and meditation and highlights the benefits of espousing a historical perspective on current scientific trends.

Around the time that researchers were shifting their focus from task-evoked processes to spontaneous brain dynamics, another comparable shift began to transpire in the cognitive sciences: whereas traditional studies had centered on controlling the experimental task, new paradigms explored the potential of manipulating instead the attention of the participant (Raz & Buhle, 2006). By providing a means of generating profound and highly-specific alterations in attention and consciousness, hypnosis and meditation emerged as useful tools in the armamentarium of the cognitive scientist. Accordingly, in the past few years researchers have begun employing these potent top–down elicitors in concert with resting state methods to elucidate the psychological correlates of the DMN (e.g., Brewer et al., 2011; Deeley et al., 2012; Demertzi et al., 2011; Hasenkamp, Wilson-Mendenhall, Duncan, & Barsalou, 2012; McGeown, Mazzoni, Venneri, & Kirsch, 2009; Pagnoni, 2012; Pyka et al., 2011; Taylor et al., 2012). Although hypnosis and meditation differ in many respects, comparing how they modulate neurocognitive processes including the DMN may shed light on the mechanisms underlying these unique and overlapping forms of self-regulation. Dumont, Martin, & Broer (this issue) provide a selective review that highlights important discrepancies among the findings of neuroimaging studies investigating the DMN and other processes such as pain perception and emotion regulation in hypnosis and meditation. Based on the inconsistencies they uncover, Dumont et al. conclude that it is premature to claim that these practices are mediated

by similar neural mechanisms. This conclusion hardly comes as a surprise given that even within the domains of hypnosis and meditation, studies often report mixed and sometimes contradictory findings. In this respect, the commentary by Grant (this issue) serves as a starting point for considering operational nuances that may influence the outcomes of these studies, including practice style and stage of training, wording and delivery of suggestion, and individual differences in responsiveness. To be sure, the comparative literature concerning hypnosis and meditation is still nascent, especially in regard to neural underpinnings. Rather than provide definitive conclusions, therefore, the articles in this special issue reveal the potential of integrating these fields to foster a more conceptually refined and methodologically rigorous exploration of these practices.

Conclusion

Both specialists and novices have much to gain from bridging the domains of hypnosis and meditation. Whereas numerous studies have documented the clinical effectiveness of these practices, few experts have compared these special phenomena to examine therapeutic power as well as the ability to illuminate cognitive questions. Juxtaposing hypnosis and meditation would likely improve our scientific descriptions of their phenomenological, psychological, and neural correlates. The robust relationship between suggestion and attention is largely overlooked in meditation research; yet, several papers in this special issue propose that parameters such as suggestion, expectation, and intention may play a more substantial role in meditative practice than heretofore acknowledged. Beyond elucidating the intrinsic characteristics of hypnosis and meditation, the papers in the present collection showcase these potent top–down elicitors as vehicles for investigating salient topics, including the neural underpinnings of perception and cognitive control, and the de-automatization of habitual processes. Hypnosis is particularly apt for developmental studies because most children are highly responsive to suggestions (Raz, in press). Further inquiries into the developmental trajectories of these phenomena, therefore, may hold important implications for the emerging field of contemplative education (Davidson et al., 2012). This special issue reflects the beginning of a promising marriage between two fields. The following collection of papers offers a sorely lacking integration and synthesis of relevant insights concerning hypnosis and meditation.

References

Augustinova, M., & Ferrand, L. (2012). Suggestion does not de-automatize word reading: Evidence from the semantically based Stroop task. *Psychonomic Bulletin & Review*, 1–7.

Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice, 10*(2), 125–143.

Benham, G., Woody, E. Z., Wilson, K. S., & Nash, M. R. (2006). Expect the unexpected: Ability, attitude, and responsiveness to hypnosis. *Journal of Personality and Social Psychology, 91*(2), 342–350.

Biswal, B., Zerrin Yetkin, F., Haughton, V. M., & Hyde, J. S. (1995). Functional connectivity in the motor cortex of resting human brain using echo-planar MRI. *Magnetic Resonance in Medicine, 34*(4), 537–541.

