Chapter 12

Mind wandering and meta-awareness in hypnosis and meditation
Relating executive function across states of consciousness

Benjamin W. Mooneyham and Jonathan W. Schooler

Abstract

Hypnosis and meditation are two of many techniques for altering individuals' cognitive and psychological states (i.e., states of consciousness). Recent investigations have demonstrated that hypnosis and meditation may both produce changes in executive processes (e.g., cognitive control, monitoring), although the precise effects of each on the sub-processes of the executive system are not fully understood, particularly for hypnosis. Drawing from the research domains of attention and meta-awareness, the authors propose an approach that may allow the characterization of the specific functional changes that occur within the executive system during various states of consciousness. As an example of the utility of this approach, the chapter offers an overview of how their empirical protocol may be utilized to examine the similarities and differences between hypnosis, mindfulness meditation, and/or other atypical states of consciousness, and provides a preliminary discussion of the implications of this proposed research.

Introduction

Recently, researchers have become increasingly interested in the ability of intervention programs, targeted to induce alternative or atypical states of consciousness, to alter cognitive abilities, particularly those that are domain-general: for instance, abilities associated with cognitive control (e.g., Colcombe & Kramer, 2003; Erickson et al., 2007; Hillman, Erickson, & Kramer, 2008; Kramer & Erickson, 2007; Morrison & Chein, 2010; Mrazek, Franklin, Phillips, Baird, & Schooler, 2013; Slagter, Davidson, & Lutz, 2011). In this chapter, we propose a method for examining the specific effect(s) of various states of consciousness (such as those induced by popular intervention programs) on executive functions such as executive control and executive monitoring and describe, as an example of this procedure, how our proposed method may inform the understanding of two practices that have each been investigated in the context of their ability to modulate executive functioning: *hypnosis* and *meditation*.

We begin by briefly considering what is already known about the relationship between hypnosis and meditation. This analysis reveals that while these two psychological interventions share some striking similarities, they also diverge in ways that have not yet been fully characterized, warranting further empirical investigation aimed at assessing the functional similarities and differences in executive functioning resulting from hypnosis and meditation. Toward this end, we propose an experimental methodology that may permit both the assessment of the particular changes in executive functioning that are associated with hypnosis, mindfulness meditation, or other atypical state of consciousness, and the direct comparison of the effects of each state within a common experimental design. Our proposed approach, adapted from the research domains of mind wandering and meta-awareness, may offer important insights regarding the relationship between executive processes and various states of consciousness. In this chapter, we employ hypnosis and mindfulness meditation as examples of atypical states of consciousness, and explore how our proposed approach may shed light upon three unresolved research issues related to these particular states: the specific dissociative effects of hypnosis, the effects of meditation practice on executive functioning, and the relationship between hypnosis and meditation.

Hypnosis versus meditation

What is the relationship between meditation and hypnosis? This question has garnered significant interest recently (see Part 3 of this volume). At the surface, meditation and hypnosis share several basic similarities, but upon closer examination it becomes clear that we do not yet fully understand either practice or the precise mechanisms by which they differ from each other.

Characteristics shared by hypnosis and (mindfulness) meditation

Hypnosis and meditation are practices associated with several common principles.

Relaxation

Both hypnosis and meditation participants often report feeling relaxed (Benson, Greenwood, & Klemchuk, 1975; Lynn, Brentar, Carlson, Kurzhals, & Green, 1992; Lynn, Malaktaris, Maxwell, Mellinger, & van der Kloet, 2012; Wallace, Benson, Wilson, 1984). However, relaxation is not required in order for hypnotic responding to occur. Moreover, meditative states can also be distinguished from relaxation states (such as with electroencephalography (EEG); Dunn, Hartigan, & Mikulas, 1999), suggesting that while relaxation may typically occur during hypnosis and meditation alike, neither state's effects can be reduced to the effects of the relaxation that occurs within the state.

Absorption

Both hypnosis and meditation are absorptive practices (see Chapter 14). Absorption can be measured at the trait level, where it indicates a dispositional tendency to experience episodes in which one's "total" attention fully engages one's representational (i.e., perceptual, enactive, imaginative, ideational) resources (Tellegen & Atkinson, 1974). Assessments of absorption have been made in relation to both hypnosis and meditation; absorption correlates positively with hypnotizability (Tellegen & Atkinson, 1974), while long-term meditators indicate higher levels of absorption than do novice meditators (Davidson, Goleman, & Schwartz, 1976). While the particular absorption that occurs during hypnosis and meditation may differ (see Semmens-Wheeler & Dienes, 2012, for a discussion of four modes of mental processing that may each be associated with different

"types" of absorption), it is nonetheless reasonable to assert that both practices are associated with some form of attentional absorption.

Characteristic distinctions between hypnosis and meditation

Despite the commonalities shared between hypnosis and meditation, several key differences between these two practices have made it difficult to precisely determine the relationship between them.

Attentional regulation/control

In hypnosis, attention is typically directed toward some external object or behavior, and this direction of attention results from a command or suggestion given by the hypnotist to the individual undergoing hypnosis. As such, attentional control is, in a manner, relegated to the hypnotist and the locus of attention determined through the specific suggestions given to the hypnotized individual. Interestingly, meditation practice often begins in a similar fashion, in which an instructor provides suggestions for the student regarding toward where and what to direct their attention (see Chapter 19). However, over the course of practice, experienced meditators come to control their attention internally (likely by training their meta-cognitive abilities; see Semmens-Wheeler & Dienes, 2012) and, in contrast to what occurs during hypnosis, learn to focus their attention not on some external action or object, but on their own internal states and experiences.

