

**On the theoretical importance of distinguishing between intentional and unintentional
types of Mind Wandering**

by

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Statement of Contributions

Study 1 has been published in *Psychological Research* (Seli, Carriere, & Smilek, 2014). Study 2 has been published in *Psychonomic Bulletin & Review* (Seli, Smallwood, Cheyne, & Smilek, 2015). Study 3 has been published in the *Journal of Experimental Psychology: Learning, Memory, & Cognition* (Seli, Cheyne, Xu, Purdon, & Smilek, 2015). Study 4 is currently under review (Seli, Wammes, Risko, & Smilek, under review). Lastly, Study 5 is currently under review (Seli, Risko, & Smilek, under review).

Abstract

When introduced to mainstream psychological research nearly a decade ago, *mind wandering* was defined as unintentional, internally-focused thought. The requirement of an absence of intention was critical in terms of the conceptualization of mind wandering because, for the better half of the past century, considerable research has examined intentional, internally-focused thought. Thus, without the stipulation of an absence of intention, mind wandering would simply refer to a construct that has long been studied by researchers, which would therefore negate the utility of introducing the neologism “mind wandering” to the scientific community. Notwithstanding the critical importance of conceptualizing mind wandering as reflecting unintentional, internally-focused thoughts, in most studies on the topic, the requisite steps have not been taken to ensure that the reported mind wandering did in fact occur without intention. The foregoing is particularly problematic as it suggests that, in many studies, absent-minded mind wandering might have been confounded with intentionally-generated thought. In the present series of studies, I examined this possibility at both the trait and state levels, and found that, (1) in studies of mind wandering, people do in fact experience and report intentional internally-focused thought as reflecting “mind wandering,” and (2) intentional and unintentional internally-focused thoughts are differentially related to certain critical measures of interest, which indicates that they are dissociable cognitive experiences. These results suggest a serious problem with the current state of the literature on mind wandering: Namely, that mind wandering, as initially conceptualized and introduced to psychological research as reflecting unintentional internally-focused thought, has likely been conflated with a very different mode of thinking (i.e., deliberately engaged thought).

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On the theoretical importance of distinguishing between intentional and unintentional types of Mind Wandering

"The less a science has advanced, the more its terminology tends to rest on an uncritical assumption of mutual understanding."
(Quine, 1936, p. 90)

The division of phenomena and constructs into binary distinctions has been an extremely useful tool in refining the conceptual and theoretical aspects of psychological research. Neisser (1963), in discussing thinking, famously observed that “nearly everyone who has touched the subject has divided mental processing into two (or more) kinds” (p. 1). The primary focus of this thesis, mind wandering – the unintentional shift of attention away from the external environment toward some other train of internally-focused thinking – was defined and developed in such a dichotomous way of thinking. Indeed, when Smallwood and Schooler (2006) first introduced the term ‘mind wandering’ to the scientific community nearly a decade ago, they proposed a dichotomous conceptualization of mind wandering as a cognitive state that is directly contrasted with, and defined in opposition to, intentional modes of thinking (such as goal-directed thinking; Smallwood & Schooler, 2006):

“Mind wandering shares certain similarities with standard views of controlled processing, however, there is an important difference. Controlled processing is generally associated with the intentional pursuit of a goal. Mind wandering, however, often occurs *without intention* (Giambra, 1995) or even awareness that one’s mind has drifted (Schooler, 2002; Schooler, Reichle, & Halpern, 2005)” (p. 946; Italics added).

It is important to note that introducing the term ‘mind wandering’ to the scientific community has utility only insofar as this cognitive experience is clearly distinguishable from

already-studied generic types of internally-guided thinking. Indeed, for the better half of the past century, considerable psychological research has examined thinking that occurs with deliberate intent (e.g., goal-directed thoughts, problem solving, etc.; e.g., Bargh, 1990; Bartlett, 1958; Bruner, Goodnow, & George 1956; Gick & Holyoak, 1980; Newell & Simon, 1972). Thus, if ‘mind wandering’ is indistinguishable from these well-studied (intentional) modes of thinking, then there would be no utility to introducing the neologism “mind wandering” to the scientific community, as doing so would, at best, fail to make any useful contribution to scientific investigations, and at worst, produce to a false dichotomy that would very likely lead to confusions in the psychological literatures focused on human thinking. Thus, if the construct of mind wandering is not made operationally distinguishable from deliberately engaged cognitions, then it would be more fruitful for the scientific community to refrain from endorsing the term ‘mind wandering’ in the first place. Indeed, this was Smallwood and Schooler’s (2006) line of reasoning in their seminal paper in which they introduced the term mind wandering – as a construct that is unique and distinguishable from deliberately engaged thought and controlled processing – to mainstream psychological science,.