Brewer, J. A., Worhunsky, P. D., Gray, J. R., Tang, Y.-Y., Weber, J., & Kober, H. (2011). Meditation experience is associated with differences in default mode network activity and connectivity. *Proceedings of the National Academy of Sciences of the United States of America, 108*(50), 20254–20259.

Cahn, B. R., & Polich, J. (2006). Meditation states and traits: EEG, ERP, and neuroimaging studies. *Psychological Bulletin, 132*(2), 180–211.

Callard, F., & Margulies, D. S. (2011). The subject at rest: Novel conceptualizations of self and brain from cognitive neuroscience's study of the 'resting state'. *Subjectivity, 4*, 227–257. doi: 10.1016/j.concog.2012.05.007

Campbell, N., Blinderman, I., Lifshitz, M., & Raz, A. (in press). Converging evidence for de-automatization as a function of suggestion. *Consciousness and Cognition*.

Carter, O. L., Presti, D. E., Callistemon, C., Ungerer, Y., Liu, G. B., & Pettigrew, J. D. (2005). Meditation alters perceptual rivalry in Tibetan Buddhist monks. *Current Biology, 15*(11), R412–R413.

Casiglia, E., Schiff, S., Facco, E., Gabbana, A., Tikhonoff, V., Schiavon, L., . . . Amodio, P. (2010). Neurophysiological correlates of post-hypnotic alexia: A controlled study with Stroop test. *American Journal of Clinical Hypnosis, 52*(3), 219–233.

Cohen Kadosh, R., Henik, A., Catena, A., Walsh, V., & Fuentes, L. J. (2009). Induced Cross-Modal Synaesthetic Experience Without Abnormal Neuronal Connections. *Psychological Science, 20*(2), 258–265.

Davidson, R. J., Dunne, J., Eccles, J. S., Engle, A., Greenberg, M., Jennings, P., . . . Vago, D. (2012). Contemplative practices and mental training: Prospects for american education. *Child Development Perspectives, 6*(2), 146–153.

Davidson, R. J., & Goleman, D. J. (1977). The role of attention in meditation and hypnosis: A psychobiological perspective on transformations of consciousness. *International Journal of Clinical and Experimental Hypnosis, 25*(4), 291–308.

Deeley, Q., Oakley, D. A., Toone, B., Giampietro, V., Brammer, M. J., Williams, S. C. R., & Halligan, P. W. (2012). Modulating the default mode network using hypnosis. *International Journal of Clinical and Experimental Hypnosis, 60*(2), 206–228.

Demertzi, A., Soddu, A., Faymonville, M. E., Bahri, M. A., Gosseries, O., Vanhaudenhuyse, A., . . . Laureys, S. (2011). Hypnotic modulation of resting state fMRI default mode and extrinsic network connectivity. In E. J. W. van Someren, Y. D. van der Werf, P. R. Roelfsema, H. D. Mansvelder & F. H. Lopes Da Silva (Eds.), *Progress in Brain Research* (Vol. 193, pp. 309–322): Elsevier.

Dienes, Z., Brown, E., Hutton, S., Kirsch, I., Mazzoni, G., & Wright, D. B. (2009). Hypnotic suggestibility, cognitive inhibition, and dissociation. *Consciousness and Cognition, 18*(4), 837–847.

Dienes, Z. & Semmens-Wheeler, R. (this issue). Response to Terhune: Metacognition and cold control in hypnosis. *Journal of Mind–Body Regulation,* 80–82.

Dumont, L., Martin, C., & Broer, I. (this issue). Functional neuroimaging studies of hypnosis and meditation: A comparative perspective. *Journal of Mind–Body Regulation,* 58–70.

Egner, T., Jamieson, G., & Gruzelier, J. (2005). Hypnosis decouples cognitive control from conflict monitoring processes of the frontal lobe. *NeuroImage, 27*(4), 969–978.

Egner, T., & Raz, A. (2007). Cognitive control processes and hypnosis. In G. A. Jamieson (Ed.), *Hypnosis and conscious states : the cognitive neuroscience perspective* (pp. 29–50). Oxford, England: Oxford University Press.

Farb, N. A. (this issue). Mind your expectations: A proposed role for suggestion in mindfulness training. *Journal of Mind–Body Regulation,* 27–42.

