Does Mind Wandering Reflect Executive Function or Executive Failure? Comment on Smallwood and Schooler (2006) and Watkins (2008)

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Abstract:
In this comment, we contrast different conceptions of mind wandering that were presented in 2 recent theoretical reviews: Smallwood and Schooler (2006) and Watkins (2008). We also introduce a new perspective on the role of executive control in mind wandering by integrating empirical evidence presented in Smallwood and Schooler with 2 theoretical frameworks: Watkins's elaborated control theory and Klinger's (1971, 2009) current concerns theory. In contrast to the Smallwood–Schooler claim that mind wandering recruits executive resources, we argue that mind wandering represents a failure of executive control and that it is dually determined by the presence of automatically generated thoughts in response to environmental and mental cues and the ability of the executive-control system to deal with this interference. We present empirical support for this view from experimental, neuroimaging, and individual-differences research.
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Article:
Two theoretical reviews of the mind-wandering literature have been published recently in *Psychological Bulletin*. The first was Smallwood and Schooler's (2006) "The Restless Mind," which argued, based on experimental, nomothetic research, that mind wandering consumes executive resources, drawing them away from one's primary task in the absence of effective metacognitive monitoring. The second was Watkins's (2008) "Constructive and Unconstructive Repetitive Thought," which presented a model to explain idiographic data from laboratory, field, and clinical studies on the consequences of repetitive thought. Both reviews deservedly draw attention to the understudied topic of thought content and its potential effects on task performance and the development of psychopathology. Moreover, their contrasting views provide an opportunity to consider the broad relevance of thought content to theories of executive function. In this comment, we point out the subtly— but significantly— different conceptions of mind wandering and control presented in these articles and we describe our own view on how to reconcile them. We focus primarily on the class of repetitive thought called *mind wandering*, defined as off-task thoughts during an ongoing task or activity. Moreover, like Watkins, our view relies heavily on findings from individual-differences research, findings that we believe pose problems for the Smallwood–Schooler executive-resource theory.

We first outline the view of executive resources and mind wandering presented by Smallwood and Schooler (2006) and then focus on the key theoretical point introduced by Watkins (2008). We ultimately introduce an extension of Watkins's claims with new evidence for the role of executive-control failures in producing mind-wandering experiences, along with a new perspective on the evidence offered by Smallwood and Schooler. The main difference between our perspective and that of Smallwood and Schooler concerns the relation between mind wandering and executive resources: They argued that mind wandering requires executive resources, whereas we argue that mind wandering results from executive-control failure. Most experimental research on mind wandering can be readily interpreted from either of our perspectives, but subtle differences between our views yield contradictory predictions about individual differences in mind-wandering susceptibility.

“The Restless Mind” (Smallwood & Schooler, 2006)

In their separate and collaborative work, Smallwood and Schooler have revitalized the laboratory approach to mind-wandering research (e.g., Schooler, Reichle, & Halpern, 2004; Smallwood, McSpadden, & Schooler, 2007, 2008; Smallwood, Obonsawin, & Heim, 2003), which had yielded few influential findings since the early 1990s. Their 2006 article comprehensively reviewed the growing experimental literature on mind wandering and rightly emphasized, in our view, the importance of understanding off-task thought to basic-science research into consciousness, metacognition, attention, and executive control. At the same time, we suggest that their theoretical claim about the relation between mind wandering and executive functions, although plausible, can be contrasted with a better alternative. The fundamental claim in question is whether or not mind wandering requires (i.e., consumes) executive resources (see also Smallwood et al., 2007).

Mind wandering varies as a function of task difficulty, and Smallwood and Schooler (2006) interpreted this finding as an executive resource trade-off between performing the task and engaging in task-unrelated thoughts (TUTs). Mind wandering de-creases, for example, as stimulus presentation rates increase in vigilance tasks (Antrobus, 1968; Giambra, 1995; Grodsky & Giambra, 1990–1991) and as memory load, or other aspects of task difficulty, increase (Antrobus, Singer, & Greenberg, 1966; Filler & Giambra, 1973; Forster & Lavie, 2009; McKiernan, D’Angelo, Kaufman, & Binder, 2006; Stuvyen, & van der Gouten, 1995; Teasdale, Lloyd, Proctor, & Baddeley, 1993). Furthermore, TUTs increase with practice on the primary task (Mason et al., 2007; Teasdale et al., 1995): Practice allows for automatization, which diminishes resource demands and so, Smallwood and Schooler argued, more executive resources remain available for mind wandering. Moreover, Smallwood and Schooler emphasized that task performance often suffers when people engage in mind wandering, as if TUTs draw attentional resources away from the task (e.g., McVay & Kane, 2009; Schooler et al., 2004; Smallwood et al., 2004, 2007, 2003). Teasdale et al. (1995) found, for example, that subjects generated less random, more stereotyped number sequences in a random-number-generation task when they were mind wandering than when they were on task. Performance on the primary task suffered when subjects reported mind wandering consistent with the claim that mind wandering draws on executive resources that would otherwise be used to perform the task (e.g., Baddeley, 1986).