Notwithstanding the critical importance of conceptualizing mind wandering as reflecting unintentional, internally-focused thoughts, in many studies on the topic, the requisite steps have not been taken to ensure that the reported mind wandering did in fact occur without intention. That is, it was not confirmed that the thoughts being measured actually qualified – in accordance with the assumed definitions and theoretical interpretations – as “mind wandering,” particularly with regard to the stipulation of a lack of intentionality. Unfortunately, despite the conceptual importance of the absence of intentionality, mind wandering has been commonly operationally defined for participants as “thinking about task-unrelated things” (e.g., Levinson, Smallwood, &

Davidson, 2012; Seli, Carriere, Thomson, et al., 2014; Seli, Cheyne, & Smilek, 2013; Smallwood, Baracaia, Lowe, & Obonsawin, 2003; Smallwood, Beach, Schooler, & Handy, 2008; Smallwood, Davies, Heim, Finnigan, Sudberry, et al., 2004; Smallwood, Obonsawin, & Heim, 2003; Smilek, Carriere, & Cheyne, 2010). Importantly, this commonly employed operational definition of mind wandering clearly allows for, and indeed implicitly requires participants to report intentionally-engaged off-task thoughts as “mind wandering.” The foregoing is particularly problematic as it suggests that, in many studies, absent-minded mind wandering might have been confounded with intentionally-generated thought.

Given the importance of the foregoing for investigations of mind wandering, in the present work I sought to examine whether (1) people do in fact experience and report intentional internally-focused thought, and (2) these intentional thoughts are dissociable from their unintentional counterparts. Assuming that people do experience and report intentional mind wandering, that these thoughts are dissociable from unintentional mind wandering, and that (at least in some cases) intentional thoughts share different associations with certain variables, this would suggest a serious problem with the current state of the literature on mind wandering. Indeed, it would suggest that mind wandering, as initially conceptualized and introduced to psychological research as reflecting unintentional internally-focused thought, has likely been conflated with a very different mode of thinking (i.e., deliberately engaged thought). Such findings would provide clear evidence necessitating a change in our way of thinking about and studying mind wandering, and would suggest that, if researchers so desire to hold fast to the notion of mind wandering being a mode of thinking that is separate from controlled processing, then they must distinguish between deliberate and spontaneous types of internally focused thought.

I began my investigation by examining the abovementioned possibilities at the trait level. In an initial study (Study 1), I explored the possibility that trait level deliberate (intentional) and spontaneous (unintentional) mind wandering differentially associated with measures of mindfulness as assessed by the Five Facet Mindfulness Questionnaire. In a follow-up study (Study 2), I then examined the hypothesis that spontaneous, but not deliberate, mind wandering ought to be associated with attention-deficit/hyperactivity disorder (ADHD) symptomatology. To foreshadow, in Study 1, I found that participants reported having experienced both deliberate and spontaneous trait-level mind wandering, and critically, that these different types of mind wandering were uniquely associated with certain aspects of mindfulness, thereby demonstrating that people do in fact experience (and are capable of reporting) deliberate mind wandering, and that deliberate and spontaneous types of mind wandering are dissociable as indicated by their unique associations with mindfulness. In Study 2, I found, as hypothesized, that spontaneous – but not deliberate – mind wandering predicted ADHD symptomatology, providing further support for the theoretical importance of distinguishing between these two types of mind wandering at the trait level.

Next, I then moved on to examine deliberate and spontaneous mind wandering at the state level. In the first study of this series (Study 3), I examined the possibility that participants lacking motivation to perform well on a laboratory task assessing sustained attention would more frequently engage in deliberate mind wandering than would their more highly motivated counterparts. In addition, I examined the possibility that the degree to which participants engaged in deliberate and spontaneous mind wandering during the sustained-attention task was uniquely predictive of their task performance. Study 4 extended the work of Study 3 by examining the influences of state-level deliberate and spontaneous mind wandering in an

educational setting (i.e., during a video-recorded lecture). Finally, in Study 5, I examined the possibility that an experimental manipulation of task difficulty would differentially affect rates of deliberate and spontaneous mind wandering. In this series of studies, the primary findings were that (1) participants do indeed experience and report state-level deliberate mind wandering, (2) whereas in some cases, deliberate and spontaneous mind wandering are equally associated with performance measures (Study 3), in others, they uniquely predict performance (Study 4), and (3) a manipulation of task difficulty, although it did not affect overall rates of mind wandering across an “easy” and a “difficult” condition, it did influence the relative rates of each type of mind wandering.