There is ample evidence that meditation practice leads to attentional improvements. For instance, experienced meditators exhibit less Stroop interference than controls during the Stroop task (Moore & Malinowski, 2009; Wenk-Sormaz, 2005), indicating improved attentional control and an ability to override a supposedly automatic process (see Chapter 16). While meditation practice has been shown to improve attentional abilities in a variety of studies, the effect of hypnosis on attention is much less straightforward. Without a hypnotic induction or a task-relevant suggestion, most studies have shown that high-hypnotizable individuals do not demonstrate improved attentional abilities, as measured by Stroop interference (e.g., Egner, Jamieson, &Gruzelier, 2005; Jamieson & Sheehan, 2004; Kaiser, Barker, Haenschel, Baldeweg, & Gruzelier, 1997; Kallio, Revonsuo, Hamalainen, Markela, & Gruzelier, 2001; Nordby, Jasiukaitis, & Spiegel, 1999).

Effect of suggestion

While high-hypnotizable individuals do not possess improved attentional abilities in the absence of a hypnotic induction or task-relevant suggestion, the story changes once a suggestion is given. When given a suggestion to view words presented in a Stroop task as meaningless, high-hypnotizable individuals actually show improved Stroop performance (Parris, Dienes, & Hodgson, 2012; Raz, Shapiro, Fan, & Posner, 2002; Raz et al., 2003). This points to the importance of suggestion within hypnotic responding, and demonstrates that high-hypnotizable individuals that have been given a specific suggestion may indeed have superior attentional abilities in comparison to low-hypnotizable individuals (even when the low hypnotizables also receive a suggestion) who show no improvements in Stroop performance when given the same suggestion.

Hypnotizability is measured through suggestibility, such that individuals who are more likely to respond in accordance with external suggestions are deemed more hypnotizable. As such, the internal state of high hypnotizables may be more malleable than it is for others, which may allow these individuals to respond to suggestions in ways that improve their attentional performance. However, while individuals with meditation practice also show improved attentional performance, they are generally less suggestible; Semmens-Wheeler and Dienes (2012) report that an examination of 12 expert meditators revealed that they were less suggestible than average

(passing 3 out of 12 suggestions, compared to an average of 5.5 suggestions passed). Additionally, across over 500 participants, hypnotizability negatively correlated with mindfulness ($r = -0.38$; Semmens-Wheeler & Dienes, 2012).

These results lead to a seemingly paradoxical conclusion: instructing high-hypnotizable individuals to respond less mindfully (i.e., hypnotically, as in the Stroop studies with task-relevant suggestions) leads them to perform better on the same attention tasks upon which meditation training improves performance (Semmens-Wheeler & Dienes, 2012; for an updated account of this research, including more recent findings, see Chapter 7). Additionally, while meditators may be less suggestible as a result of their meditation practice, it is suggestion that enables the improvement in attentional performance in high hypnotizables to occur.

The need to examine attention and executive processing in both hypnosis and meditation

Despite the similarities between hypnosis and meditation, a closer examination of the effects of each practice reveals that the distinction between the two may not be made simply. In order to more fully understand the relationship between hypnosis and meditation, it may be necessary to investigate the effects of each practice at a more fine-grained level by independently examining the component sub-processes of attention and executive processing. We propose an empirical framework in which to examine the effects of each practice on these sub-processes of executive functioning within a single experimental design, and we will outline our proposed approach in the sections to come. First, we discuss current and competing theories of hypnosis, as our protocol may disambiguate a variety of hypnosis-related findings and possibly provide evidence in favor of one theory of hypnosis or another.

Dissociation theories of hypnosis

Various theories of hypnosis exist that posit that some form of dissociation occurs during hypnosis (e.g., Bowers, 1992; Bowers & Davidson, 1991; Hilgard, 1977; Jamieson & Woody, 2007; Janet, 1901, 1907). However, the type of dissociations proposed within the various theories differ, and a distinction can be made between theories that posit a dissociation *of experience* versus a dissociation *of control*.

Dissociation of experience

Theories of dissociated experience within hypnosis have been around for some time (Janet, 1901, 1907), perhaps reflecting the extent to which these theories capture the central feature of hypnosis: the lack of experienced volition. The most prominent of these theories is Hilgard's (1977) "neo-dissociation" theory. This theory proposes that the lack of consciously perceived volition that coincides with the hypnotic state is the result of an *amnesia-like barrier*, which blocks some mental activity from the conscious access it would have in a non-hypnotic circumstance. As such, while a hypnotized individual may have no "conscious" awareness of the volition that accompanies their actions under hypnosis, it is not because volition is lacking, but, rather, because the hypnotized individual becomes dissociated from their own experience of volition. Thus, one may be fully capable of exerting volitional control of one's actions while under hypnosis, but hypnosis may produce a barrier between conscious experience and its subsequent reportability. Additionally, through investigation, Hilgard claimed that, with appropriate suggestions employed, one could access a *hidden observer*, a conscious entity capable of reporting mental activity that had

otherwise been blocked from awareness (Hilgard, 1991, 1994; Hilgard, 1977). This led to the conclusion that hypnosis may produce parallel streams of consciousness (through the amnesia-like barrier) that are largely unintegrated.