Smallwood and Schooler’s (2006) nuanced view of the resource balance between mind wandering and performance is that TUTs predict poor performance only on primary tasks that require an intermediate degree of controlled processing and metacognitive monitoring. When task demands are low, resources are simultaneously available for mind wandering and self-monitoring; thus, TUTs can be stopped when they are detected. When task demands are high, few resources are available for either monitoring or mind wandering. It is only during moderately demanding tasks that resources may be split between performance and mind wandering, but without enough devoted to monitoring. The consequence, then, is that mind wandering may go undetected, leading to performance errors. According to their view, mind wandering is automatic on some dimensions but not on others (see Bargh, 1994): It occurs unintentionally and sometimes without awareness, but it also demands limited resources. Based on this view, mind wandering consumes the same resources, or uses the same mechanisms, that are responsible for executive control. Smallwood and Schooler, in later work, further suggested a “processing overlap with the brain’s executive system,” thereby arguing that the same mechanisms that are engaged by the task are diverted to produce the content of mind-wandering episodes (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009, p. 5).

Smallwood and Schooler (2006) recognized that their view of mind wandering as a resource-demanding phenomenon is paradoxical: Mind wandering reflects controlled processing, insofar as it demands resources, yet it is often unintentional. The paradox arises because intention is central to most characterizations of cognitive control (e.g., Hasher & Zacks, 1979; Posner & Snyder, 1975). To contend with the paradox, Smallwood and Schooler introduced two further, critical ideas: (a) subjects’ goals (and thoughts thereof) can be triggered automatically by salient cues, a point made compellingly by Klinger’s extensive research on fantasy and thought flow (e.g., Klinger, 1971, 2009, 1999) and; (b) consciousness and metaconsciousness are discrete mental states (Schooler, 2002), in that a reader may be momentarily unaware of her own conscious experiences, as when a reader finds herself having moved her eyes over a page of text while thinking about something else.

Thus, “mind wandering can occur against our best intentions because the automatic activation of a personally relevant, but task-unrelated, goal has temporarily drawn our attention away from the primary task” (Smallwood & Schooler, 2006, p. 953). Smallwood and Schooler further argued that, following the priming of a mind-wandering episode, resources are required to maintain the TUT.

We agree that mind wandering is often automatically activated, as Smallwood and Schooler (2006) suggested, but we suggest that TUTs do not draw on executive resources nor do they rely on the same cognitive mechanisms that are used for executive control. Rather, we propose that mind wandering reflects a failure of the executive-control system to adequately combat interfering thoughts that are generated and maintained automatically (i.e., unintentionally and without consuming executive resources but potentially controllable; Bargh, 1994). We turn now to Watkins (2008), who similarly relied on the concept of an executive-control system to explain the regulation of conscious thought.

“Constructive and Unconstructive Repetitive Thought” (Watkins, 2008)

In his review, Watkins (2008) proposed a control-theory approach to understanding the consequences of repetitive thought (Martin & Tesser, 1989, 1996). He argued that repetitive thought arises as output from a feedback loop involved in evaluating discrepancies between the end state of goals and their current status. At any given time, a hierarchy of goals guides one’s behavior (Carver & Scheier, 1999). Control theory states that repetitive thought will be constructive (e.g., acceptance and growth following a personal tragedy) when it aids a person in resolving the discrepancy and moving toward the desired state (e.g., Martin & Tesser, 1989, 1996), and it will be unconstructive (e.g., exacerbating depressive symptoms) when an unattainable goal has not yet been abandoned.

Klinger (e.g., 1971, 2009) has argued that, as goals are established, they become current concerns and are kept especially accessible until they are resolved or abandoned. These current concerns may be cued by the environment (or by other thoughts). When this occurs, concern-related thoughts at various levels within the hierarchy compete for attention. From a cognitive-control perspective, the admittance of current concerns into awareness must be regulated in a top-down manner, at least in some contexts, so that environmental cues are not unopposed in their influence on thought content. Watkins (2008) posited that momentary constraints placed on the level of construal, or the concreteness of goals, helps to regulate thought content. A concrete level of construal focuses on the specific task goal and the particular behaviors to complete the goal (e.g., bending one’s knees when setting up a basketball free throw), whereas an abstract level of construal allows thoughts about higher order goals (e.g., getting a basketball scholarship to college). The level of construal for optimal performance depends on the task and contextual variables (see action identification theory; Vallacher & Wegner, 1987).