Study 1

The following work has been published in *Psychological Research* (Seli, Carriere, & Smilek, 2014).

Here we sought to demonstrate a dissociation between trait-level tendencies to mind-wander spontaneously (unintentionally) and deliberately (intentionally). Participants completed online versions of the Mind Wandering Spontaneous (MW-S) and the Mind Wandering Deliberate (MW-D) self-report scales and the Five Facet Mindfulness Questionnaire (FFMQ). The results revealed that deliberate and spontaneous mind wandering were uniquely associated with some factors of the FFMQ. Notably, while the MW-D and the MW-S were positively associated with each other, the MW-D was uniquely positively associated with the '*Non-Reactivity to Inner Experience*' factor of the FFMQ whereas the MW-S was uniquely negatively associated with this factor. We also showed that conflating deliberate and spontaneous mind wandering can result in a misunderstanding of how mind wandering is related to other traits. We recommend that studies assessing individual differences in mind wandering should distinguish between deliberate and spontaneous subtypes of mind wandering to avoid possibly erroneous conclusions.

Imagine an individual who is capable of sustaining her attention to a task when necessary, but spends much of her time deliberately mind wandering. Now imagine an individual who, despite his best intentions, cannot keep his mind from spontaneously wandering away from his everyday tasks. Here we have two individuals who frequently engage in mind wandering, but who do so for very different reasons. We refer to these two types of mind wandering as deliberate (intentional) and spontaneous (unintentional), respectively. Although there is reason to believe that these two types of mind wandering occur in everyday life (Carriere, Seli, & Smilek, 2013), recent investigations of mind wandering have largely neglected the distinction between deliberate and spontaneous types of mind wandering, and have used trait-level questionnaires that do not distinguish between these subtypes, but instead provide an “overall” assessment of mind-wandering propensity. Building on recent work that has argued for the utility of treating mind wandering as a heterogeneous class of experiences (Smallwood & Andrews-Hanna, 2013), in the present study we demonstrate the importance of distinguishing between deliberate and spontaneous experiences of mind wandering at the individual-difference level. In particular, we show that these two types of mind wandering are differentially associated with other individual traits, and that conflating these types of mind wandering can lead to incorrect general conclusions about mind wandering and its associates.

The idea that mind wandering occurs in deliberate and spontaneous forms has been around for quite some time. Indeed, in his early work on the topic, Giambra (1995) noted that: “TUITs [i.e., task-unrelated imagery and thoughts] 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). Despite this early distinction between spontaneous and deliberate mind wandering, almost all of the subsequent research on the topic has assessed

reports of “overall” mind wandering (e.g., Baird et al., 2012; Killingsworth & Gilbert, 2010; McVay & Kane, 2009; Mrazek, Phillips, Franklin, Broadway, & Schooler, 2013; Seli, Carriere, Levene, & Smilek, 2013; Seli, Cheyne, et al., 2015; Smallwood, Baracaia, Lowe, & Obonsawin, 2003), overlooking the potentially interesting differences between deliberate and spontaneous mind wandering and their correlates. Critically, most of these researchers who have refrained from distinguishing between deliberate and spontaneous mind wandering have nevertheless discussed mind wandering in terms of 1) the *unintentional drifting* of one’s thoughts from a focal task toward inner, task-unrelated thoughts (e.g., Smallwood & Schooler, 2006) and 2) *failures in executive control* (e.g., McVay & Kane, 2010), with the working assumption that reports of mind wandering are not reflective of intentional or deliberate shifts in attention toward internal thought. Of course, if, as we argue here, at least some of the mind wandering that is indexed by researchers is of the deliberate, intentional, type, then discussing mind wandering exclusively in terms of “unintentional shifts” and “failures in executive control” will necessarily fail to capture the full range of this cognitive experience (for further discussion of the issues involved in measuring complex constructs, see, e.g., Smith, Fischer, & Fister, 2003).