Given researchers' largely unsuccessful attempts to verify the hidden observer (Green, Page, Handley, & Rasekhy, 2005; Spanos, 1983; Spanos & Hewitt, 1980; Spanos, de Groot, Tiller, Weekes, & Bertrand, 1985), Hilgard's (1977) "neo-dissociation" theory of hypnosis has been met with skepticism. However, Hilgard also argued that hypnotic responses might appear to lack volition (from the perspective of the one hypnotically responding) through a different mechanism (instead of the proposed amnesia-like barrier): circumvention around executive control processes. If hypnotic suggestions are able to bypass the "executive control" system, they may act directly on lower "subsystems of control," thereby initiating the acts demanded by the suggestion without executive initiative. Such a process would produce a similar feeling of a lack of conscious volition, but this feeling would result from an actual dissociation of *control,* in that the suggestion would take effect regardless of the "intent" of the executive control system. With this in mind, Bowers (1992) proposed that neo-dissociation theory should be divided into two separate theories: theories of *dissociated experience* and theories of *dissociated control.*

Dissociation of control

Originally stemming from neo-dissociation theory itself, Bowers (1992) first formalized the *dissociated control theory* of hypnosis. This theory postulates that hypnosis alters control processes themselves rather than merely altering perceived control. In its most basic form, the idea is simple: in hypnosis, the lower "subsystems of control" (such as those involved in coordinating motor movements, lexical processing, etc.) may be directly influenced by suggestion. Such direct access may permit these subsystems of control to produce behaviors that are not directed, initiated, or governed by the higher-level executive control system. Thus, actions performed under hypnosis will lack the usual amount of intervention from executive control processes, and will therefore be perceived to have occurred without volitional control (Sadler & Woody, 2010).

Investigations of executive control processes during hypnosis have lent support to the idea that hypnosis involves some form of dissociated control. Many of these studies have utilized classic "frontal lobe" tasks, such as the Stroop task, to demonstrate that high-susceptible individuals tend to make more errors and suffer greater interference (as measured by reaction time) on the Stroop task than low-susceptible individuals (either while under hypnosis or after a de-induction that was preceded by a hypnotic suggestion) (Jamieson & Sheehan, 2004; Kaiser et al., 1997; Nordby et al., 1999; Sheehan, Donovan, & MacLeod, 1988). *Dissociated control* accounts of hypnosis are bolstered by neuroimaging and electroencephalographic reports of increased activation in conflict-monitoring areas of the brain (specifically, the dorsal anterior cingulate cortex; dACC) for high-susceptible individuals while performing the Stroop task under hypnosis, as well as the finding that the functional connectivity between this conflict-detection region and another "cognitive-control" region, the lateral prefrontal cortex (lPFC), is decreased during the Stroop for high-susceptible individuals while under hypnosis (Egner et al., 2005), a finding which suggests that hypnosis limits the degree to which control processes are able to adjust in response to detected conflict.

Inferring the role of "control" itself in hypnosis from Stroop-like tasks is difficult, however, as it is often unclear whether performance decrements in the Stroop task are due to deficits in conflict monitoring, signaling between conflict monitoring and cognitive-control systems, maintaining and implementing appropriate task set variables within the cognitive-control system, or

other processes (Egner & Raz, 2007). Although recent studies have attempted to further clarify the origin of poor Stroop performance under hypnosis, with some success, isolating the changes that occur within particular component processes (and their interactions) during hypnosis will be important to fully explain hypnosis; it is also a central aim of our proposed study.

A variant, and more specific, form of dissociated control theory, the *second-order theory of dissociated control* (a term coined by Woody & Sadler, 1998), also posits that the effect of hypnosis is exerted through dissociated control, but with different locus of dissociation. (This theory shares substantial overlap with the ideas put forth by Jamieson and colleagues in their recent work; Egner et al., 2005; Jamieson & Sheehan, 2004; Jamieson & Woody, 2007). Rather than having the dissociation occur between the higher-level executive control system and the lower subsystems of control, the second-order theory of dissociated control states that the dissociation occurs, instead, between the higher-level *executive control system* and the *executive monitoring system*, such that the executive monitoring system is unable to modulate any directive imposed by the executive control system once the directive has been initiated. This idea is supported by findings that suggest that it may not be a lack of executive processing per se that is responsible for the relationship between hypnosis and poor performance in tasks like the Stroop but, rather, a disconnect between executive monitoring and cognitive control systems: Egner et al. (2005) showed that, while a conflict-detection region of the brain (dACC) showed increased activity for high-susceptible individuals performing the Stroop task under hypnosis, no corresponding increase was observed in a key cognitive-control region (the lPFC), suggesting that there may be a disconnect in communication between these monitoring and control regions during hypnosis. Furthermore, these regions showed decreased functional connectivity during the Stroop task for the high-susceptible individuals, providing direct evidence in support of the notion of *second-order dissociated control*.

Woody & Sadler's integrative model

In response to the propagation of various dissociative theories of hypnosis, Woody and Sadler (Sadler & Woody, 2010; Woody & Sadler, 2008) presented an "integrative model" in which the dissociations predicted by alternative theories could each be depicted within a single framework (see Figure 12.1).

In this model, separate functional modules are depicted for executive control, executive monitoring, and the subsystems of control, with suggestion serving as the input and behavior serving as the output. As such, the model depicts two levels of control: the higher level consists of executive control and executive monitoring, while the lower level is more diverse and consists of various "system-specific" control processes; these "subsystems of control" within the lower level are variegated in nature, comprising constituent and domain-specific processes (such as visual search, word recognition, or motor function) underlying more complex behaviors. Furthermore, the model posits two feedback loops: one loop going from executive control to the subsystems of control, to executive monitoring, and then repeating; the other going reciprocally between executive control and executive monitoring.