Farb, N. A. S., Anderson, A. K., Mayberg, H., Bean, J., McKeon, D., & Segal, Z. V. (2010). Minding one's emotions: Mindfulness training alters the neural expression of sadness. *Emotion, 10*(1), 25–33.

Fernandez-Duque, D., & Posner, M. I. (2001). Brain imaging of attentional networks in normal and pathological states. *Journal of Clinical and Experimental Neuropsychology, 23*(1), 74–93.

Grant, J. A. (this issue). Towards a more meaningful comparison of meditation and hypnosis. *Journal of Mind–Body Regulation,2*(1), 71–74.

Grant, J. A., & Rainville, P. (2005). Hypnosis and meditation: Similar experiential changes and shared brain mechanisms. *Medical Hypotheses, 65*(3), 625–626.

Greicius, M. D., Krasnow, B., Reiss, A. L., & Menon, V. (2003). Functional connectivity in the resting brain: A network analysis of the default mode hypothesis. *Proceedings of the National Academy of Sciences, 100*(1), 253–258.

Halsband, U., Mueller, S., Hinterberger, T., & Strickner, S. (2009). Plasticity changes in the brain in hypnosis and meditation. *Contemporary Hypnosis, 26*(4), 194–215.

Hasenkamp, W., Wilson-Mendenhall, C. D., Duncan, E., & Barsalou, L. W. (2012). Mind wandering and attention during focused meditation: A fine-grained temporal analysis of fluctuating cognitive states. *NeuroImage, 59*(1), 750–760.

Holroyd, J. (2003). The science of meditation and the state of hypnosis. *American Journal of Clinical Hypnosis, 46*(2), 109–128.

Iani, C., Ricci, F., Baroni, G., & Rubichi, S. (2009). Attention control and susceptibility to hypnosis. *Consciousness and Cognition, 18*(4), 856–863.

Iani, C., Ricci, F., Gherri, E., & Rubichi, S. (2006). Hypnotic suggestion modulates cognitive conflict - The case of the flanker compatibility effect. *Psychological Science, 17*(8), 721–727.

Jensen, C. G., Vangkilde, S., Frokjaer, V., & Hasselbalch, S. G. (2012). Mindfulness training affects attention—Or is it attentional effort? *Journal of Experimental Psychology: General, 141*(1), 106–123.

Johnson, W. (1982). *Riding the ox home: History of meditation from shamanism to science*. London, England: Rider & Co.

Kihlstrom, J. F. (2008). The domain of hypnosis, revisited. In M. Nash & A. Barnier (Eds.), *Oxford handbook of hypnosis* (pp. 21–52). Oxford, England: Oxford University.

Kirsch, I., & Braffman, W. (2001). Imaginative suggestibility and hypnotizability. *Current Directions in Psychological Science, 10*(2), 57–61.

Kirsch, I., Cardeña, E., Derbyshire, S., Dienes, Z., Heap, M., Kallio, S., . . . Whalley, M. (2011). Definitions of hypnosis and hypnotizability and their relation to suggestion and suggestibility: A consensus statement. *Contemporary Hypnosis and Integrative Therapy, 28*(2), 107–115.

Kosslyn, S. M., Thompson, W. L., Costantini-Ferrando, M. F., Alpert, N. M., & Spiegel, D. (2000). Hypnotic Visual Illusion Alters Color Processing in the Brain. *American Journal of Psychiatry, 157*(8), 1279–1284.

Kozasa, E. H., Sato, J. R., Lacerda, S. S., Barreiros, M. A. M., Radvany, J., Russell, T. A., . . . Amaro, E. Jr. (2012). Meditation training increases brain efficiency in an attention task. *NeuroImage, 59*(1), 745–749.

Kuyken, W., Byford, S., Taylor, R. S., Watkins, E., Holden, E., White, K., . . . Teasdale, J. D. (2008). Mindfulness-based cognitive therapy to prevent relapse in recurrent depression. *Journal of Consulting and Clinical Psychology, 76*(6), 966–978.

