Mind-Wandering With and Without Intention

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Abstract

The past decade has seen a surge of research examining mind-wandering, but most of this research has not considered the potential importance of distinguishing between intentional and unintentional mind-wandering. However, a recent series of papers has demonstrated that mind-wandering reported in empirical investigations frequently occurs with and without intention, and more critically, that intentional and unintentional mind-wandering are dissociable. This emerging literature suggests that to increase clarity in the literature, there is a need to reconsider the bulk of the mind-wandering literature with an eye toward deconvolving these two different cognitive experiences. In this review, we highlight recent trends in investigations of the intentionality of mind-wandering and outline a novel theoretical framework regarding the mechanisms underlying intentional and unintentional mind-wandering.

Keywords

The Intentionality of Mind-Wandering

Research on mind-wandering has seen a massive increase in recent years, spreading to a wide variety of psychological domains including those examining cognition [1–10], neuroscience [11–16], education [17–20], creativity [21,22], clinical populations [23–26], and workplace functioning [27], to name a few. The rapidly growing body of research on mind-wandering was largely stimulated by Smallwood and Schooler's [28] integrative review of related concepts such as 'task-unrelated imagery and thoughts (TUITs)' [29] and 'stimulus-independent thought' [30]. Although the unification of these related concepts under the single term 'mind-wandering' has proven to be exceptionally useful in stimulating research, the field has now advanced to a point where it is necessary to make finer distinctions and to consider different types of mind-wandering [31]. One such distinction, originally advanced prior to the recent surge of research focused on "mind-wandering," is

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that between intentional task-unrelated thought and unintentional task-unrelated thought [32] (see Box 1). Although this distinction has been largely ignored since its inception, an emerging area of research focused on the intentionality of mind-wandering has clearly demonstrated the practical and theoretical utility of making this distinction. In this review, we discuss this recent trend, and make the case that the distinction between intentional and unintentional mind-wandering is becoming, and ought to continue to be, a prominent focus in research on mind-wandering.

Box 1

Differences between Unintentional and Intentional Mind-Wandering

An early distinction between unintentional and intentional task-unrelated imagery and thoughts (TUITs) was advanced over 20 years ago by Giambra and colleagues [29,32,39]. Giambra [29] noted "TUITs may occupy awareness because they capture our attention – an uncontrolled shift – or because we have deliberately shifted our attention to them – a controlled shift" (p. 2). He also identified several ways in which these two types of attentional shifts differ. According to Giambra [29]:

> "Voluntary shifts of attention to TUITs would seem to involve higher orders of control in information processing or be motivationally determined and to be benign because of their controlled nature. However, involuntary shifts of attention from the task at hand to TUITs would seem to involve lower orders of control in information processing and not [be] motivationally determined; in addition, involuntary shifts may be less benign because they are uncontrolled" (p. 2).

To these differences between intentional and unintentional TUITs (or mind-wandering), we could also add possible differences in subjective experiences. Unintentional episodes of mind-wandering lack a distinct moment of conscious initiation, and during these episodes, participants are likely not meta-cognitively aware that they are mind-wandering. Consequently, once the episode is detected, the participant might experience surprise, vexation, and the feeling of a lack of control. In contrast, intentional episodes of mind-wandering are associated with a conscious moment of intention to initiate (or to continue) a mind-wandering episode. Moreover, intentional mind-wandering likely includes metacognitive awareness of its occurrence (at least at some point during the episode) and is therefore unlikely to be associated with surprise at or vexation, or the feeling of a lack of control.

Interestingly, although unintended, episodes of unintentional mind-wandering are nevertheless experienced as being authored by the individual (in the sense of authorship noted by [80]) and are thus accompanied by a sense of agency. In other words, unintentional mind-wandering is not experienced as being derived from an alien source, but as originating within the individual. In this way, unintended mind-wandering is similar to non-deliberate action. With respect to non-deliberate action, Bayne and Levy [81] note: "Few of our actions derive from processes of conscious deliberation, and there is no reason to think that those actions that are non-deliberative are any less authored than those that are." Nevertheless, an interesting direction for future research is to examine

how people's feeling of authorship (i.e., agency) differs between intentional and unintentional bouts of mind-wandering.

Mind-Wandering Can Occur With or Without Intention

Although mind-wandering was initially defined as off-task thought that occurs either with or without intention [28], some researchers have assumed that the mind-wandering they have examined in their investigations occurred without intention [2,11,33–38]. At face value, this seems to be a reasonable assumption. That is, when participants enter the laboratory, there is a tacit assumption that they will do their best to attend to the assigned tasks. Hence, in cases where participants report the experience of mind-wandering during task completion, it would be reasonable for a researcher to assume that this mind-wandering occurred despite the participants' best intentions to remain focused on the task (i.e., that it occurred unintentionally). Notwithstanding the apparent soundness of this assumption, it has been challenged by recent studies that have validated and extended previous work [32,39] showing that, in the laboratory, people's mind-wandering episodes are frequently engaged with intention [40–44].