Each of these loops are enacted via functional connections between the modules within the model (labeled paths A–E in Figure 12.1) and, according to dissociative theories of hypnosis, it is the relative strengths of these connections that are predicted to change within the hypnotic state. However, the prediction of which particular paths change in strength during hypnosis is determined by the theory being considered. For instance, the theory of dissociated experience predicts that the dissociative effect of hypnosis occurs through a dampening of paths C and E, where information regarding executive control is prevented from reaching awareness in the executive
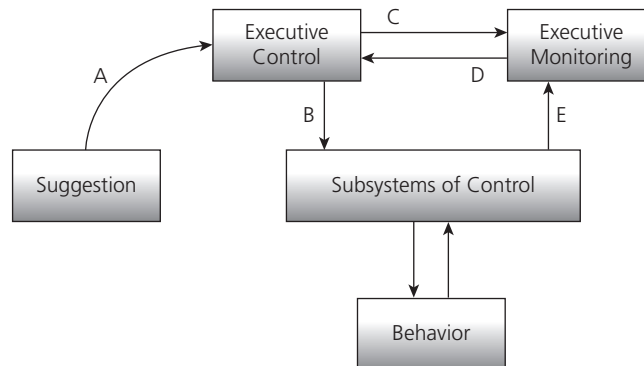
Fig. 12.1 Woody and Sadler's (2008) integrative model.

This material has been adapted from Erik Z. Woody and Pamela Sadler, Dissociation theories of hypnosis, In Michael R. Nash and Amanda J. Barnier (eds), *Oxford Handbook of Hypnosis*, p. 90, figure 4.2 © 2012, Oxford University Press, and has been reproduced by permission of Oxford University Press http://ukcatalogue.oup.com/p2p/endecaSearch. do?keyword=Oxford%20handbook%20of%20hypnosis. For permission to reuse this material, please visit http://www. oup.co.uk/academic/rights/permissions.

monitor (path C); such an inhibition may therefore explain why individuals lack awareness of their executive control efforts (i.e., it may simply be because this effort does not get monitored sufficiently enough to reach awareness). Additionally, a more pronounced dissociation of experience (like the form originally proposed by Hilgard) would also involve dampening the outputs from the subsystems of control to the executive monitoring system (path E), thus producing "amnesia" for one's actions altogether.

The theory of dissociated control, on the other hand, posits a reduction in the strength of path B, where the subsystems of control operate without "normal" amounts of executive control being imposed upon them. Thus, the dissociation does not involve a misperception of experience but, rather, a real inability to executively control one's actions under hypnosis.

Finally, the second-order theory of dissociated control predicts a weakening of path D, where the executive monitoring system is therefore unable to modulate the operation of the executive control system, leading to more rigid and less flexible behaviors under hypnosis.

A study proposal: testing the locus of hypnotic dissociation and comparing hypnotic versus meditative effects

Despite a rapid accumulation of findings from empirical investigations into hypnosis and meditation, we have yet to reach a clear understanding of the particular functional changes induced by either activity. We have, as of yet, been unable to reach strong conclusions about how the dissociative effects of hypnosis ought to be characterized, while at the same time, the relationship between the effects of hypnosis and meditation remains largely speculative. We propose that, in order to better resolve this issue, researchers must consider the effects of each activity within a common and comprehensive model of executive functioning. Furthermore, an investigation aimed at distilling the particular functional effects of either meditation or hypnosis (or both) must be able to simultaneously examine each individual functional "connection" within the comprehensive model. If a method can be established to measure each functional connection independently within a single experimental design, then we may be able to specify the particular functional

connections that are targeted by hypnotic inductions, meditation practice, or other experiences which produce atypical states of consciousness (such as drug use, brain injury, or the experience of "flow").

We now present a design for a possible approach, rooted in Woody & Sadler's (2008) integrative functional model, that would attempt to separately measure the effects of hypnosis and meditation (or any other atypical state of consciousness) on each individual component "connection" within the model, thereby allowing for a more rich understanding of both the particular functional effects of each activity, as they pertain to executive functioning, and also the functional relationship between the practices/states under investigation.

One design, every path?

Is it possible to characterize the functional changes associated with hypnosis and/or meditation within Woody and Sadler's integrative model, and can changes along each path be quantified within a single study? In order to do so, several requirements must be met:

1 Measure the effect of suggestion alone (compared to suggestion plus hypnosis or suggestion plus meditation; path A)

2 Measure executive control exerted upon "subsystems of control" (path B)

3 Measure executive control exerted upon executive monitoring (path C)

4 Measure the effect of executive monitoring (e.g., meta-awareness) on executive control (path D)

5 Measure awareness of output from subsystems of control (path E).

To meet these requirements, a study needs to combine methodologies. First and foremost, the study must assess cognitive control (such as in the context of sustained attention or response inhibition); this enables a measure of path B. Secondly, the study must assess individuals' awareness of not only their performance but of their fluctuations in cognitive control; this allows paths E and C, respectively. Thirdly, the dependent measure related to the effect of the imposed suggestion must be independent of other influences, permitting a measurement of path A. Finally, the study must measure individuals' propensity/ability to adjust their cognitive control in the face of performance-related cues that reach awareness, in order to assess path D.