Lichtenberg, P., Bachner-Melman, R., Gritsenko, I., & Ebstein, R. P. (2000). Exploratory association study between catechol-O-methyltransferase (COMT) high/low enzyme activity polymorphism and hypnotizability. *American Journal of Medical Genetics, 96*(6), 771–774.

Lifshitz, M., Campbell, N., & Raz, A. (in press). Varieties of attention in hypnosis and meditation. *Consciousness and Cognition*. doi: 10.1016/j.concog.2012.05.008

Lifshitz, M., Howells, C., & Raz, A. (2012). Can expectation enhance response to suggestion? De-automatization illuminates a conundrum. *Consciousness and Cognition, 21*(2), 1001–1008.

Lutz, A., Dunne, J. D., & Davidson, R. J. (2006). Meditation and the neuroscience of consciousness: An introduction. In P. D. Zelazo, M. Moscovitch & E. Thompson (Eds.), *Cambridge Handbook of Consciousness*. New York, NY: Cambridge University Press.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences, 12*(4), 163–169.

Lynn, S. J., Das, L. S., Hallquist, M. N., & Williams, J. C. (2006). Mindfulness, acceptance, and hypnosis: Cognitive and clinical perspectives. *International Journal of Clinical and Experimental Hypnosis, 54*(2), 143–166.

Lynn, S. J., Kirsch, I., Barabasz, A., Cardeña, E., & Patterson, D. (2000). Hypnosis as an empirically supported clinical intervention: The state of the evidence and a look to the future. *International Journal of Clinical and Experimental Hypnosis, 48*(2), 239–259.

Lynn, S. J., Malakataris, A., Maxwell, R., Mellinger, D. I., & van der Kloet, D. (this issue). Do hypnosis and mindfulness practices inhabit a common domain? Implications for research, clinical practice, and forensic science. *Journal of Mind–Body Regulation, 2*(1), 12–26.

MacLeod, C. M. (1992). The Stroop task: The "gold standard" of attentional measures. *Journal of Experimental Psychology: General, 121*(1), 12–14.

MacLeod, C. M., & Dunbar, K. (1988). Training and Stroop-like interference: Evidence for a continuum of automaticity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14*(1), 126–135.

Manna, A., Raffone, A., Perrucci, M. G., Nardo, D., Ferretti, A., Tartaro, A., . . . Romani, G. L. (2010). Neural correlates of focused attention and cognitive monitoring in meditation. *Brain Research Bulletin, 82*(1–2), 46–56.

Mazzoni, G., Rotriquenz, E., Carvalho, C., Vannucci, M., Roberts, K., & Kirsch, I. (2009). Suggested visual hallucinations in and out of hypnosis. *Consciousness and Cognition, 18*(2), 494–499.

McGeown, W. J., Mazzoni, G., Venneri, A., & Kirsch, I. (2009). Hypnotic induction decreases anterior default mode activity. *Consciousness and Cognition, 18*(4), 848–855.

McGeown, W. J., Venneri, A., Kirsch, I., Nocetti, L., Roberts, K., Foan, L., & Mazzoni, G. (2012). Suggested visual hallucination without hypnosis enhances activity in visual areas of the brain. *Consciousness and Cognition, 21*(1), 100–116.

McLeod, S. (2005). The benefits and pitfalls of the teacher–meditator relationship. *Contemporary Buddhism, 6*(1), 65–78.

Mrazek, M. D., Smallwood, J., & Schooler, J. W. (2012). Mindfulness and mind-wandering: Finding convergence through opposing constructs. *Emotion, 12*(3), 442–448.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3*(5), 400–424.

Oakley, D. A., & Halligan, P. W. (2009). Hypnotic suggestion and cognitive neuroscience. *Trends in Cognitive Sciences, 13*(6), 264–270.

Oakley, D. A., & Halligan, P. W. (2010). Psychophysiological foundations of hypnosis and suggestion. In Steven Jay Lynn, Judith W. Rhue & I. Kirsch (Eds.), *Handbook of clinical hypnosis* (Second ed.). Washington, DC: American Psychological Association.

Pagnoni, G. (2012). Dynamical properties of BOLD activity from the ventral posteromedial cortex associated with meditation and attentional skills. *The Journal of Neuroscience, 32*(15), 5242–5249.