The proposal that goals can be construed at different levels is of particular relevance to our perspective on mind wandering. A concrete level of construal is required for optimal functioning in novel or difficult tasks (see also Vallacher & Wegner, 1987), whereas a more abstract level of construal can occur during an easy task with little or no influence on performance. For example, during a difficult puzzle, only information related to the goal of solving the puzzle should be admitted into awareness. In contrast, during a leisurely drive across town, when the task of controlling the car is highly automatic, information related to higher order abstract goals can occupy attention without significant cost to driving (e.g., making a good impression by arriving on time to an appointment). Watkins’s (2008) view is that the adoption of a more concrete than abstract level of construal allows for a sharper focus on the specific means for accomplishing the goal.

According to Watkins (2008), one’s level of construal is jointly affected by the extent to which goal progress is possible, by self-related beliefs (e.g., self-esteem), by mood, and by executive-control capability. We focus specifically on Watkins’s perspective that executive control is necessary to match the level of construal to the demands of the situation. Watkins’s view is not a theory of mind wandering, per se, but it can contribute to researchers’ understanding of executive control and TUTs. Executive resources limit the type of information that gains entry into awareness, depending on the demands of the task (i.e., matching the level of construal to the situational demands). Thus, elaborated control theory predicts that a person with limited executive-control capabilities, relative to someone with greater capabilities, will be less able to implement the proper level of construal for the task or activity at hand; consequently, he or she will experience more repetitive, off-task thoughts (or mind wandering), resulting in poor performance on the primary task. This idiographic prediction is contrary to the one that would be generated from the executive-demand view of mind wandering (Smallwood & Schooler, 2006; we have more to say about this later). Our claim, consistent with elaborated control theory, is that executive control is engaged to prevent mind wandering and that variation in executive control (both inter- and intraindividual) partially determines the intrusion of TUTs into conscious experience.

Implicit in Watkins's (2008) approach is the continued existence of discrepancies (i.e., current concerns) at all levels of the goal hierarchy that, when activated by cues, may trigger mind wandering (e.g., Klinger, 1971, 1999). Goal evaluation (i.e., comparing the desired state to the end state and updating goals) is continuous and generates a stream of thoughts, outside of awareness, that compete for attention. The entry of these thoughts into awareness is moderated by control over the level of construal (i.e., control over whether thoughts are about immediate task demands or about more abstract, high-level goals). From this perspective, off-task thoughts do not consume executive resources; rather, executive processes control the types of thoughts that gain entry into awareness. We suggest that an abstract level of construal (i.e., letting thoughts about higher order goals flow in an uncontrolled manner) is the default mode of processing (see also Vallacher & Wegner, 1987); control mechanisms are initiated to constrain the level of construal and to allow thoughts into awareness only when they are appropriately related to the immediate task goal. We suggest, also, that an abstract level of construal allows for a large network of related concepts to be activated, increasing the number of off-task thoughts that are likely to be generated, thereby increasing the probability of a mind-wandering episode (see our Control Failures X Concerns perspective below).

The idea that mind wandering content is continuously, automatically, and unintentionally generated in a resource-free manner (i.e., that it represents a default state of mind) is consistent with Watkins's (2008) elaborated control theory and Klinger's (1971, 2009) current concerns theory. It contrasts sharply, however, with Smallwood and Schooler's (2006) view that mind wandering is resource demanding.1

A Control Failure X Concerns Perspective on Mind Wandering and Executive Control

> The developmental continuity of fantasy and early play together with the diurnal continuity of fantasy and dreams suggests that they all form phases of a common continuous stream of activity, a kind of baseline activity to which organisms return when not engaged in scanning or acting upon their environment. The particular structural characteristics of this baseline activity are determined by the physiological and developmental context in which it occurs. (Klinger, 197 1, pp.347–348)

Does mind wandering require executive resources? Smallwood and Schooler (2006) claimed that it does: "If the primary task requires the individual to maintain and coordinate task-relevant information in awareness, then few resources will be available to coordinate a mind-wandering episode" (p. 949). In contrast, we conceive of mind wandering as resulting from a failure of executive control over automatically (and continuously) cued thoughts, rather than as consuming executive resources. The two perspectives seem similar, and indeed they might account for the majority of relevant empirical data equally well. However, our view accounts for several empirical findings that the Smallwood–Schooler view does not, including experimental effects of fatigue and alcohol on mind wandering and many individual-differences findings. Below we outline our Control Failure X Concerns perspective on mind wandering and then reexamine evidence for a resource-demanding view (Smallwood & Schooler, 2006) according to our perspective.