Although, to date, most researchers have overlooked Giambra’s early distinction between deliberate and spontaneous mind wandering, in some recent work (Carriere et al., 2013) we sought to shed some light on this issue. In our study, we used an individual-differences approach to determine whether mind wandering relates to self-reported fidgeting. Our hypothesis was that fidgeting might be positively associated with mind wandering, to the extent that both result when we no longer maintain attentive control over the mind. In the course of our investigation, we developed a questionnaire intended to measure a unitary construct of mind wandering at the trait level. Instead we found that the questionnaire had a two-factor structure, and those two factors

were best captured by a distinction between spontaneous, uncontrolled mind wandering and deliberate, willful mind wandering. Although the two scales were highly positively correlated, when entered into a regression analysis as simultaneous predictors of fidgeting we found that spontaneous, but not deliberate, mind wandering was uniquely correlated with fidgeting. Moreover, we similarly observed that one's self-reported propensity to act without awareness (i.e., to act mindlessly) was uniquely associated with spontaneous, but not deliberate, mind wandering. Thus, consistent with Giambra's (1995) early claim, these findings lend support to the hypothesis that there are indeed two distinguishable forms of mind wandering.

While our recent work (Carriere et al., 2013) suggests that mind wandering can be separated into deliberate and spontaneous types, it is important to note that, in our study, when removing the shared variance between spontaneous and deliberate mind wandering, we observed that it was always spontaneous, but not deliberate, mind wandering that was associated with the dependent variables of interest (i.e., fidgeting and acting without awareness). This suggests the possibility that, although the distinction between spontaneous and deliberate mind wandering is sound (as suggested by the factor analysis), this distinction might not be useful because both types of mind wandering might have similar – if not identical – consequences and associates. Moreover, spontaneous mind wandering may consistently be the more strongly associated of the two with other variables, which would result in it always providing the only unique prediction. Indeed, irrespective of whether one frequently engages in deliberate or spontaneous mind wandering, it is the case that, by definition, during both types of mind wandering one's thoughts are not focused on the task at hand; as a result, one might expect to observe performance decrements and other similar associates in both cases. Thus, to demonstrate the *practical utility* in distinguishing between deliberate and spontaneous mind wandering, one must demonstrate

that these two types of mind wandering can *each* be uniquely associated with some variables of interest.

In our earlier work (Carriere et al., 2013) we focused on the association between mind wandering and mindlessness (acting without awareness), but mindlessness is just one aspect of the larger construct of mindfulness. In the present study, we therefore explored the possibility that deliberate and spontaneous mind wandering might differentially associate with some of the other important aspects mindfulness, as assessed by the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). True to its name, the FFMQ consists of five subscales measuring different facets of mindfulness, namely: (1) *Non-Reactivity to One's Inner Experience*, (2) *Observing/Attending to One's Sensations, Perceptions, Thoughts, and Feelings*, (3) *Acting with Awareness*, (4) *Describing One's Feelings, Sensations, and Experience* (i.e., to oneself), and (5) *Not Judging One's Experiences* (see Baer et al., 2006). These five facets of mindfulness provide a potentially fruitful testing ground for dissociating deliberate and spontaneous mind wandering because the facets include aspects of mental control, which ought to be related to people's propensity to spontaneously mind wander, as well as aspects of deliberate exploration of inner experience, which ought to be related to people's propensity to deliberately mind wander. Admittedly, as our study was exploratory we did not have any specific hypotheses with regard to the relation between spontaneous and deliberate mind wandering and the five facets of mindfulness, except for the relation between mind wandering and the third facet, which closely overlaps with our assessment of mindlessness in our previous work (Carriere et al., 2013). We felt that specific hypotheses were not critical because we simply sought to explore the possibility that distinguishing between these two types of mind wandering is of practical use. Importantly, given the purely exploratory nature of this study, we

sought to first observe the relations in a large sample and then replicate our observations in a second large sample.

Study 1 Method

Participants

To demonstrate replication of our findings we analyzed data from two separate samples of students enrolled in undergraduate Psychology courses at the University of Waterloo. The first sample consisted of 721 participants, and the second of 767 participants, all of whom completed every item of each questionnaire included in the study. Also included among the scales of interest (i.e., Mind Wandering: Spontaneous (MW-S), Mind Wandering: Deliberate (MW-D), and the Five Facet Mindfulness Questionnaire; FFMQ) were various other questionnaires of interest to other researchers, but not analyzed for the present study. Collectively these questionnaires were given to participants in the first month of classes, and the order of presentation of the questionnaires was randomized across participants. Participants were therefore unaware of the relatedness of our scales. Participants received partial course credit for completing the questionnaires.