Pagnoni, G., Cekic, M., & Guo, Y. (2008). "Thinking about not-thinking": Neural correlates of conceptual processing during Zen meditation. *PLoS ONE, 3*(9), e3083. doi:10.1371/journal.pone.0003083

Parris, B. A., Dienes, Z., & Hodgson, T. L. (2012). Temporal constraints of the post-hypnotic word blindness suggestion on Stroop task performance. *Journal of Experimental Psychology: Human Perception & Performance*. doi: 10.1037/a0028131

Petersen, S. E., & Posner, M. I. (2012). The attention system of the human brain: 20 years after. *Annual Review of Neuroscience, 35*, 73–89.

Pintar, J., & Lynn, S. J. (2008). *Hypnosis: A Brief History*. Oxford, England: Wiley-Blackwell.

Posner, M. I., & Fan, J. (2004). Attention as an organ system. In J. R. Pomerantz & M. C. Crair (Eds.), *Topics in Integrative Neuroscience: From Cells to Cognition*. Cambridge, UK: Cambridge University Press.

Priftis, K., Schiff, S., Tikhonoff, V., Giordano, N., Amodio, P., Umiltà, C., & Casiglia, E. (2011). Hypnosis meets neuropsychology: Simulating visuospatial neglect in healthy participants. *Neuropsychologia, 49*(12), 3346–3350.

Pyka, M., Burgmer, M., Lenzen, T., Pioch, R., Dannlowski, U., Pfleiderer, B., . . . Konrad, C. (2011). Brain correlates of hypnotic paralysis—a resting-state fMRI study. *NeuroImage, 56*(4), 2173–2182.

Raichle, M. E. (2010). Two views of brain function. *Trends in Cognitive Sciences, 14*(4), 180–190.

Raichle, M. E., MacLeod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., & Shulman, G. L. (2001). A default mode of brain function. *Proceedings of the National Academy of Sciences, 98*(2), 676–682.

Raichle, M. E., & Snyder, A. Z. (2007). A default mode of brain function: A brief history of an evolving idea. *NeuroImage, 37*(4), 1083–1090.

Raz, A. (2004). Atypical attention: Hypnosis and conflict resolution. In M. I. Posner (Ed.), *Cognitive Neuroscience of Attention* (pp. 420–429). New York, NY: Guilford Press.

Raz, A. (2005). Attention and hypnosis: Neural substrates and genetic associations of two converging processes. *International Journal of Clinical and Experimental Hypnosis, 53*(3), 237–258.

Raz, A. (2007). Suggestibility and hypnotizability: Mind the gap. *American Journal of Clinical Hypnosis, 49*(3), 205–210.

Raz, A. (2011). Hypnosis: A twilight zone of the top–down variety. *Trends in Cognitive Sciences, 15*(12), 555–557.

Raz, A. (in press). Hypnosis as a lens to the development of attention. *Consciousness and Cognition*. doi: 10.1016/j.concog.2012.05.011

Raz, A., & Buhle, J. (2006). Typologies of attentional networks. *Nature Reviews Neuroscience, 7*(5), 367–379.

Raz, A., & Campbell, N. K. J. (2011). Can suggestion obviate reading? Supplementing primary Stroop evidence with exploratory negative priming analyses. *Consciousness and Cognition, 20*(2), 312–320.

Raz, A., Fan, J., & Posner, M. I. (2005). Hypnotic suggestion reduces conflict in the human brain. *Proceedings of the National Academy of Sciences of the United States of America, 102*(28), 9978–9983.

Raz, A., Kirsch, I., Pollard, J., & Nitkin-Kaner, Y. (2006). Suggestion reduces the stroop effect. *Psychological Science, 17*(2), 91–95.

Raz, A., Landzberg, K. S., Schweizer, H. R., Zephrani, Z. R., Shapiro, T., Fan, J., Posner, M. I. (2003). Posthypnotic suggestion and the modulation of Stroop interference under cycloplegia. *Consciousness and Cognition, 12*(3), 332–346.

Raz, A., Moreno-Iniguez, M., Martin, L., & Zhu, H. (2007). Suggestion overrides the Stroop effect in highly hypnotizable individuals. *Consciousness and Cognition, 16*(2), 331–338.