Executive Control, Interference, and Goal Maintenance

Mind wandering occurs during attention-demanding tasks when control processes are insufficient to deal with the interference created by off-task thoughts. Unlike Smallwood and Schooler (2006), we do not believe that mind wandering draws on the same executive resources or mechanisms as executive control, but rather that mind wandering can be controlled or prevented using the executive-control system and that mind-wandering episodes reflect failures of the control system (potentially due to the unavailability of executive resources for proper thought control). According to our view, mind wandering is prevented when control is proactively initiated and maintained in response to task demands (i.e., when the appropriate level of construal is applied) or when control is reactively initiated to block or suppress TUTs as they are activated in response to cues. These two components of executive control (i.e., proactive and reactive) are dissociable using behavioral measures and in their association with different brain areas, in particular, the dorsolateral prefrontal cortex (PFC) and anterior cingulate cortex (ACC), respectively (e.g., Botvinick, Braver, Barch, Carter, & Cohen, 2001; Braver, Gray, & Burgess, 2007; J. W. Brown & Braver, 2005; Engle & Kane, 2004).

Kane and Engle (2003) distinguished individual differences in goal maintenance (a form of proactive control) from competition resolution (a form of reactive control) in a Stroop task. They found that people who varied in working memory capacity (WMC), which is broadly associated with executive-control capabilities (e.g., Engle & Kane, 2004), differed in their ability to (a) proactively maintain accessibility of the task goal (color naming) throughout the task and (b) reactively resolve the competition evoked, in the moment, from incongruent color–word stimuli. In a Stroop task consisting of mostly congruent trials (i.e., most words presented in matching colors such as *RED* in red), low-WMC subjects committed more errors on rare incongruent trials (e.g., *BLUE* in red) and showed greater reaction time facilitation on congruent trials. This pattern suggests that low-WMC subjects frequently reverted to the habit of reading words rather than naming their colors (i.e., inadequately maintaining access to the task goal). Moreover, low-WMC subjects were slower to respond than high-WMC subjects even in contexts that better reinforced the task goals and even when low-WMC subjects responded correctly on incongruent trials; low-WMC subjects appeared deficient in reactively resolving color–word conflict, even when the task goal was accessible enough to prevent overt errors.

The proactive and reactive components of executive control are associated with PFC and ACC, respectively, based on sustained neural activity in response to initial task demands (proactive initiation) and on more punctuated activity in response to immediate conflict within the task (reactive initiation; Botvinick et al., 2001; Braver et al., 2007). Although PFC and ACC most clearly contribute to the control of behavior (i.e., to task performance), these regions may also help control thought. Mitchell et al. (2007), for example, examined the effects of proactive and reactive control in thought regulation, specifically in attempting to not think about a white bear. Subjects showed a proactive, sustained increase in PFC activity as they tried to suppress the thought, and they showed more transient, tonic ACC activity in reaction to actually thinking about a white bear. These findings should also generalize to situations in which subjects attempt to constrain their thoughts to specific goals concerning the current task (i.e., to maintain a concrete level of construal) instead of suppressing a particular thought, especially when that task is novel or difficult. That is, PFC activity should reflect proactive attempts to maintain a de-sired train of thought, whereas ACC activity should mark occasions on which proactive control failed and interference arose from a competing thought stream (see, e.g., MacDonald, Cohen, Stenger, & Carter, 2000).

Reexamining the Evidence From Smallwood and Schooler (2006)

The evidence cited by Smallwood and Schooler (2006) regarding their claim that mind wandering requires executive resources can be reinterpreted in light of our view that mind wandering represents a failure of executive control. For example, we argue that the decrease in mind wandering that accompanies increases in task demands (e.g., stimulus presentation rate or memory load) reflects the initiation of controlled processing to block interfering, off-task thoughts, instead of a division of executive resources between behavior and thought. That is, some tasks do not require much executive control or they may no longer require it after significant practice. Therefore, the content of conscious thought does not need to be regulated or constrained to the specific task goals and an abstract level of construal is allowed. In contrast, both mind wandering and distraction-based performance errors during difficult tasks can be attributed to the failure to proactively maintain mental access to the necessary task goals in the face of interference. For example, Teasdale et al. (1995) found that performance deficits in random-number generation accompanied mind wandering. This finding may indicate momentary disruptions of the control system rather than a consistent division of resources between mind wandering and generating numbers.

We thus suggest, more generally, that the inverse relation between task demands and mind wandering may result from the proactive initiation of executive control in response to task demands. A difficult or novel task initiates a greater degree of controlled processing (and a more concrete level of construal; Watkins, 2008) than does an easy or practiced task. Executive-control processes, then, are elicited that defend against interfering, off-task thoughts.