The finding that people frequently report intentional mind-wandering was revealed in a series of experiments that examined rates of mind-wandering while participants completed behavioral tasks. To capture moments during which people intentionally and unintentionally mind-wandered, these experiments have relied upon a variant of the commonly used experience-sampling technique, which involves periodically presenting participants with "thought probes" while they complete an ongoing task. Although thought probes traditionally require participants to periodically report whether they are focused on the current task or mind-wandering, to examine the intentionality of mind-wandering episodes, recent studies have required participants to instead report whether they were (1) focused on the task, (2) intentionally mind-wandering, or (3) unintentionally mind-wandering [40,44]. Despite the fact that some researchers have come to assume that laboratory-based mind-wandering reflects unintentionally engaged off-task thought, 34% to 41% of the mind-wandering that participants reported while completing these laboratory tasks has been engaged with intention ([41,45], respectively). Although other studies have found comparatively less intentional mind-wandering in laboratory tasks [40], the fact that, in at least some tasks, a substantial portion of mind-wandering occurs intentionally suggests that participants may not be particularly motivated to complete some psychological tasks, or that they may perceive the tasks to be sufficiently easy that they believe they can afford to mind-wander without hindering performance (see Box 2).

Box 2

Implications of the Finding that People Frequently Intentionally Mind-Wander

That participants frequently intentionally mind-wander is important because it indicates that they may, in some (but not all) situations, have low motivation to perform the kinds of tasks that are frequently used by mind-wandering researchers. This is, however,

somewhat ironic because many researchers have largely been interested in examining unintentional mind-wandering [33–35,82–89], and to this end, they have often presented participants with tedious and boring tasks to elicit unintentional mind-wandering (e.g., sustained-attention and vigilance tasks; [14,67,90–95]). However, given that (1) people's level of motivation tends to be rather low when they experience boredom [96,97], and (2) decreases in motivation levels are associated with increases in intentional mind-wandering [41], it might be that the common employment of boring tasks in the context of research on mind-wandering has inadvertently elicited intentional mind-wandering. The implication, then, is that researchers who are specifically interested in examining unintentional mind-wandering might want to more carefully consider the type of tasks they choose to administer in their investigations.

Although rates of intentional mind-wandering appear to be particularly high in cases where researchers employ relatively boring tasks – as is typically done in research investigating mind-wandering – it appears that intentional mind-wandering also rears its head during other, ostensibly less boring, tasks that might be of interest in other domains of psychological research. For instance, one study [45] showed that participants viewing a video-recorded lecture in the laboratory reported intentional mind-wandering to roughly 10% of thought probes (with similar rates of intentional mind-wandering reported during reading tasks; [51]). Because thought probes provide an estimate of the total amount of time participants spend mind-wandering during laboratory tasks, this finding indicates that participants spent about 10% of their time deliberately disengaging from the task in the service of mind-wandering, or about three of the 30 minutes that it took to complete the task. Thus, beyond having implications for the field of mind-wandering, the finding that people intentionally mind-wander in the laboratory while completing various psychological tasks might be important for the field of psychology as a whole. Indeed, although it is commonly assumed that participants are motivated to be attentive to the psychological tasks they are given, it appears that they spend a considerable amount of time deliberately thinking about things other than the task.

Complementing these state-level findings, research that has investigated rates of mind-wandering at the trait level has revealed a similar pattern of results. Because investigations of mind-wandering at the trait level are concerned with peoples' reports of their everyday experiences of mind-wandering, these studies have often assessed the intentionality of mind-wandering by administering questionnaires that require people to retrospectively report the extent to which they have engaged in intentional and unintentional mind-wandering in their daily lives [23,42,46,47], although some researchers have more directly assessed rates of intentional and unintentional mind-wandering in daily life, while people were engaged in everyday activities ([48–50]; see Box 3). Critically, research administering such questionnaires has reported that people frequently engage in intentional mind-wandering in everyday life, and that these rates actually exceed those of unintentional mind-wandering [42,46,47]. Moreover, recent research has shown positive correlations between state- and trait-level reports of intentional and unintentional mind-wandering [42]: That is, individuals who more frequently report intentional mind-wandering in their everyday lives also more frequently report intentional mind-wandering when probed during behavioural tasks in the

laboratory. Likewise, individuals who more frequently report unintentional mind-wandering in their everyday lives tend to report more unintentional mind-wandering in the laboratory. Importantly, this work has provided evidence for the construct validity and the generalizability of both trait and state indices of mind-wandering.

Box 3

Intentional and Unintentional Mind-wandering in Everyday Life

One study [48] examined people's rates of mind-wandering in everyday life by administering a 'daily-life experience-sampling protocol' that required participants to respond, via a Palm Pilot PDA, to questionnaires pertaining to their cognitive activity as they went about their daily routines. In particular, over the course of a week, between noon and midnight, participants' Palm Pilots would beep to signal them to complete eight questionnaires. Critically, included among the questionnaires was an item pertaining to participants' rates of intentional mind-wandering: "I allowed my thoughts to wander on purpose." This item, presented in any cases where participants indicated that they were mind-wandering, was endorsed with a mean response of 4.06 on scale from 1 to 7 (1 = not at all, 7 = very much), suggesting that in everyday life, intentional mind-wandering is a relatively common event.