A proposed study

What follows is a description of a study design that represents one possible approach toward isolating the specific effects of hypnosis and meditation on cognitive control and awareness within the framework of an integrative model of hypnosis. Such an approach should be able to assess changes in the "strength" of each of the various paths within the model (e.g., paths A through E in the aforementioned integrative model; see Figure 12.1) that occur during either hypnosis or meditation. The approach that we outline here is largely borrowed from a methodology with which the present authors are familiar: to combine a task requiring sustained attention to external stimuli with assessments of on-line meta-awareness. This is a common procedure in the domain of mind wandering (e.g., Christoff, Gordon, Smallwood, Smith, & Schooler, 2009; Levinson, Smallwood, & Davidson, 2012; Smallwood et al., 2008; Smallwood & Schooler, 2006). We believe that this procedure has the capacity to isolate changes along each functional path within Woody and Sadler's integrative model, thus potentially providing useful insights into the nature of hypnosis and meditation.

Basic design

The basic concept of the study is to compare the effects of a hypnotic induction *plus* suggestion or a meditation practice session *plus* suggestion to the effects of suggestion alone, within a task design that allows for each path within the integrative model to be separately tested. As such, we envision this study to have three between-subject conditions:

1   Hypnotic induction *plus* task-based suggestion

2   Meditation practice *plus* task-based suggestion

3   Task-based suggestion *only*.

By employing these three conditions, this study would allow for the effect(s) of hypnosis to be isolated from the effect of suggestion (by comparing the hypnotic-induction (with suggestion) group to the suggestion-only group). The effect(s) of meditation may be similarly isolated by comparing the meditation (with suggestion) group to the suggestion-only group. Finally, this design may also allow for the effect(s) of hypnosis plus suggestion to be compared to the effect(s) of meditation plus suggestion, a comparison that may shed light on the fundamental relationship between these two practices.

Because the integrative model includes paths directly related to aspects of executive control and awareness, the task must garner measurements separately related to each of these. As such, the study should include a task that can be used to measure cognitive control, and also assessments of individuals' awareness (and meta-awareness). We believe that the Sustained Attention to Response Task (SART; Robertson et al., 1997) combined with "thought probes" would be well suited to assess the changes along each path of the integrative model that are uniquely attributable to hypnosis and meditation practice. In brief, this is because the SART provides several dependent measures that reflect aspects of either "lower-level" task performance or cognitive control, while thought probes provide an avenue to examine conscious awareness of these variables (i.e., task performance and cognitive control). The rationale for this particular design will become clearer when we explore how each path could be assessed. First, however, let us divest the rest of the proposed study's design.

Hypnotic induction

Isolating the effect(s) of hypnosis will involve comparing the response characteristics of two groups of individuals: one group who receive a task-related suggestion only, and another group who receive a hypnotic induction prior to being given the same task-related suggestion. As such, this study should only recruit participants who score highly on hypnotic susceptibility in order to ensure that the hypnotic induction will actually have an effect.

Meditation practice

In order to isolate the effect of meditation practice on executive functions such as executive control and meta-awareness, it will be necessary to compare performance on the SART between a group of individuals who receive the "control" treatment, which is a suggestion only, and a group who perform meditation practice and also receive the same suggestion as the control group. However, because it is likely that the effects of meditation and suggestion are not merely additive, but rather more complex, this method of comparing the effects of suggestion only to meditation plus suggestion may not isolate the "pure" effect of meditation on executive functioning. It will, on the other hand, allow an assessment of the cognitive effects of pairing suggestions with meditative practice, rather than in using suggestions in isolation.

Our own laboratory has previously demonstrated that an effect of meditation practice can be observed after a practice session of as little as 8 minutes: a period in which participants are asked

to continuously attend to their breath (Mrazek, Smallwood, & Schooler, 2012). This mindful breathing was able to induce changes in SART response behavior in a previous study conducted in our laboratory (Mrazek et al., 2012). As such, the meditation practice plus suggestion group should perform a similar mindfulness practice routine before receiving the task-based suggestion and performing the SART.

The Sustained Attention to Response Task

The Sustained Attention to Response Task, or SART, is a task that is often employed to assess individuals' propensity to exhibit lapses in sustained attention (Cheyne, Carriere, & Smilek, 2006; Cheyne, Carriere, Solman, & Smilek, 2011; Cheyne, Solman, Carriere, & Smilek, 2009; Christoff et al., 2009; McVay & Kane, 2009; Mrazek et al., 2012; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997; Smallwood et al., 2008; Smallwood, Fitzgerald, Miles, & Phillips, 2009). The SART is a variant of the common Go/No-Go procedure, but features a switching of the response demands such that participants are asked to respond to frequent non-target stimuli while withholding responses to infrequent target stimuli.

From the SART, several performance markers are often used as dependent measures. First, the number or proportion of No-Go presentations producing "SART errors" (i.e., errors of commission)—a failure to withhold a response to the target stimulus—is of principle interest, as this measure reflects "strong" lapses in sustained attention or disengagement from the task (Cheyne et al., 2009; Seli, Cheyne, & Smilek, 2012; Smallwood et al., 2008). Additionally, reaction time (RT) measures, such as average RT, may be assessed but, more commonly, the response time coefficient of variability (RT CV)—equal to the standard deviation of an individual's RT, divided by their mean RT—is used as a more subtle measure of failures in sustained attention.

Greater RT CV is posited to reflect less focused sustained attention, as modest attentional disengagements (states described by Cheyne et al. (2009) as *focal task inattention* and *global task inattention*) tend to produce a speeding of RTs, while more pronounced disengagements (*response disengagement*) produce larger RTs; these inattention/disengagement effects, when combined, produce an overall increase in RT CV. As a general conclusion, RT CV appears to most accurately reflect trial-by-trial fluctuations in sustained attention (indicating concomitant fluctuations in cognitive control) to the task (Cheyne et al., 2009, 2011).