Although our alternate proposal regarding load and practice effects may explain the task-demand and practice findings no better than does the Smallwood and Schooler (2006) view, we claim that it provides a better account of other findings. The experimental, nonidiographic findings that are most difficult to reconcile with the Smallwood and Schooler (2006) view are that TUTs increase with fatigue (e.g., Antrobus, Coleman, & Singer, 1967; Antrobus et al., 1966; McVay & Kane, 2009; Smallwood et al., 2004; Smallwood, Heim, Riby, & Davies, 2005; Teasdale et al., 1995) and with alcohol consumption (Finnigan, Schulze, & Smallwood, 2007; Sayette, Reichle, & Schooler, 2009). If executive resources are depleted via demanding tasks or alcohol (e.g., Muraven & Baumeister, 2000; Steele & Josephs, 1988), and if mind wandering requires such resources, then TUTs should diminish with sufficient fatigue or inebriation. If, however, as we argue, mind wandering results from control-system failures, then more failures—and more mind wandering—should occur as executive control becomes fatigued or impaired by alcohol.

Individual Differences in Mind Wandering and Executive Control

Individual differences in executive capabilities, or in initiating proactive or reactive control processes in the face of interference, should—and do—predict the propensity to mind wander across contexts. We suggest that recent work examining variation in WMC and mind wandering conflicts with Smallwood and Schooler's (2006) claim that mind wandering consumes executive re-sources. If TUTs demanded these resources, then individuals with more resources at their disposal (e.g., high-WMC individuals) should mind wander more often than do those with fewer resources. That is, high-WMC individuals compared to low-WMC individuals are likely to have resources beyond those that are needed for task completion; they should thus have the propensity to mind wander more. However, consistent with the elaborated control theory (Watkins, 2008), we have found the opposite pattern. People with high WMC, who show superior executive control across many tasks (Engle & Kane, 2004), report less frequent mind wandering during attention-demanding activities than do low-WMC individuals, both in and out of the laboratory (Kane et al., 2007; McVay & Kane, 2009). Furthermore, a second idiographic prediction follows from Smallwood and Schooler's view of mind wandering. When high-WMC subjects mind wander, their task performance should be less affected than that of low-WMC subjects, because high-WMC subjects will have the resources to split resources between off-task thoughts and performance. However, we reexamined data from McVay and Kane (2009) and found that WMC does not affect the relation between mind wandering and performance: Subjects were less accurate on trials in which they reported off-task thoughts, irrespective of WMC.

Individual differences in psychopathological symptoms, which often covary with executive capabilities, also appear to affect the maintenance of on-task thoughts amid interference from off-task thoughts. As one might expect, research demonstrates an empirical connection between mind wandering and attention-deficit/ hyperactivity disorder (ADHD), a condition associated with inattentiveness and with deficits on many executive-function tasks (e.g., Barkley, 1997; Karatekin, 2004; Shallice et al., 2002). Shaw and Giambra (1993) administered a vigilance task to a group of adults who had been diagnosed with ADHD in childhood and to a group of healthy controls. Subjects with ADHD reported a higher frequency of TUTs during the vigilance task (*M*s = 83% and 67%, respectively), inconsistent with a resource-demanding view of mind wandering. Intrusive thoughts and rumination are also part of the diagnostic criteria for several mood disorders, including depression. Smallwood, O'Connor, and Heim (2006) demonstrated a strong, positive relation between dysphoria (i.e., subclinical depression) and TUT rates ($r = .61$) during a word-fragment-completion task. Thus, mild depression was associated with in-creased ruminative thought. According to Smallwood and Schooler (2006), high rates of mind wandering should be associated with high capacity, but there is no theoretical reason for depression or ADHD to increase executive resources. Rather, these psychopathologies are thought to be associated with failures of executive control.

As far as we are aware, the only idiographic finding that may pose difficulty for our view of mind wandering is that older adults report less mind wandering than do younger adults, both via retrospective questionnaires (e.g., Giambra, 1977–1978, 1979– 1980) and via in-the-moment thought reports during ongoing tasks (Giambra, 1989, 1993). These findings are surprising from the perspective that older adults exhibit considerable executive-control deficits relative to young adults (for review, see Braver & West, 2008). They also seem contrary to our claim that subjects who exhibit executive-control deficits should also show high mind-wandering rates. We suggest an alternative explanation, however, based on the logic of current concerns theory (Klinger, 1971, 1999, 2009). That is, mind wandering is determined by two factors: executive-control capabilities and the extent to which interfering thoughts are cued and automatically generated in the moment. Consider an analogy with Stroop task performance. Color naming is faster and more accurate when the color carrier is a neutral letter string (e.g., *XXXX* in red) than when it is a conflicting color word (e.g., *BLUE* in red); it may also be easier to sustain attention to an activity when there are relatively few interfering, off-task thoughts triggered by the task environment.