In more recent work investigating mind-wandering in everyday life, researchers [49] examined the intentionality of mind-wandering of students enrolled in a large undergraduate course. Students enrolled in the course were queried about their mind-wandering during almost every class across an entire semester. Importantly, at various points throughout the lectures, students were asked to report whether they were "on task," "intentionally mind-wandering," or "unintentionally mind-wandering." Results indicated that participants reported mind-wandering roughly 34% of the time, with slightly more than half of their mind-wandering episodes occurring intentionally (see Figure I). Thus, again, this finding suggests that in everyday life, people frequently experience intentional mind-wandering.
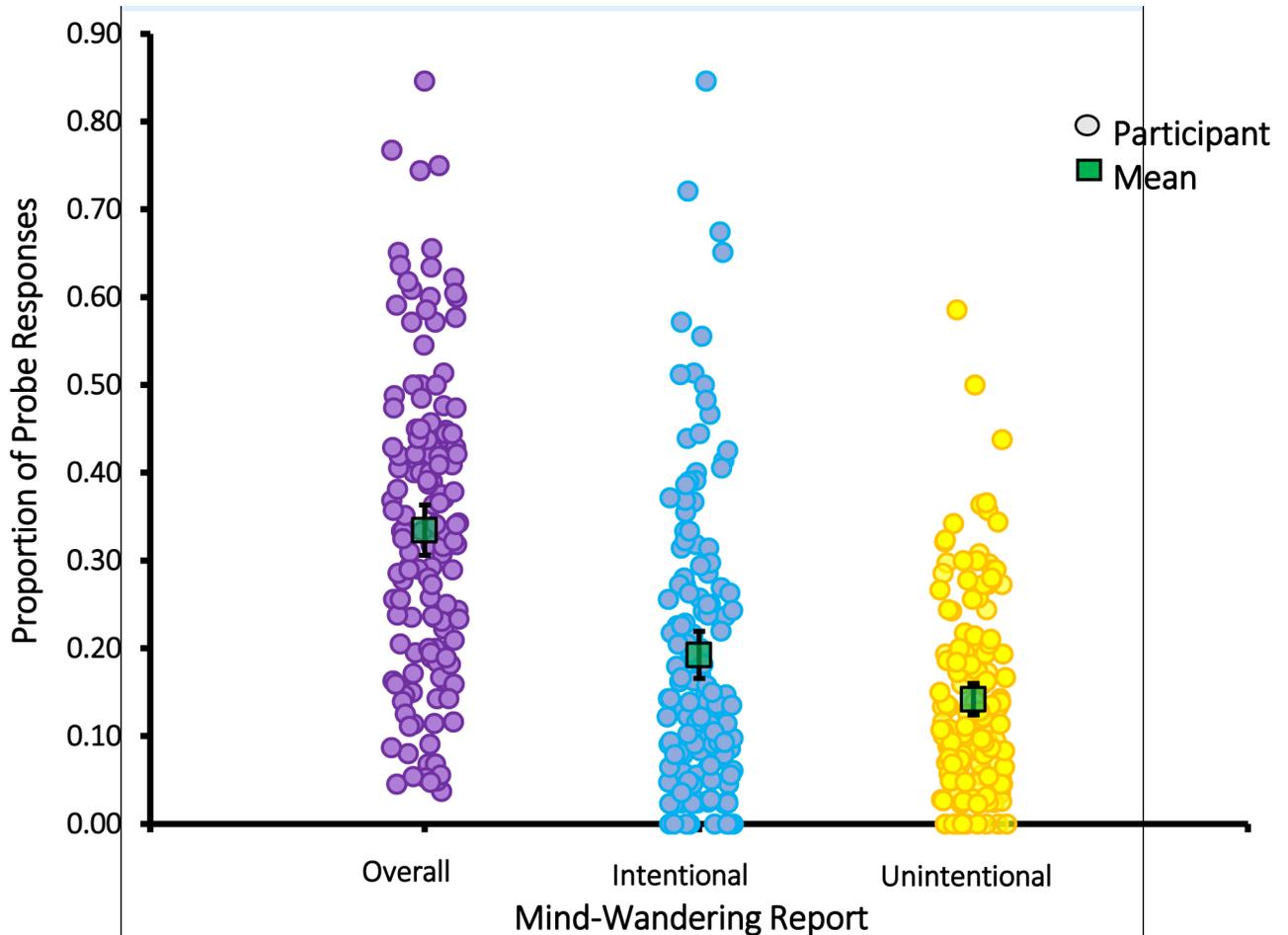
Figure I. Rates of Overall, Intentional, and Unintentional Mind-Wandering in the Classroom across and Entire Semester
Mean proportion of the thought probes to which participants responded that they were engaging in overall (either intentional or unintentional), intentional, or unintentional mind-wandering (squares), as well as individual data points for each student included in the analysis (circles). Error bars reflect 95% confidence intervals. Adapted from [49].

Dissociating Intentional and Unintentional Mind-Wandering

Although the foregoing research has clearly demonstrated that people experience and report intentional and unintentional mind-wandering at both the trait and state levels, it is important to evaluate whether these two types of mind-wandering behave differently. Showing that unintentional and intentional mind-wandering are sometimes dissociable would indicate the importance of distinguishing between the two and present an important challenge for previous research working under the assumption of a unitary (unintentional) view of mind-wandering. Importantly, recent research has shown that these two types of mind-wandering are sometimes (although not always [47]) dissociable in that they are (1) uniquely associated

with certain individual-differences variables [25], and (2) differentially influenced by certain experimental manipulations [44,51].