SART framing When carrying out the SART, participants are usually instructed to perform the task as quickly and accurately as possible (Robertson et al., 1997). This proposed study would employ a slight variation on the instructions in order to produce dependent measures that capture the strength of each path separately. The instructions for this study's SART should, instead, stress that participants try to perform the task *as accurately as possible* (as in typical versions of the SART), and also *as steadily as possible*. The reason for this modification in the framing of the SART is to allow the estimation of individuals' awareness of the degree of executive control that they have been exerting during the task. By asking individuals to gauge their current pace at moments throughout the task, such as by asking whether it is faster or slower than their average pace up to that point, we can determine the extent to which modulations in executive control (reflected by changes in pacing) reach conscious awareness; this extent will provide an avenue to assess the strength of path C in the aforementioned model (see Figure 12.1).

SART suggestion In order to isolate the effects of hypnosis and meditation from the effect of suggestion, each of the three groups of participants should receive an identical suggestion. Providing a suggestion will allow for comparing the strength of the integrative model's path "A" under hypnosis or after meditation to its strength in the absence of either intervention. In order

to isolate this "A" path, we propose the following suggestion: "You may make fewer errors if you go slowly." Thus, the suggestion would be to go slowly; our rationale for this will be explained in detail shortly. It is worth noting, however, that this suggestion may also help overcome methodological issues within standard SART versions, as there is evidence that speed–accuracy trade-offs occur within the SART (Seli et al., 2012). As such, in standard SART versions, the number of SART errors produced is contaminated by this trade-off, where up to half of SART errors may result solely from attempts at speeded responding; instructing participants to go more slowly reduces SART errors overall (presumably reducing the number of errors due to this trade-off), and thus the number of SART errors in a "slow" SART may provide a better pure measure of lapses in sustained attention (Seli et al., 2012).

SART probes Two types of "thought probes" should be presented to the participant during the SART: a "performance" probe and a "pacing" probe. The probes should be presented together following No-Go targets, ideally in counterbalanced order.

> *Performance probes.* To probe their awareness of their performance, participants should be asked: "Did you make an error withholding a response to the last target?" They should then be required to respond either "yes" or "no."

> *Pacing probes.* To probe their awareness of their pacing, participants should also be asked: "Were your reaction times since the most recent probe *more variable* or *less variable* than your average variability in reaction time so far during this task?" They should then be required to respond either "more variable" or "less variable."

Using dependent measures to test each path in the integrative model

The design strategies likely elicit questions regarding why they have been specified, as such, and how they may be used to test particular paths within the model presented earlier. We will now attempt to describe how the paths in the integrative model can be related to dependent measures associated with this study.

Path A: the effect of suggestion on executive control

Path A indicates the degree to which an external suggestion has an effect on executive control. Given that the suggestion provided in this study is to *go slowly* in order to make fewer errors, the suggestion's effect on executive control can be measured by the average RT to non-targets (across the entire task), where relatively slower RTs indicate a greater effect of suggestion. By then comparing the RTs of either the hypnotic-induction or meditation-practice group to the control (suggestion-only) group, we can identify the effect of each of these cognitive interventions on path A[1]:

Effect of hypnosis/meditation on path A = [Average RT to non-targets (hypnosis/
meditation group)]–[Average RT to
non-targets (control group)]

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[1] As mentioned, it is possible that meditation and suggestion do not combine in a purely additive manner. Within path A, we may be able to directly assess this possibility, as a result in which suggestion has a smaller effect within the meditation-plus-suggestion condition than in the suggestion-only condition would demonstrate a reduction in the effect of suggestion as a result of meditation practice, and thus a non-additive effect of combining the two manipulations.

Path B: executive control over "subsystems of control"

Because the SART is a task that requires cognitive control in order to correctly withhold responses to the rare target stimuli, SART errors (in which a participant fails to withhold a response to the target) represent a direct measure of the extent to which individuals' "subsystems of control" are being modulated by executive control. As such, the effects of hypnosis and meditation on path B can be determined by comparing the number of SART errors between participants in each induction-receiving group and the suggestion-only group:

Effect of hypnosis/meditation on path B = [Average number of SART errors (hypnosis/meditation group)]–[Average number of SART errors (control group)]

Path C: awareness of executive control

Whether modulations of executive control reach awareness (through executive monitoring mechanisms) determines the strength of path C in the integrative model. With this in mind, note that while SART errors can be seen as an indication of the amount of executive control being directed toward the task, so too can the *pacing* of participants' responses. (Remember that a key alteration of the standard SART protocol in this study is to stress that participants should try to be both *accurate* and *steady*.) Moreover, if a SART error reaches awareness, this must take a route "through the model" that goes via paths B and E. However, the *pacing* of participants' responses should be directed in a top-down manner from the system of executive control, and if information regarding pace reaches awareness directly, then this would be done through path C. As such, measuring the strength of path C requires determining the extent to which participants are aware of variations in the pace at which they are performing the SART. This can be readily measured given knowledge of participants' RTs to each non-target and their responses to the *pacing probes*. For instance, if participants' predictions regarding their individual-trial RT variability are more accurate within the hypnosis group than within the control group, then this would indicate that the strength of path C is increased under hypnosis; if the opposite trend is found, this supports the notion that path C is weakened during hypnosis (a prediction consistent with theories of dissociated experience). This same logic can be applied to examine the effect of meditation practice by comparing the meditation-practice and control groups:

Effect of hypnosis/meditation on path C = [Percent of pacing probes with correct response (hypnosis/meditation group)]–[Percent of pacing probes with correct response (control group)]

Path D: effect of executive monitoring on subsequent executive control

Path D measures the extent to which the executive monitoring system is able to produce modulations in executive control. The primary, and most obvious, way in which this would occur within the SART would be for the executive monitoring system to signal the executive control system *if it detects an error* (via signals from the subsystems of control), in order to improve subsequent performance. This study has been designed to obtain measurements of when participants are (or are not) aware of whether they have made an error: the performance probes. As such, a method for measuring the strength of path D would consist of examining performance on trials that

occur *immediately following a noticed error in the SART*, seeing whether subsequent performance improves. If hypnosis or meditation were to strengthen path D, then we should see that participants in that particular induction-receiving group perform better on the SART following noticed errors than the control group:

Effect of hypnosis/meditation on path D = [Number of SART errors made in trials immediately following performance probes indicating a noticed error (control group)]– [Number of SART errors made in trials following performance probes indicating a noticed error (hypnosis/meditation group)]

Notice that, while this formulation is similar to those of paths A–C, the directionality has been reversed, such that the induction-receiving group's value is subtracted from the control group's value. This is simply for the sake of consistency, such that, were either induction to be associated with an increase in the strength of path D, then the value of this effect would take a positive valence.

Path E: awareness of "subsystem"-produced activity

Path E measures the extent to which signals from the "subsystems of control" are able to reach awareness through executive monitoring of the subsystems. Given that the subsystems of control employed within the SART include both the systems responsible for the visual processing of the stimuli and the systems responsible for responding to the stimuli, path E can be measured by assessing the extent to which participants' performance on the SART reaches awareness (through executive monitoring). Since the study design includes frequent probes regarding their awareness of their performance within the task (the performance probes), we can measure the extent to which participants' awareness of their performance accurately reflects their actual performance. That is, if participants show the ability to make veridical (i.e., accurate) assessments of their performance, then it can be concluded that the response-related activity of the subsystems of control is available to, and being accessed by, the executive monitoring system. If participants' judgments of their performance are non-veridical (i.e., inaccurate), then this is likely due to information not being sufficiently monitored by the executive monitoring system:

Effect of hypnosis/meditation on path E = [Percent of performance probes with correct response (hypnosis/meditation group)]– [Percent of performance probes with correct response
(control group)]

As formulated here (and also with regard to path C), this effect would be measurable in terms of a difference in percentages. If hypnosis or meditation were to increase the strength of path E, then this effect would take on a positive value, whereas if either induction were to decrease the strength of path E, then this effect would take a negative value.

Path-related predictions from dissociation theories of hypnosis

In contrasting the strength of these functional "connections" between a hypnosis-plus-suggestion condition and a suggestion-only condition, the set of path(s) that exhibit differences between

the two conditions would ultimately be one of many possible outcome sets. The particular set of changes observed may promote one dissociative view of hypnosis over another, as different dissociative accounts make contrasting predictions regarding which paths should be affected by hypnosis. Alternatively, the results of a study such as this may provide compelling evidence against any of the dissociative accounts of hypnosis as they are currently formulated, and/or the results may provide the basis for a new, more comprehensive dissociative theory of hypnosis.

Dissociation of control

Theories which posit that hypnosis induces a *dissociation of control* make relatively straightforward predictions regarding the effect of hypnosis on each of the functional paths included in Woody and Sadler's integrative model (see Figure 12.1). If hypnosis primarily involves a dissociation between cognitive control systems/processes and the lower subsystems that are necessarily recruited during task performance, then the prediction would be that the hypnosis-plus-suggestion group should exhibit a relative (i.e., compared to the suggestion-only group) decrease in the strength of path B in the model. As such, this group should demonstrate a relative increase in SART errors during the task.

Control may, however, be dissociated via another functional change within the model. The theory of *second-order dissociation of control*, for instance, makes a separate prediction from the former control dissociation theory, as it predicts that the dissociation occurs through a weakening of path D, rather than path B. This weakening of path D would impair one's ability to adjust the amount of cognitive control being directed toward the task in situations in which executive monitoring processes reveal the need to do so. In the case of our study design, this would appear as an inability to improve performance subsequent to errors that have been consciously noticed.

Dissociation of experience

The theory of *dissociated experience* during hypnosis makes a prediction that stands in contrast to both of the aforementioned control-related dissociation theories. This theory predicts that the executive monitoring system, being crucial for awareness, should become decoupled from the executive processes that are being initiated, maintained, and adjusted while performing a task under hypnosis. Moreover, the monitoring system may additionally be blinded to the actual performance of the lower "subsystems of control" in the case of a more pronounced dissociation from experience. Thus, within the framework of the integrative model, the theory of *dissociated experience* predicts that the hypnosis-plus-suggestion group should exhibit a relative decrease in the strength of path C, and possibly also in the strength of path E.