According to this Control Failure X Concerns view, predictions about individual differences in mind wandering must consider people's control capabilities, the number and significance of their current life concerns, and the likelihood that the prevailing context will prime those concerns (Klinger, 197 1). Antrobus and colleagues (1966) made a similar point empirically by presenting personally relevant information to subjects directly before assessing their TUTs during a vigilance task. Half the young-adult subjects heard a contrived (but realistic) radio broadcast about an escalation of the Vietnam War while they waited to participate in the experiment. Not surprisingly, these subjects subsequently reported more TUTs than did control subjects during the vigilance task. According to our view, the increase in mind wandering occurred because the news increased subjects' baseline thought production by triggering attempts to assimilate the new information (information in the radio broadcast) with their life goals. Similar findings have been reported by Horowitz and colleagues (e.g., Horowitz & Becker, 197 1; Horowitz, Becker, & Moskowitz, 197 1), who experimentally increased subjects' TUT rates by showing them an unpleasant, stressful film beforehand, and by Klos and Singer (1981), who manipulated their young-adult subjects' thoughts by having them first simulate a coercive or a collaborative interaction with one of their parents.

Returning to mind wandering in adult aging, then, we may reinterpret age differences in TUTs. Older adults may generate fewer interfering thoughts than do younger adults because they have fewer goals and a different goal hierarchy (e.g., more relationship-oriented goals; Carstensen, 1993, 1995). Indeed, Parks, Klinger, and Perlmutter (1988 – 89) found that older adults endorsed fewer current concerns than did younger adults. This suggests that typical older subjects arrive at the laboratory with fewer life concerns to potentially interfere with their task-relevant thoughts. Moreover, older adults may be less likely than younger adults to have any concern-related TUTs triggered by the laboratory context, even if the groups have the same number and urgency of concerns: The environment of most laboratories (e.g., computers, young research assistants, university buildings) simply presents more salient cues to the concerns of younger than older adults (see Klinger, 1999).

Finally, a separate category of thought needs further attention in cognitive-aging work: task-related interference (TRI; Smallwood et al., 2006), the interference that can arise when people's thoughts turn to evaluating their task performance. These thoughts may be task-related, in a sense, but they are often detrimental to performance (see Beilock, 2008; Sarason, Pierce, & Sarason, 1996). Watkins (2008) used the example of a basketball player who attempts to sink a free throw. A novice is more likely to make the shot if he or she focuses on the mechanics of shooting, rather than focusing on the consequences of missing (e.g., losing the game). This latter type of thought reflects a poorly modulated level of construal, in that interfering thoughts are task related but do not aid performance as would a more concrete construal. We suspect that older adults often experience excessive thoughts about their lab-task performance and about how they may compare to younger adults as a consequence of fears and biases associated with cognitive aging (i.e., stereotype threat; Hess, Auman, Colcombe, & Rahhal, 2003). Giambra's (1989, 1993) laboratory studies of the relation between aging and TUTs did not consider task-related interference when probing older adults' thoughts, but such thoughts might be construed by subjects as task related. Thus, the old adults may have classified these intrusions as on task, artificially lowering their self-reported TUT rates. Further research should therefore explore the interplay among executive-control processes, the cuing of current concerns, and task-related interference in both younger and older adults.

The Default Network: Generating Competition to On-Task Thoughts

We have argued that individual and contextual variation in mind wandering is affected by executive-control capabilities and by the extent to which individuals and contexts will generate potentially interfering thoughts about current concerns (Klinger, 1971, 2009). Consistent with this argument, neuroimaging studies have identified several regions of the brain, labeled the *default network*, that may represent ongoing mental processes independent of the cur-rent task set (e.g., Buckner, Andrews-Hanna, & Schacter, 2008; Raichle et al., 2001). These brain areas show heightened activity during rest, or ostensibly taskless, periods and substantial task-induced deactivation (i.e., activity reduction that occurs at the onset of cognitive tasks). We suggest that the basic function of the default network is to continuously evaluate life goals and discrepancies and that it automatically generates the content of mind-wandering episodes (see also Klinger, 2009). Our claim, that the contents of mind-wandering episodes are generated as the default (automatically and inversely related to executive-control areas of the brain), contradicts the executive-resource-demanding view of mind wandering (Smallwood & Schooler, 2006).

Buckner and Carroll (2007) proposed that the default network is responsible for self-projection—mentally transporting oneself into alternate times, locations, or perspectives—as manifested in episodic memory, navigation, prospection (i.e., anticipating future events), and theory of mind (taking another's perspective). We note that self-projection is also a core concept in Singer's (1968; Singer & Singer, 2006) seminal theory of daydreaming. Specifically, as the developmental descendent of imaginative play, day-dreaming allows self-projection into alternative pasts and futures (see also Klinger, 1971). Bar (2007; Bar, Aminoff, Mason, & Fenske, 2007) had similarly attributed self-projection to the default network, but he also described the processes by which self-projection occurs and suggests a reason for their representing a default mode of activity. Default-mode processes run continuously in response to external and internal cues. Incoming information activates associations (semantic and episodic representations) generated from past experiences. These associations are updated by new information (memory integration or consolidation) and are used to generate predictions about future events. When incoming information is incongruent with activated associations, default-network processes generate analogies that can be used to make new predictions. Thus, the predictions continuously generated by the default network guide people's thoughts, behaviors, and perceptions.