Measures

As in our previous work (Carriere et al., 2013), here we used the 4-item Mind Wandering: Deliberate (MW-D) scale and the 4-item Mind Wandering: Spontaneous (MW-S) scale to index deliberate and spontaneous mind wandering, respectively. The MW-D includes items related to intentional mind wandering, such as: “I allow my thoughts to wander on purpose,” and the MW-S includes items related to unintentional mind wandering, such as: “I find my thoughts wandering spontaneously.” Both are scored using a seven-point Likert scale.

In addition to administering the two mind-wandering questionnaires, we measured mindfulness using the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006), which is comprised of five different scales that index various aspects of mindfulness, including: (1) *Non-Reactivity to Inner Experience*, (2) *Observing/Attending to Sensations, Perceptions, Thoughts, and Feelings*, (3) *Acting with Awareness*, (4) *Describing One's Feelings, Sensations, and Experience*, and (5) *Non-Judging of Experience*. The *Non-Reactivity to Inner Experience* scale includes items such as “I perceive my feelings and emotions without having to react to them”; the *Observing/Attending to Sensations* scale includes items such as “I pay attention to sensations, such as the wind in my hair or sun on my face”; the *Acting with Awareness* scale includes (reverse coded) items such as “I find it difficult to stay focused on what’s happening in the present”; the *Describing One's Feelings, Sensations, and Experience* scale consists of items such as “I’m good at finding the words to describe my feelings”; finally, the *Non-Judging of Experience* scale includes items such as the reverse coded item “I criticize myself for having irrational or inappropriate emotions.” Each of the five factors from the FFMQ is scored using a five-point Likert scale. The *Acting with awareness* scale of the FFMQ is notably comprised almost entirely of items taken from the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) and all items on this scale are reverse-coded. We have previously used a similar subset of items from the MAAS as a measure of one’s general lack of attentiveness, by simply refraining from reverse-scoring the items (Carriere et al., 2013). Likewise, as can be seen in the sample item, the *Non-Judging of Experience* scale of the FFMQ also consists entirely of reverse-scored items that actually measure judgment of one’s experiences.

Study 1 Results

Descriptive Analyses and Correlations

Descriptive statistics and Cronbach's Alphas for the MW-D, MW-S, and all five facets of the FFMQ are presented in Table 1. All measures demonstrated good psychometric properties and reliability across both samples. The Pearson product-moment correlation coefficients for all measures are presented in Table 2. As observed in previous work (Carriere et al., 2013), deliberate mind wandering (MW-D) showed a strong positive correlation with spontaneous mind wandering (MW-S). Moreover, the MW-D was associated with only three of the five mindfulness scales, whereas the MW-S was associated with all five of these scales. Finally, the correlation analysis showed strong relations of the MW-D and MW-S with the Acting with awareness scale of the FFMQ, as was initially demonstrated by Carriere et al., (2013; using the roughly equivalent MAAS-LO). For studies showing similar associations of other mind wandering and mindfulness measures, see Ottaviana and Couyoumdjian (2013), and Mrazek, Smallwood, and Schooler (2012).

Table 1. Descriptive Statistics and Cronbach's Alpha for All Measures (Sample 1: N = 716; Sample 2: N = 762).

	Sample 1				Sample 2			
	Mean (SD)	Skew ^a	Kurtosis ^b	α	Mean (SD)	Skew ^a	Kurtosis ^b	α
MW-D	4.39 (1.49)	-0.23	-0.53	.890	4.41 (1.44)	-0.24	-0.54	.883
MW-S	4.03 (1.46)	-0.13	-0.50	.879	4.31 (1.42)	-0.23	-0.34	.881
Non-reactivity to inner experience	3.07 (0.79)	-0.06	-0.20	.862	3.00 (0.81)	0.03	0.02	.865
Observing/attending to sensations	3.36 (0.74)	-0.26	-0.13	.813	3.28 (0.75)	-0.15	-0.26	.812
Acting with awareness	2.32 (0.83)	-0.17	-0.34	.890	2.17 (0.84)	0.01	-0.52	.895
Describing one's feelings	3.10 (0.85)	0.04	-0.49	.878	3.05 (0.83)	0.06	-0.47	.878
Non-judging of experience	2.08 (0.97)	0.07	-0.66	.920	2.01 (0.99)	0.15	-0.64	.923