In the context of task-related dependent measures, a (relative) reduction in the strength of path C would be modeled by individuals in the hypnosis-plus-suggestion group exhibiting worse accuracy on the *pacing probes* than individuals in the suggestion-only group; because the pacing probes have been specified to measure the extent to which individuals are aware of variations in the degree of executive control that they are exerting, poor performance on this probe item would indicate that information about fluctuations in executive control is not being registered by executive monitoring processes. If the *dissociation of experience* is driven instead by a reduction in the strength of path E, then this should be reflected in the relative performance of the two groups of individuals on the *performance probes*. The performance probes have been specified to measure individuals' conscious awareness of whether or not they have recently made an error on the SART, and so if the hypnosis-plus-suggestion group performs relatively worse on these judgments, this would indicate that the hypnotized individuals lacked awareness of their own performance, implicating deficient appropriate input from the lower subsystems to the executive monitor.

Path-related predictions for meditation practice

The effect of a brief mindfulness meditation training session on SART performance has already been characterized (Mrazek et al., 2012), therefore providing a few clear predictions regarding the path-specific changes that may appear when comparing the meditation-practice group to the control group in our proposed study. In Mrazek et al.'s (2012) study, they found that an 8-minute mindfulness meditation practice session improved two SART-related dependent measures—SART errors and RT CV—when the SART was performed immediately following the meditation session. Both measures decreased (i.e., improved) as a result of meditation practice (Mrazek et al., 2012). As such, this leads us to predict that the proposed study should reveal that meditation (plus suggestion) leads to an increase in the strength of path B, as this is directly measured by the frequency of SART errors.

The predictions regarding the other paths in the model lack such direct empirical support, though this does not prevent us from predicting that meditation practice may increase the strength of paths C, D, and E as well, as meditation practice has often been employed as a means of improving attentional, and therefore executive, functioning overall. However, despite evidence that meditation training improves various aspects of executive functioning (e.g., Chambers et al., 2008; Chiesa, Calati, & Serretti, 2011; Lutz, Slagter, Dunne, & Davidson, 2008; Moore & Malinowski, 2009; Tang et al., 2007; Teper & Inzlicht, 2013; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010), the supposedly altered functional relationships between each of the modules in the model (resulting from meditation training) have not yet been assessed simultaneously in a single study.

Theoretical implications of the proposed study

While it is difficult to forecast the particular outcomes of this proposed study, the results would likely have implications for several points of contention regarding both hypnosis and meditation.

Hypnosis: control versus experience

Given that this study has been proposed as a method for testing the strength of pathways within a model that was originally conceived as a way to integrate pre-existing, yet different, dissociative accounts of hypnosis, it should be unsurprising that the outcome of this study may ultimately weigh in favor of one dissociative account over another. Of central importance here is the debate regarding whether hypnosis involves a dissociation of *experience* or *control*. It is also possible that the idea of a specific, "local" dissociation being responsible for hypnotic effects does not fully account for the hypnotic phenomena which we are able to observe; hypnosis may require a more holistic perspective, one which takes into account each of the dynamic functional relationships between cognitive and psychological component systems/processes, and a study such as this may aid our willingness to adopt and formulate such a conclusion if it is warranted by the data.

Meditation

While Woody and Sadler's (2008) model was originally proposed as a way of integrating various dissociative perspectives of hypnosis into a single framework, it may nonetheless provide a foundation upon which several points regarding the effects of mindfulness meditation may be clarified. For instance, while it is known that mindfulness meditation practitioners have heightened sustained attention abilities and are less susceptible to distractions in tasks of cognitive control (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; Carter et al., 2005), it has not

been determined whether this is solely a result of greater executive control per se, or if these characteristics result from a change in communication or cooperation between the executive control system and the executive monitoring system. Working with our proposed framework, this study may be capable of elucidating any change in dynamics that occurs between these functional subsystems.

Summary

Borrowing from methodologies commonly employed to assess lapses in attention (i.e., mind wandering) and meta-awareness, and utilizing a framework that holds different aspects of executive functioning within a single model, we have proposed an experimental protocol that may elucidate our understanding of the particular functional changes that occur with respect to executive functioning as a result of either hypnosis or meditation practice, but which could be applied equally well toward examining the changes in executive functioning that occur alongside other states of consciousness. By formulating various dependent variables so that they correspond to individual and particular functional "connections" within an integrative model of executive functioning, each "connection" may be assessed separately and independently.

The study design that we have proposed and outlined in this chapter, which focuses on the states of consciousness associated with hypnosis and mindfulness meditation, provides an opportunity to simultaneously address three separate research questions related to these practices:

1   Can the dissociation(s) associated with hypnosis be precisely specified?

2   Can a similar specification be made regarding the functional changes associated with mindfulness meditation practice?

3   What is the relationship between the effects of hypnosis and meditation on executive processes?

In addition to the general utility of our combination of model and design in assessing the effects of particular states of consciousness on executive functioning, we believe that the debate regarding the type of dissociation(s) that may occur during hypnosis warrants an empirical investigation that is capable of testing and comparing the various dissociative theories of hypnosis. The potential results from this proposed study would likely bolster pre-existing dissociative theories of hypnosis, but they may also provide an impetus to refocus theories of hypnosis—either toward any "local" dissociations (i.e., along a single path in the model) that may be revealed by this proposed study, or toward a more holistic "conglomeration" of dissociative effects if the results were to suggest that a single-dissociation account is insufficient.

Similarly, the effects of meditation training on executive functioning (although currently better understood than the effects of hypnosis) require better specification, for the relative impact of short meditation practice sessions on executive sub-processes such as control and monitoring has not been fully characterized. Finally, given the natural comparisons drawn between hypnosis and meditation, we believe it is a worthwhile endeavor to directly compare the functional effects of each; in doing so, we may resolve some debates or incite others, but surely the data will speak for itself.

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Chapter 12

Q. No.	Query
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