The self-projection function of the default network and its outcomes (i.e., associations, analogies, and predictions) help explain the continuous, and sometimes interfering, nature of default processing. If the ultimate goal of human cognition is to under-stand and adapt to changing environments, then our default function should assimilate incoming information and predict the future in relation to our pressing goals. This proposal is clearly consistent with Klinger's (1971, 1999, 2009) theory that cues in the environment activate thoughts about our current concerns. Our active, most accessible goals are both primed and modified by new information and they help generate associations, analogies, and predictions.

The default network has also been implicated directly in mind wandering (McGuire, Paulesu, Frackowiak, & Frith, 1996; McKiernan et al., 2006), in that the default network is especially active when subjects report TUTs. For example, Mason et al. (2007) found that task-induced deactivations in several default-network regions correlated significantly (*r*s > .50) with subjects' general retrospective reports of mind-wandering propensity (i.e., frequent mind wanderers showed less default-mode deactivation than infrequent mind wanderers). Mason et al. suggested that mind wandering reflects periodic thought intrusion via the default net-work. According to our view, thoughts from abstract levels of construal will intrude when executive systems fail to maintain proactive control. Mind wandering thus represents a return to a default state of mind (Klinger, 1971, 2009), whereby thoughts are generated automatically and without constraint. This claim is in conflict with Smallwood and Schooler's (2006) view that mind wandering requires resources.3

Neuroimaging evidence for our view that the executive-control system exerts influence over the generation of TUTs (i.e., over the default network) comes from Weissman, Roberts, Visscher, and Woldorff (2006). They found trial-by-trial trade-offs between control areas of the brain and the default network. Reductions in attention-control-area activity (e.g., in dorsolateral PFC) reliably predicted lapses of attention (i.e., very long reaction times) in a local–global selective attention task. Moreover, the default network showed heightened activity during these attention-lapse trials (for similar results from other attention tasks, see Eichele et al., 2008; Li, Yan, Bergquist, & Sinha, 2007). These results, together with research showing that executive and default networks are anticorrelated (see Buckner et al., 2008), are consistent with our view that executive control limits the entrance of TUTs into consciousness by implementing the proper level of construal (Watkins, 2008). Moreover, communication between the executive-control areas of the brain and the default network should vary with individual differences in mind-wandering propensity. As we already noted, people with ADHD mind wander more often than do controls (Shaw & Giambra, 1993), and a recent study revealed abnormalities in the functional connectivity of circuits connecting the default and executive control networks in a sample of individuals with ADHD (Castellanos et al., 2008). Indeed, Castellanos et al. (2008) argued that the increased incidence of mind wandering in people with ADHD is due to insufficient neural communication between the executive-control and default net-works.

Although considerable evidence supports the claim that default and executive-control networks oppose one another (see also Fox et al., 2005; Greicius, Krasnow, Reiss, & Menon, 2003), a recent study by Christoff et al. (2009) reported evidence that is inconsistent with this claim. They conducted an fMRI study in which subjects were scanned as they completed a primary task (a go/ no-go task) and responded to thought probes. Each time subjects reported having an off-task thought they were asked to rate their awareness of it. Christoff et al. found that executive-control regions, including PFC and ACC, were especially activated preceding trials on which subjects reported TUTs. Moreover, PFC and ACC activity was stronger during mind wandering without awareness than with awareness.

These data appear to indicate that mind wandering requires executive resources (Smallwood & Schooler, 2006), but we favor another interpretation. Christoff et al. (2099) acknowledged that executive-control activity during TUTs may reflect conflict detection (ACC) or the subsequent initiation of control processes (PFC) to refocus attention. They argued against this possibility, however. If executive-control networks were involved in the return to task-oriented thought, then they should have been more active during mind wandering with awareness than without. This is a sensible argument, but we counter it with the following: (a) When subjects are unaware of their mind wandering, they may require even more control activity to bring their thoughts back on track, leading to an increase in PFC and ACC activity during TUTs without awareness; (b) unconscious monitoring processes may be responsible for tracking and redirecting one's thoughts, as argued by Wegner (1994) and Schooler (2002); thus, awareness of mind wandering may be unnecessary for triggering executive control. We suggest that an important test of the Christoff et al. and Smallwood and Schooler (2006) claim will be to compare executive-control-network activity during unconstrained thought (i.e., rest) and during off-task mind wandering in the same group of subjects. If generating and maintaining mind-wandering episodes requires executive resources, then those resources should be used regardless of whether there is a competing primary task: Executive-control structures should be especially, and similarly, active during restful thought and during TUTs. If, however, executive-control areas are only active in service of redirecting thoughts back toward the task, they should be active only during TUTs and not during unconstrained thought or rest.