Note. ^a S.E. = .09, ^b S.E. = .18

Table 2. Pearson Product-Moment Correlation Coefficients of All Measures (Sample 1: N = 716, Sample 2: N = 762)

	Sample 1						Sample 2					
	MW-S	Non-reactivity	Observing	Acting	Describing	Non-judging	MW-S	Non-reactivity	Observing	Acting	Describing	Non-judging
MW-D	.45***	.03	.17***	-.28***	-.05	-.14***	.40***	.00	.14***	-.26***	-.07	-.16***
MW-S	-	-.23***	.14***	-.60***	-.17***	-.36***	-	-.19***	.17***	-.59***	-.22***	-.33***
Non-reactivity to inner experience		-	.15***	.26***	.20***	.27***		-	.11**	.19***	.17***	.22***
Observing/attending to sensations			-	-.03	.15***	-.16***			-	-.06	.12**	-.24***
Acting with awareness				-	.27***	.41***				-	.26**	.38***
Describing one's feelings					-	.17***					-	.15**
Non-judging of experience						-						-

Note. *** $p < .001$, ** $p < .01$, 2-tailed

Regression Analyses

As the MW-D and MW-S continued to be strongly correlated in these samples, we next sought to determine their unique contributions to each of the five facets of the FFMQ.

Predicting the *Non-Reactivity to Inner Experience* Facet. We first conducted a multiple regression analysis predicting the *Non-reactivity to Inner Experience* facet of the FFMQ (FFMQ-NR) with the MW-D and MW-S (see Table 3). In both samples the MW-D shows a significant, albeit small, positive semi-partial correlation with the FFMQ-NR. Given an essentially non-existent zero-order correlation, this suggests that the positive relation of the MW-D and FFMQ-NR was suppressed by the strong positive correlation of the MW-D and MW-S. Indeed, the MW-S continued to demonstrate a moderate negative semi-partial correlation with the FFMQ-NR in the multiple regression analysis. Furthermore, including the MW-D in the multiple regression allowed for a significant boost in predictive power over the MW-S alone (Sample 1: $F_{change}(1, 713) = 17.79, p < .001$, Sample 2: $F_{change}(1, 759) = 5.81, p = .016$). This outcome is particularly interesting in that it demonstrates significant yet contradictory relations of the two forms of mind wandering with one's tendency to be non-reactive to inner experiences – with the tendency to deliberately mind-wander potentially facilitating this more detached perspective on one's experiences and the tendency to spontaneously mind-wander potentially inhibiting such detachment.

Table 3. Multiple regression testing for unique contributions to Non-reactivity to inner experience by deliberate mind wandering (MW-D), spontaneous mind wandering (MW-S) (Sample 1: $N = 716$, Sample 2: $N = 762$)

Dependent variable: Non-reactivity to inner experience

	Sample 1			Sample 2		
	<i>sr</i>	<i>t</i>	<i>P</i>	<i>sr</i>	<i>t</i>	<i>p</i>
MW-D	.15	4.22	<.001	.09	2.41	.016
MW-S	-.28	7.72	<.001	-.21	5.81	<.001
	<i>Final Model: R = .28, F(2, 713) = 28.96, p < .001</i>			<i>Final Model: R = .21, F(2, 759) = 17.02, p < .001</i>		

Predicting the Observation/Attending to Sensations Facet. We next conducted a multiple regression analysis predicting the *Observing and Attending to Sensations, Perceptions, Thoughts, and Feelings* facet of the FFMQ (FFMQ-O). Here, again, we found significant unique semi-partial correlations for each of the MW-D and MW-S when predicting the FFMQ-O, as shown in Table 4. In this case, unlike with the FFMQ-NR, both the MW-D and MW-S independently positively predict the FFMQ-O, and do so to an equal, albeit small, extent (indeed,

the nominally larger of the two relations is flipped between the MW-D and MW-S across samples). Also, as was observed with the FFMQ-NR, including the MW-D provided a significant boost in predictive power over the MW-S alone (Sample 1: $F_{change}(1, 713) = 9.65, p = .002$, Sample 2: $F_{change}(1, 759) = 5.49, p = .019$). Thus, one's tendency to be more observant of one's sensations, perceptions, thoughts and feelings is associated with an increased tendency to engage in both deliberate and spontaneous mind wandering.

