



Similarities and differences between mind-wandering and external distraction: A latent variable analysis of lapses of attention and their relation to cognitive abilities



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ABSTRACT

The current study examined the extent to which task-unrelated thoughts represent both vulnerability to mind-wandering and susceptibility to external distraction from an individual difference perspective. Participants performed multiple measures of attention control, working memory capacity, and fluid intelligence. Task-unrelated thoughts were assessed using thought probes during the attention control tasks. Using latent variable techniques, the results suggested that mind-wandering and external distraction reflect distinct, yet correlated constructs, both of which are related to working memory capacity and fluid intelligence. Furthermore, the results suggest that the common variance shared by mind-wandering, external distraction, and attention control is what primarily accounts for their relation with working memory capacity and fluid intelligence. These results support the notion that lapses of attention are strongly related to cognitive abilities.

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1. Introduction

One hallmark of our cognitive system is our ability to focus attention on goal-related information and to maintain and sustain attention on goal-relevant information among potent distractors. This ability to focus attention is needed in a host of activities where any lapses of attention could result in unwanted outcomes such as driving accidents, lower academic performance, failures to spot weapons during baggage screening, and many others (e.g., Reason, 1990; Reason & Mycielska, 1982; Unsworth, Brewer, & Spillers, 2012; Unsworth, McMillan, Brewer, & Spillers, 2012). Understanding lapses of attention, whereby attention has shifted away from goal-relevant information due to external (distractions) or internal stimuli (mind-wandering) is important for understanding the attentional system more broadly and for predicting when and for whom attention failures are most likely. The current study examined the extent to which mind-wandering and external distraction are the same or different constructs and the extent to which they are related to other cognitive abilities such as attention control, working memory capacity, and fluid intelligence.

1.1. Task-unrelated-thoughts

A great deal of research has recently examined the extent to which we can maintain attentional focus on a task or whether our attention drifts to task-unrelated-thoughts. Task-unrelated-thoughts (TUTs) refer to situations in which attention has shifted from the current task to thoughts unrelated to the current task. For example, mind-wandering refers to a situation in which attention has shifted away from what a person is doing to self-generated thoughts unrelated to the task being performed. A number of laboratory techniques have been developed to examine TUTs including thought probe techniques in which periodically throughout a task participants are probed as to their current state (on-task or off-task) and this is examined as a function of various experimental manipulations and individual differences correlates (see Smallwood & Schooler, 2006 for a review). This research has found that TUTs vary as a function of task variables such as time on task, task complexity, and task difficulty (McVay & Kane, 2010; Smallwood & Schooler, 2006). Importantly, TUT rates correlate with task performance such that performance is lower when participants report TUTs on the preceding trial compared to when participants report that they are currently focused on the task (McVay & Kane, 2010; Smallwood & Schooler, 2006). In terms of individual differences, a number of recent studies have demonstrated that variation in TUTs is related to a number of cognitive variables including working memory capacity, attention

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control, reading comprehension, and fluid intelligence such that high performing participants typically report fewer TUTs than low performing participants in particularly attention demanding tasks (Kane et al., 2007; McVay & Kane, 2012b; Mrazek et al., 2012; Unsworth & McMillan, *in press*; see Mooneyham & Schooler, 2013 for a review). This work suggests that the probe techniques for examining TUTs have been shown to be both reliable and valid and have demonstrated the importance of examining TUTs during a number of tasks and situations.

1.2. Distinguishing mind-wandering and external distraction

Although the work reviewed above suggests the importance of TUTs to a number of domains, more work is needed to better understand the nature of TUTs. Typically, TUTs are associated with mind-wandering, in which attention is shifted from the current task to internal thoughts unrelated to the task at hand (Smallwood & Schooler, 2006). Indeed, in most of the studies reviewed previously, when referring to TUTs, the authors of those studies are primarily only talking about mind-wandering. However, given the way in which TUTs are typically assessed it is not possible to distinguish TUTs that are due to mind-wandering exclusively versus TUTs that are due to distractions from external stimuli. That is, prior work has typically relied on thought probe techniques where participants indicate that they were just on-task or off-task.¹ It is possible that when participants indicate that they are off-task that some of the time they are referring to the fact that they were mind-wandering, whereas other times they may be referring to the fact that they were distracted from external stimuli (such as the experimenter walking around). In order to better examine possible differences between mind-wandering and external distraction Stawarczyk, Majerus, Maj, Van der Linden, and D'Argembeau (2011; see also Stawarczyk, Majerus, Maquet, & D'Argembeau, 2011) introduced a novel experience sampling method to distinguish the different varieties of TUTs. Specifically, Stawarczyk et al. used a thought probe technique in which participants were not simply instructed to indicate if they were on- or off-task, but rather participants had to indicate if they were on-task, if they were experiencing task-related interference (interfering thoughts related to the appraisal of the current task such as worry about performance), if they were distracted by external stimuli, or if they were mind-wandering. Thus, with this technique it is possible to examine the extent to which mind-wandering and external distraction similarly result in poorer task performance. Implementing this technique in the sustained attention to response task (SART; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) Stawarczyk, Majerus, Maj, et al. (2011) found that roughly 20% of the responses to the thought probes were external distractions and roughly 21% were mind-wandering. Additionally, when participants reported that they experienced either external distraction or mind-wandering performance was worse than when participants reported that they were focused on the task. Furthermore, examining individual differences Stawarczyk et al. found that individuals with high levels of either external distraction or mind-wandering tended to demonstrate worse performance than participants who reported fewer external distraction or mind-wandering. Therefore TUTs likely represent a combination of external distraction and mind-wandering, both of which are related to performance. These results point to the importance of distinguishing mind-