Are Default-Network (and Mind-Wandering) Processes Resource Free?

We recognize that some functions attributed to the default network (e.g., Bar, 2007; Buckner & Carroll, 2007; Buckner et al., 2008) seem complex and potentially resource demanding. On the one hand, we argue that mind wandering taps into an ongoing and automatically generated stream of thought originating in the de-fault network. On the other hand, we attribute complex functions to the same neural system. This discrepancy is more apparent than real. We do not claim that all default-network activity reflects mind wandering. Rather, default-mode functions may sometimes be brought under conscious control and directed in a top-down manner. We posit, however, that bottom-up, environmentally cued processes of the default network continue without conscious direction, automatically generating thoughts that sometimes enter awareness as mind-wandering episodes. Evidence for this type of automatic processing comes from other, seemingly complex, cognitive phenomena, such as autobiographical memory retrieval.

Involuntary autobiographical memories are representations from personal experience that enter awareness in the absence of any attempt at conscious retrieval and without any obvious relation to ongoing activities. Thus, many of these memories can be classified as TUTs. With some care, the retrieval of autobiographical memories can often be traced to environmental cues (Ball & Little, 2006), just as many mind-wandering episodes can (e.g., Klinger, 1999). Of importance to our theoretical perspective, these involuntary memories are retrieved through an automatic and effortless direct retrieval process (Conway & Pleydall-Pierce, 2000), also known as ecphoric retrieval (Moscovitch, 1994). Ecphoric retrieval occurs as a rapid and obligatory interaction between cue and memory, such that no controlled or strategic search process is initiated. Relevant behavioral evidence comes from subjective reports of the retrieval process and from evidence that retrieval time occurs in less than 2 s after cuing (controlled searches of autobiographical memory generally take 2–5 s; Berntsen & Hall, 2004; Haque & Conway, 2001; Mace, 2006). Evidence from neuroscience further indicates two dissociable pathways that are involved in accessing autobiographical memories: a top-down search process initiated in left frontal cortex and a bottom-up spread of activation from medial temporal cortex (Miyashita, 2004). The bottom-up spread of activation is consistent with our claim that mind-wandering content is automatically and continuously generated.

Involuntary, automatic memory retrieval is not unique to auto-biographical representations of the past. Semantic memories for facts and song lyrics (Kvavilashvili & Mandler, 2004), as well as rehearsals of prospective memories (Kvavilashvili & Fisher, 2007), also pop into mind without conscious, directed retrieval (see also the resolution of tip-of-the tongue states; A. S. Brown, 1991). These examples of automatic retrieval may reflect periodic conscious intrusions from a continuous process of goal evaluation that otherwise occurs outside of awareness. When these intrusions reach awareness, people experience them as mind wandering.

Conclusions

We have introduced a new perspective on the role of executive control on mind wandering by integrating the empirical evidence presented by Smallwood and Schooler (2006) with the theoretical perspectives offered by Watkins (2008) in his elaborated control theory and by Klinger (1971, 1999, 2009) in his current concerns theory. We argue that mind wandering represents, in part, a failure of executive control, rather than a drain on executive resources. The occurrence of mind wandering is dually determined by the presence and urgency of automatically generated, personal-goal-related thoughts (from the default-mode brain network) in response to cues in the external and internal environment, as well as the ability—or inability—of the executive-control system to de-fend primary-task performance against interference from these thoughts.

Notes:

1 We accept the possibility, however, that after the initial hijacking of attention, an individual may choose to exert control over the new train of thought, thereby reestablishing the primary task at the time and potentially using resources to continue it. An individual’s primary goal is not necessarily defined by the experimenter in a laboratory; she may choose to intentionally think about other things (see the tune-out vs. zone-out distinction in Smallwood & Schooler, 2006).

2 In a reanalysis of data from McVay and Kane (2009), we found that, like TUTs, instances of TRI predicted in-the-moment errors. Accuracy rates on rare no-go trials in a go/no-go task were lower following TRI than following on-task thoughts (Ms = .66 and .45 for on-task and TRI, respectively), $t(233) = 11.69$.

3 Returning briefly to our discussion of older adults and mind wandering, Damoiseaux et al. (2008) reported a paucity of activity in the default network during periods of rest (when there is no specific task) in older adults compared to younger adults. This finding is consistent with our claim that older adults may be generating fewer off-task thoughts to compete with on-task thinking in the laboratory, resulting in their overall lower rates of mind wandering versus younger adults.

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