Individual Differences in Intentional and Unintentional Mind-wandering

Research examining possible dissociations of intentional and unintentional mind-wandering at the individual-differences level has shown that these two types of mind-wandering sometimes independently predict variables of theoretical interest. For example, intentional and unintentional mind-wandering have been found to be differentially associated with attention-deficit/hyperactivity disorder (ADHD; [23]) and obsessive-compulsive disorder (OCD; [25]). In particular, whereas individuals reporting higher rates of unintentional mind-wandering also report more symptoms associated with ADHD and OCD, research has failed to observe a relation between rates of intentional mind-wandering and ADHD/OCD symptomatology. In addition, it has been shown that people's level of motivation to perform well on a given task is negatively associated with rates of intentional mind-wandering during that task, whereas the link between motivation and unintentional mind-wandering appears to be less robust [41,45].

Collectively, this research has demonstrated that there are cases in which individual-differences variables are more strongly associated with unintentional than intentional mind-wandering (e.g., ADHD and OCD), and conversely, cases in which such variables show the exact opposite pattern of results (e.g., motivation). Moreover, there has been at least one demonstration of a situation in which an individual-differences variable shared opposing unique associations with intentional and unintentional mind-wandering. Specifically, whereas rates of intentional mind-wandering uniquely positively predict people's tendency to be non-reactive to their inner experiences (an aspect of mindfulness), rates of unintentional mind-wandering uniquely negatively predict this same factor [47]. Taken together, these dissociations indicate that intentional and unintentional mind-wandering are sometimes uniquely associated with certain individual-differences variables, which suggests the importance of separately assessing trait levels of these two types of mind-wandering.

State-Level Dissociations of Intentional and Unintentional Mind-wandering

Recent research has also shown that intentional and unintentional mind-wandering can behave quite differently under certain experimental manipulations. For example, one study [51] combined a re-reading manipulation with a thought-probe measure of mind-wandering and found that individuals mind-wandered more while re-reading compared to an initial reading. If the researchers had stopped there, they would have concluded, in line with extant literature, that rereading makes it more difficult to prevent our minds from unintentionally wandering away from the task. Although this is not an unreasonable conclusion to draw, it turns out to be incorrect: Follow-up experiments using probes that indexed the intentionality of mind-wandering revealed that the effect of re-reading on mind-wandering was driven completely by an increase in intentional mind-wandering, and that re-reading had no influence on unintentional mind- wandering.

In a similar vein, it was recently demonstrated that manipulations of task difficulty can have opposing effects on intentional and unintentional mind-wandering: whereas participants

reported more intentional mind-wandering in an easy task than in a difficult task, they reported more unintentional mind-wandering in a difficult task than in an easy task [44]. This latter finding is particularly important because it reinforces the idea that the standard practice of conflating intentional and unintentional mind-wandering will likely produce underspecified or even incorrect conclusions, as it would have in the re-reading study discussed above. Indeed, although rates of intentional and unintentional mind-wandering varied across the easy and the difficult condition, there was no difference in rates of mind-wandering across conditions when the intentionality of the episodes was ignored (as is the standard practice in the field). Hence, had the researchers not distinguished between intentional and unintentional mind-wandering, they would have drawn the incorrect conclusion that the task-difficulty manipulation did not affect rates of mind-wandering. Importantly, given that the vast majority of research on the topic of mind-wandering has not distinguished between intentional and unintentional types, this and other related findings suggest the possibility that some of the conclusions drawn in previous studies were incorrect or at least underspecified.

Taken together, the foregoing findings provide evidence that (1) challenges the notion that mind-wandering is a unitary construct that exclusively reflects unintentional thought, and (2) suggests that intentional and unintentional mind-wandering reflect unique, dissociable constructs that can behave differently in empirical investigations (see Figure 1, Key Figure).

Intentionality in Existing Models of Mind-Wandering

As one might surmise from the discussion above, to date the topic of intentionality has not been addressed in theoretical models of mind-wandering. Although this absence of intentionality does not necessarily commit these models to the idea that intentional mind-wandering does not exist, it does carry with it the implicit assumption that separate mechanisms are not required to explain the maintenance and occurrence of these two types of mind-wandering. For example, one prominent model of mind-wandering, known as the Executive-Control-Failure account [2], posits that mind-wandering results from a failure of working memory to control or suppress interfering thoughts. Here, the focus on "failures of control" suggests that this model was specifically intended to provide an explanation of unintentional mind-wandering (although there remains the possibility that this model was intended to accommodate both intentional and unintentional mind-wandering while attributing both types of mind-wandering to the same mechanism; i.e., a failure of control). Either way, specific consideration of intentional and unintentional mind-wandering has, to date, been absent from this model.

Another prominent model, known as the Attentional-Resources account [28], posits that instead of reflecting a failure of executive control, mind-wandering actually requires the engagement of executive-control resources for its sustenance. This account remains agnostic with respect to the role of intentionality in mind-wandering; hence, it does not specify any unique mechanism(s) associated with intentional and unintentional mind-wandering, nor does it make predictions regarding the intentionality of mind-wandering.