wandering and external distraction in order to better understand the broad nature of TUTs in terms of similarities and differences between mind-wandering and external distraction.

Current theorizing has, for the most part, suggested that mind-wandering is distinct from external distraction and is not simply another form of a lapse of attention (Barron, Riby, Greer, & Smallwood, 2011; Schooler et al., 2011; Smallwood, 2013). In particular, Smallwood and colleagues have suggested that mind-wandering is a state where attention is shifted from external events to internal thoughts and is thus, decoupled from perceptual inputs (e.g., Barron et al., 2011; Smallwood, 2013). Accordingly, given that mind-wandering reflects a state of attention that is decoupled from external information, this view suggests that mind-wandering and external distraction are distinct. That is, when attention is shifted internally and decoupled from the external environment, individuals are less likely to process external information whether it be task-relevant information or external distractors. Evidence consistent with this claim comes from a study by Barron et al. (2011) in which participants performed a visual oddball task where on some trials a novel distractor stimulus was presented. Following the oddball task participants reported their propensity for mind-wandering via a self-report questionnaire. Barron et al. found that individuals who reported more mind-wandering demonstrated reductions in cortical processing (specifically reductions in the P3a) for target and distractor stimuli. Barron et al. suggested that these results provide evidence for the idea that mind-wandering is a state in which attention is decoupled from the external environment and that mind-wandering is not simply a state of distraction (see also Smilek, Carriere, & Cheyne (2010) who demonstrated that instances of mind-wandering are associated with increased blinking). Because Barron et al. found that participants who reported the most mind-wandering demonstrated the smallest cortical responses to the distractor stimuli, they suggested that mind-wandering and external distraction do not reflect common processes. However, one issue with this study is that the distractor stimuli were actually task-relevant distractors in that the distractor stimuli were of the same shape and appeared in the same visual location as target stimuli, and in order to distinguish target from distractor, some minimal amount of processing would be needed. Clearly, these task-relevant distractors are very different from other external distractors (such as the fire alarm going off during an experiment) which are not relevant to the task at hand. Thus, it is unclear whether mind-wandering and external distraction from task-unrelated information are distinct.

An alternative view is that mind-wandering and external distraction both reflect failures of attention control and thus, both reflect general lapses of attention (Kane & McVay, 2012; McVay & Kane, 2010; Unsworth, Redick, Lakey, & Young, 2010). According to these views attention control is needed to maintain task goals in a readily accessible state in working memory to bias responding for correct behaviors. Any lapse of attention due to internal (e.g., mind-wandering) or external stimuli (e.g., loud noises) will cause the task goal to be temporarily lost from working memory potentially resulting in goal neglect in which prepotent response tendencies will guide behavior. Therefore, according to attention control views, TUTs should be related to performance on a number of attentional control tasks, which is exactly the case (McVay & Kane, 2009, 2012b). Furthermore, according to attention control views, mind-wandering and external distraction should be positively correlated such that individuals who experience more mind-wandering should also experience more external distraction in situations where attention control is needed to maintain task goals. Evidence consistent with this position comes from a recent diary study in which participants performed a number of working memory capacity and attention control tasks in the lab and were required to carry a diary for week listing their various everyday attentional failures (as well as other failures; Unsworth, Brewer, et al., 2012). It was found that the majority of attentional failures were due to external distraction or mind-wandering. Importantly, it was found that everyday mind-

¹ Not all studies simply have participants report whether they are on- or off-task, but also have them report the contents of their thoughts. For example, some studies have had participants report what they had been thinking prior to the probe (e.g., Baird, Smallwood, & Schooler, 2011) whereas other studies have had participants respond based on different categories of thoughts (e.g., thinking about the past or the future; McVay & Kane, 2012b; Unsworth & McMillan, 2013). Given that participants are specifically reporting the contents of their thoughts in terms of mind-wandering, these approaches do not confound mind-wandering and external distraction.

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