Raz, A., & Shapiro, T. (2002). Hypnosis and neuroscience: A cross talk between clinical and cognitive research. *Archives of General Psychiatry, 59*(1), 85–90.

Raz, A., Shapiro, T., Fan, J., & Posner, M. I. (2002). Hypnotic Suggestion and the Modulation of Stroop Interference. *Archives of General Psychiatry, 59*(12), 1155–1161.

Raz, A., Zhu, H., Yu, S., Bansal, R., Wang, Z., Alexander, G. M., . . . Peterson, B. S. (2009). Neural substrates of self-regulatory control in children and adults with Tourette syndrome. *Canadian Journal of Psychiatry, 54*(9), 579–588.

Semmens-Wheeler, R., & Dienes, Z. (this issue). The contrasting role of higher order awareness in hypnosis and meditation. *Journal of Mind–Body Regulation, 2*(1), 43–57.

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review, 84*(2), 127–190.

Slagter, H. A., Davidson, R. J., & Lutz, A. (2011). Mental training as a tool in the neuroscientific study of brain and cognitive plasticity. *Frontiers in Human Neuroscience, 5*.

Spiegel, D., White, M., & Waelde, L. C. (2010). Hypnosis, mindfulness meditation, and brain imaging. In D. Barrett (Ed.), *Hypnosis and Hypnotherapy* (pp. 37–52). Santa Barbara, CA: Greenwood Publishing Group.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*(6), 643–662.

Szekely, A., Kovacs-Nagy, R., Bányai, É. I., Gősi-Greguss, A. C., Varga, K., Halmai, Z., . . . Sasvari-Szekely, M. (2010). Association Between Hypnotizability and the Catechol-O-Methyltransferase (COMT) Polymorphism. *International Journal of Clinical and Experimental Hypnosis, 58*(3), 301–315.

Tang, Y.-Y., Rothbart, M. K., & Posner, M. I. (2012). Neural correlates of establishing, maintaining, and switching brain states. *Trends in Cognitive Sciences, 16*(6), 330–337.

Taylor, V. A., Daneault, V., Grant, J. A., Scavone, G., Breton, E., Roffe-Vidal, S., . . . Beauregard, M. (2012). Impact of meditation training on the default mode network during a restful state. *Social Cognitive and Affective Neuroscience*. doi:10.1093/scan/nsr087

Taylor, V. A., Grant, J. A., Daneault, V., Scavone, G., Breton, E., Roffe-Vidal, S., Beauregard, M. (2011). Impact of mindfulness on the neural responses to emotional pictures in experienced and beginner meditators. *NeuroImage, 57*(4), 1524–1533.

Teper, R., & Inzlicht, M. (2012). Meditation, mindfulness, and executive control: The importance of emotional acceptance and brain-based performance monitoring. *Social Cognitive and Affective Neuroscience*. doi: 10.1093/scan/nss045

Terhune, D.B. (this issue). Metacognition and cold control in hypnosis. *Journal of Mind–Body Regulation, 2*(1), 75–79.

Terhune, D. B., Cardeña, E., & Lindgren, M. (2010). Disruption of synaesthesia by posthypnotic suggestion: An ERP study. *Neuropsychologia, 48*(11), 3360–3364.

Terhune, D. B., Cardeña, E., & Lindgren, M. (2011). Dissociated control as a signature of typological variability in high hypnotic suggestibility. *Consciousness and Cognition, 20*(3), 727–736.

Williams, J. M. G., & Kabat-Zinn, J. (2011). Mindfulness: Diverse perspectives on its meaning, origins, and multiple applications at the intersection of science and dharma. *Contemporary Buddhism, 12*(1), 1–18.

Wright, A., Rickards, H., & Cavanna, A. E. (2011). Impulse-control disorders in gilles de la tourette syndrome. *Journal of Neuropsychiatry and Clinical Neurosciences, 24*(1), 16–27.

Zeidan, F., Grant, J. A., Brown, C. A., McHaffie, J. G., & Coghill, R. C. (2012). Mindfulness meditation–related pain relief: Evidence for unique brain mechanisms in the regulation of pain. *Neuroscience Letters, 520*(2), 165–173.