Lastly, a more recently advanced theoretical framework for mind-wandering, referred to as the Process-Occurrence Framework [52], distinguishes between the initiation and the continuation of a mind-wandering episode, linking the Executive-Control-Failure account to the moment of initiation, and the Attentional-Resources account to the continuation of the episode. Although this framework has provided much clarity in the literature by resolving the apparent conflict between the Attentional Resource and Executive Control Failures accounts, it does not appear to add any specification regarding the role of intentionality of mind-wandering that goes beyond the two former accounts.

As presently construed, then, the dominant models of mind-wandering can be argued to suggest that, although mind-wandering may occur both intentionally and unintentionally, these two types of mind-wandering do not require separate theoretical treatment. Of course, this interpretation is largely based on the tendency of existing models to refrain from explicitly addressing the distinction between unintentional and intentional mind-wandering, not the explicit denial of the existence of intentional and unintentional mind-wandering. Nonetheless, an important direction for the literature on mind-wandering will be to determine whether a single set of mechanisms can be used to explain these two types of mind-wandering.

A Framework for Understanding Intentional and Unintentional Mind-Wandering

In considering the potential mechanisms underlying intentional and unintentional mind-wandering, it may be useful to build on an existing distinction between volitional and reflexive shifts of attention, which has played a major role in general theories of human attention [53]. For instance, Kahneman's [54] classic Capacity Model of Attention includes an "allocation policy" that controls the distribution of "available capacity" to various tasks, and this allocation policy is believed to be governed by several factors including "enduring dispositions which reflect the rules of involuntary attention" and "momentary intentions" (p. 11). Similarly, theories of spatial attention distinguish between endogenous and exogenous shifts of attention among different types of content [55]: Endogenous shifts of attention are said to be volitional and guided by "top-down" goals, whereas exogenous shifts are believed to reflect involuntarily shifts of attention initiated by salient external stimuli in a "bottom-up" manner (e.g., an abrupt onset; [56]).

The distinction between volitional and reflexive attention in existing theories of human attention can be thought of as corresponding to intentional and unintentional mind-wandering in the following way: Intentional control over mind-wandering and endogenous control over attention would both be characterized as involving a 'willful' or 'volitional' shift to some content, which is internal in the former case and external in the latter case [57]. At the same time, unintentional mind-wandering and exogenous control of attention would both reflect the process of attentional capture, despite people's best attempts to focus their attention on their current task. In the case of exogenous capture, the "capturing" stimulus is thought to be an external stimulus (e.g., a loud noise). However, in the case of unintentional mind-wandering, this 'stimulus' could be a node of high activation in one's semantic

network that is, at the time, below the threshold of awareness [2]. These nodes of high activation (or perhaps low threshold) might correspond to current concerns [58] or recently primed concepts [59].

From this perspective, the reported dissociations between intentional and unintentional mind-wandering could be re-interpreted as reflecting the engagement of different attentional-control networks. For example, the selective effect of re-reading on intentional mind-wandering could be construed as an endogenous shift of attention away from the reading that is prompted by the realization that comprehension of the text during the second reading should require fewer attentional resources and less effort [60]. Furthermore, the relation between OCD/ADHD and unintentional mind-wandering could reflect the more frequent occurrence of salient, and thus exogenously attention-capturing, self-generated thoughts in these special populations.

In addition to providing a framework for explaining existing results, drawing parallels between intentional and unintentional mind-wandering, and endogenous and exogenous shifts of attention (respectively) could lead to novel predictions. For example, these two modes of attentional control have been associated with two distinct neural systems (for reviews, see [61,62]), with endogenous control being associated with a dorsal frontoparietal network (including the frontal eye fields and the intraparietal sulcus/superior parietal lobule) and exogenous control being associated with a ventral frontoparietal network (including the temporoparietal junction and the ventral frontal cortex). Given these findings, it seems possible that intentional and unintentional mind-wandering also engage distinct neural systems, with the possibility that there might even be some overlap between these networks and the exogenous/endogenous networks involved in spatial shifts of attention (see Box 4).

Box 4

Mind-Wandering and the Brain

A growing body of work has identified various brain regions that are most active during episodes of mind-wandering relative to periods of on-task thought. A recent meta-analysis of neuroimaging studies examining mind-wandering [35] confirms that the brain regions involved in overall mind-wandering overlap with areas associated with default-mode-network (DMN; a network that is active when participants do not have a task to complete), as well as the frontoparietal-control network (a network associated with executive control). The areas involved in mind-wandering, and those typically involved in the DMN and frontoparietal-control network, are shown in Figure I (taken from [35]). The idea that frontal executive-control regions are involved in mind-wandering is also supported by recent studies showing that transcranial-direct-current stimulation (tDCS) applied to the lateral prefrontal cortex can modulate the amount of reported mind-wandering [33,98].

The involvement of the control network in mind-wandering is particularly noteworthy. It has been argued that the control network is coopted by the mind-wandering episode, such that the "executive control regions guide, evaluate, and select among the various spontaneous streams of thoughts, memories, and imaginings offered up to consciousness

by the DMN" [35]. If mind-wandering is exclusively unintentional, as sometimes assumed, then the idea that control regions support mind-wandering is important because executive processes are often associated with intentional direction of thought. Indeed, co-operation between the frontoparietal control network and the DMN, similar to that observed during mind-wandering, has been reported in goal-directed cognitive tasks such as autobiographical planning [99].

However, it is important to note that the neuroimaging and tDCS studies that implicate control regions in mind-wandering did not distinguish between intentional and unintentional mind-wandering. In light of the prevalence of intentional mind-wandering in laboratory tasks, and given the boring conditions typically experienced in neuroimaging studies, it seems reasonable to assume that at least some of the observed mind-wandering has been largely intentional. This observation raises the interesting possibility that activation of the executive-control regions might be mostly reflective of intentional, rather than unintentional, mind-wandering. Indeed, consideration of the fact that mind-wandering can involve intentional or unintentional modes of control, together with the observation that there are two modes of control over spatial attention [55], suggests the possibility that the existing neuroimaging findings have conflated two distinct control networks (intentional and unintentional). Thus, an important direction for future research will be to assess the potentially distinct neural correlates of intentional and unintentional mind-wandering.
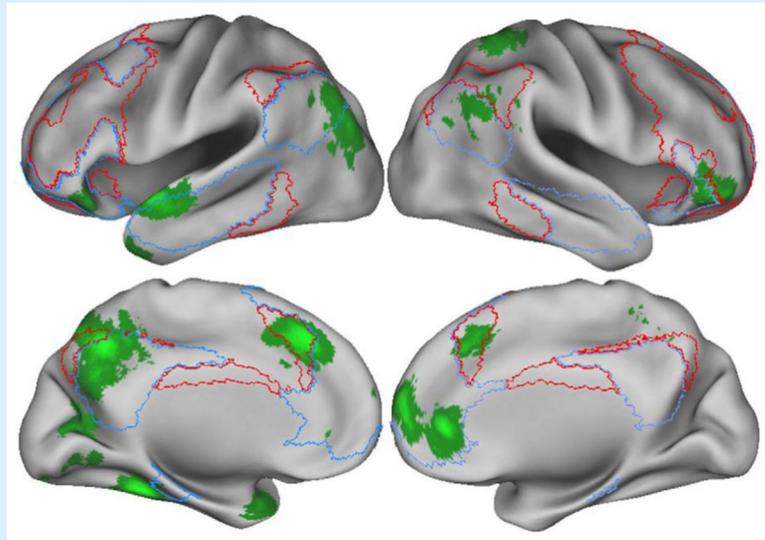
Figure I. Brain Activations during Periods of Mind-Wandering Contrasted with the Default Mode Network (DMN) and the Frontoparietal Control Network
Significant meta-analytic clusters of brain activity associated with periods of mind-wandering (green clusters) contrasted with the DMN (blue) and frontoparietal control network (red). Meta-analytic activity associated with mind-wandering shows marked overlap with both the DMN and frontoparietal control network. DMN and frontoparietal control network masks are based on aggregate data from 1000 subjects, as reported by [100]. Taken from [35].

Moreover, construing intentional and unintentional mind-wandering as reflecting the action of different control networks raises the interesting issue of what factors might influence these different modes of control. For instance, intentional mind-wandering might be heavily influenced by factors such as (1) an individual's level of intrinsic motivation to complete a task (i.e., whether tasks are 'have-to' or 'want-to' tasks; [63,64]), (2) an individual's level of interest in a task [65], (3) an individual's metacognitive beliefs about the extent to which mind-wandering influences performance, and (4) an individual's ability and inclination to strategically mind-wander during moments of low task demand [37,66,67]. In contrast, unintentional mind-wandering might be more heavily influenced by (1) the amount of unused resources available for task-unrelated processing [68], (2) the gravity of personal concerns [58], (3) 'opportunity costs' that arise while completing a task [69], and (4) an individual's decision to take an 'active' (intense) or 'passive' (relaxed) stance towards attentional control in a given situation [54]. It is important to note, however, that we are not ruling out the possibility that some of the foregoing factors might influence both intentional and unintentional mind-wandering; indeed, there is good reason to believe that many factors will have some effect on both modes of control. For instance, low motivation to complete a particular task might lead to deliberate shifts of attention toward mind-wandering and also make it easier for activation in the semantic network to unintentionally attract attention, thus pulling attention from a primary task.

In discussing parallels between intentional and unintentional mind-wandering, and endogenous and exogenous shifts of attention, it should be noted that intentionality during mind-wandering need not be restricted to the initiation of a mind-wandering episode. Indeed, control over the distribution of resources likely dynamically unfolds over time [70]. As such, intentional mind-wandering can also manifest as an allowance of the continuation of a previously unintentionally progressing episode (e.g., endogenous maintenance of attention at a location that was arrived at exogenously). Similarly, unintentional mind-wandering can manifest as an intended episode of mind-wandering that has gone beyond an intended stopping point (e.g., exogenous maintenance of attention at a location that was arrived at endogenously).

The Practical Benefits of Assessing the Intentionality of Mind-Wandering

Beyond having important theoretical implications, the finding that people frequently engage in intentional mind-wandering might play a pivotal role in practical research aimed at developing methods to reduce the occurrence of mind-wandering. Although mind-wandering has been associated with certain beneficial outcomes (e.g., autobiographical planning, creativity [71]), it has also been associated with numerous serious negative consequences (e.g., car accidents, deficits in reading comprehension, problems with workplace functioning [71]). Thus, it is perhaps unsurprising that researchers have been eager to develop methods with which rates of mind-wandering can be reduced in daily life. To date, a few such methods have been identified. First, working under the theory that mind-wandering is sometimes the result of unfulfilled goals hijacking one's attention, one study showed that instructing people to formulate specific plans aimed at resolving their unfulfilled goals led to a subsequent reduction in mind-wandering or "intrusive thoughts" [72]. In another study,

researchers had participants engage in mindfulness meditation, showing that this practice minimized subsequent rates of mind-wandering [73].

As researchers continue to investigate methods with which to reduce the occurrence of mind-wandering, it will be important for them to consider how different methods of remediation might vary in their effectiveness depending on whether the mind-wandering in question is intentional or unintentional. In particular, the specific methods that minimize the occurrence of these two types of mind-wandering might well differ. For example, in the context of a lecture, unintentional mind-wandering might be reduced by increasing the salience of the presented material [74,75], perhaps by including stimulating presentation slides or interesting videos. Thus, carving mind-wandering at this joint might provide fruitful grounds for future research to identify methods of remediation.

Concluding Remarks and Future Perspectives

The findings reviewed here provide strong evidence to suggest that people's minds wander both with and without intention. This research has revealed that unintentional and intentional mind-wandering are differentially associated with various individual-differences variables, and can be dissociated experimentally. These dissociations suggest that these two types of mind-wandering might be associated with different underlying mechanisms. Although speculative at present, these different underlying mechanisms might profitably be viewed as being analogous to the long-held distinction between exogenous and endogenous attentional control.

The emergence of the distinction between intentional and unintentional mind-wandering has also opened the door to numerous opportunities for future research. At the most basic level, the majority of research to date has used dichotomous probes to measure mind-wandering: a methodology that we now know glosses over the distinction between unintentional and intentional mind-wandering. Thus, revisiting this work with this distinction in mind promises valuable new insights. For example, individual differences in working memory are known to be related to rates of mind-wandering: Understanding whether working memory is related to unintentional, intentional, or both types of mind-wandering would provide valuable constraints on existing theory (i.e., the Executive-Control Failure Account; [2]). Beyond revisiting important past work, thinking about the intentionality of mind-wandering provides both a new perspective on old questions and brings into focus completely novel lines of inquiry. In terms of providing a new perspective on old questions, the distinction between unintentional and intentional mind-wandering could help disambiguate patterns of brain activation associated with mind-wandering (Box 4). In terms of generating novel questions, placing intentional mind-wandering under the microscope raises new questions about how metacognition or meta-attention might contribute to rates of mind-wandering (See Outstanding Questions).

Outstanding Questions Box

- *How do people report on the intentionality of mind-wandering?* The intentionality of mind-wandering might wax and wane throughout an episode. Thus, when people report on the intentionality of mind-

wandering, it is unclear which component of the episode informs this report. For example, reports might be informed by the initiation of the episode, the episode's most recent segment, or the average time spent mind-wandering with intention. Elucidating the processes involved in informing reports of intentionality is important for our theoretical understanding of mind-wandering, and it will therefore be an important direction for future research.

- *Do the methods aimed at reducing mind-wandering differentially affect intentional and unintentional mind-wandering?* Researchers have been eager to develop methods with which to reduce the occurrence of mind-wandering. To date, a few such methods have been identified (e.g., mindfulness meditation). Because rates of intentional and unintentional mind-wandering behave differently under certain experimental manipulations, it will be important for research to consider how different methods of remediation might vary in their effectiveness depending on whether the mind-wandering in question is intentional or unintentional.

- *What are the neural correlates of intentional and unintentional mind-wandering?* Neuroimaging studies of mind-wandering have not distinguished between intentional and unintentional types. However, in line with the literature on endogenous and exogenous modes of control over attention, intentional and unintentional mind-wandering might be subserved by different attentional networks.

- *Does the content of intentional and unintentional mind-wandering differ?* Episodes of mind-wandering are known to vary in content (e.g., in terms of temporal focus, valence, etc.). However, it remains unknown whether the content of mind-wandering reliably differs as a function of intentionality.

Another area where the intentional/unintentional distinction could prove useful concerns the link between mind-wandering, on the one hand, and episodic or autobiographical memory and future thinking, on the other. Recent research has revealed numerous similarities between episodic memory and future thinking, including reliance on the default-mode network [76,77], which, as we discuss in Box 4, has also been linked to mind-wandering. Cognitive studies suggest that during bouts of mind-wandering, people sometimes remember past experiences and, to an even greater extent, imagine future experiences [78]. However, it is currently unknown whether the relative frequencies of episodic memories and future thoughts differ during incidents of intentional versus unintentional mind-wandering. Indeed, some researchers [78] have suggested that the focus on future thoughts during mind wandering episodes suggests a possible functional role for mind-wandering in problem solving, but it is unknown whether such functionality is equally characteristic of intentional and unintentional mind-wandering. Finally, recent research on cognitive aging has also suggested a link between mind-wandering and involuntary autobiographical memory

retrieval – older adults show reductions in both compared with young adults [79] – but it is unknown whether the age-related reduction in mind wandering applies to both intentional and unintentional varieties.

The distinction between unintentional and intentional mind-wandering will likely also prove useful beyond the laboratory. For example, it will be important for future work to investigate the possibility that methods aimed at reducing rates of intentional and unintentional mind-wandering might vary in terms of their effectiveness depending on the type of mind-wandering in question. This fine-grained look at the mind-wandering promises more targeted interventions, for example, in the classroom and/or workplace.

Given that intentional and unintentional mind-wandering have been shown to sometimes behave differently, making the distinction between the two would appear to have important implications for most, if not all areas of mind-wandering research. However, we do not intend to suggest that researchers ought to always examine the intentionality of mind-wandering. That said, in cases where the distinction between intentional and unintentional mind-wandering is not made, we believe that it will be important for researchers to restrict any inferences they draw to mind-wandering in more generic terms, and to acknowledge that assessments of intentionality might provide a more nuanced understanding of their findings.

Although investigations of the intentionality of mind-wandering have opened new doors, treading through those doors will not come without its challenges. One significant challenge that strikes at the heart of mind-wandering research in general pertains to whether we can trust individuals' self-reports of their mental states. In particular, can we trust individuals' self-reports of whether a given episode of mind-wandering was unintentional or intentional? How might task-demands or social-desirability effects influence responses, and in particular, individuals' willingness to report intentional mind-wandering? Addressing these issues will be critical if the distinction between unintentional and intentional mind-wandering is to play a central role in the future of mind-wandering research. Notwithstanding these challenges, recent trends in examining the intentionality of mind-wandering promise both exciting future avenues of research and, ultimately, a deeper understanding of the wandering mind.

Acknowledgments

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Trends Box

- Researchers are beginning to recognize the importance of distinguishing between intentional and unintentional forms of mind-wandering.

- The standard practice has been to employ dichotomous probes that ask people to report whether they are "on task" or "mind-wandering," which conflates intentional and unintentional types of mind-wandering.

- A growing number of studies have shown that people intentionally mind-wander both in laboratory tasks and in everyday life, and that intentional and unintentional mind-wandering are dissociable cognitive experiences.

- Extant theories have largely neglected the distinction between unintentional and intentional mind-wandering and must be amended to include the important role of intentionality.
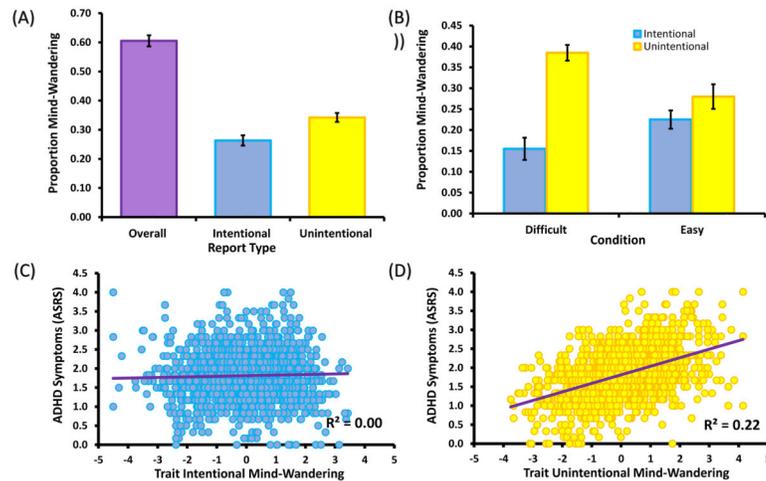
Figure 1 (Key Figure). Dissociations of Intentional and Unintentional Mind-Wandering
(A) Mean proportion of the thought probes to which participants reported overall mind-wandering (the sum of intentional and unintentional mind-wandering), intentional mind-wandering, or unintentional mind-wandering. Error bars are ± 1 *SEM*. Adapted from [41]. (B) Mean proportion of mind-wandering type (intentional, unintentional) reported during an easy and a difficult sustained-attention task. Participants reported more intentional mind-wandering in the easy than in the difficult condition, and conversely, more unintentional mind-wandering in the difficult than in the easy condition. Error bars are ± 1 *SEM*. Adapted from [44] (reprinted with permission from Psychological Science). (C) Scatterplot showing a non-significant relation between mean trait-level reports of intentional mind-wandering (residualized on trait-level reports of unintentional mind-wandering) and mean attention-deficit/hyperactivity disorder (ADHD) symptomatology, assessed by the Adult Self-Report ADHD scale (ASRS). Adapted from [23] (reprinted with permission from Springer Nature Publishing Group). (D) Scatterplot showing a significant positive relation between mean trait-level reports of unintentional mind-wandering (residualized on trait-level reports of intentional mind-wandering) and mean ADHD symptomatology, assessed by the ASRS. Adapted from [23] (reprinted with permission from Springer Nature Publishing Group).