Table 4. Multiple regression testing for unique contributions to Attending to sensations, perceptions, thoughts, and feelings by deliberate mind wandering (MW-D), spontaneous mind wandering (MW-S) (Sample 1: $N = 716$, Sample 2: $N = 762$)

Dependent variable: Observing and attending to sensations, perceptions, thoughts, and feelings

	Sample 1			Sample 2		
	<i>sr</i>	<i>t</i>	<i>P</i>	<i>sr</i>	<i>t</i>	<i>p</i>
MW-D	.11	3.11	.002	.08	2.34	.019
MW-S	.07	2.02	.044	.12	3.32	.001
	<i>Final Model: R = .18, F(2, 713) = 11.38, p < .001</i>			<i>Final Model: R = .18, F(2, 759) = 12.18, p < .001</i>		

Predicting the *Acting with Awareness* Facet. The relation of one's tendency to be aware of and attentive to one's body, behaviour, and surroundings with the tendency to engage in deliberate and spontaneous mind wandering has already been reported by Carriere and colleagues (2013). In that paper we reported no significant unique contribution of the MW-D when predicting the MAAS-LO, the scale which comprises the majority of the items of the *Acting with Awareness* facet of the FFMQ (FFMQ-A). Nonetheless, as the FFMQ-A does contain some additional items and therefore may demonstrate a different pattern of relations, we conducted a similar multiple regression analysis predicting the FFMQ-A with the MW-D and MW-S. As shown in Table 5, we closely replicate the earlier findings, demonstrating no significant semi-partial correlation of the MW-D and FFMQ-A when controlling for the MW-S, despite again finding a moderate zero-order correlation of the MW-D and FFMQ-A in both samples. Likewise, we found the MW-S was a strong predictor of the FFMQ-A, once again demonstrating that spontaneous, but not deliberate mind wandering, is strongly associated with the tendency to be inattentive and unaware of one's body, behaviour, and surroundings.

Table 5. Multiple regression testing for unique contributions to Acting with awareness by deliberate mind wandering (MW-D), spontaneous mind wandering (MW-S) (Sample 1: $N = 716$, Sample 2: $N = 762$)

Dependent variable: Acting with awareness

	Sample 1			Sample 2		
	<i>sr</i>	<i>t</i>	<i>P</i>	<i>sr</i>	<i>t</i>	<i>p</i>
MW-D	-.01	0.20	.838	-.02	0.80	.424
MW-S	-.53	17.54	< .001	-.53	17.98	< .001
	<i>Final Model: R = .60, F(2, 713) = 195.45, p < .001</i>			<i>Final Model: R = .59, F(2, 759) = 199.20, p < .001</i>		

Predicting the *Describing One's Feelings Facet*. Continuing on with the fourth facet of mindfulness assessed by the FFMQ, *Describing One's Feelings, Sensations, and Experience* (FFMQ-D), we again predicted the FFMQ-D with both the MW-D and MW-S in a multiple regression analysis. Shown in Table 6, and similar to the findings with the FFMQ-A, a small-to-moderate semi-partial correlation was observed with only the MW-S. Thus, it seems only the tendency to spontaneously engage in mind wandering is associated with a decreased tendency to (internally) describe one's feelings, sensations, and experiences to oneself. One notable difference between the current relations and those observed with the FFMQ-A is that for the

MW-D both the semi-partial and zero-order correlations were non-significant in this case, and therefore controlling for the MW-S had no practical effect on the outcome of the analysis (in the same way, controlling for the MW-D did not change the relation of the FFMQ-D and MW-S).

Table 6. Multiple regression testing for unique contributions to Describing one’s feelings, sensations, and experience by deliberate mind wandering (MW-D), spontaneous mind wandering (MW-S) (Sample 1: $N = 716$, Sample 2: $N = 762$)

Dependent variable: Describing one’s feelings, sensations, and experience

	Sample 1			Sample 2		
	<i>sr</i>	<i>t</i>	<i>p</i>	<i>sr</i>	<i>t</i>	<i>p</i>
MW-D	.03	0.86	.388	.02	0.69	.488
MW-S	-.16	4.64	< .001	-.21	6.04	< .001
	<i>Final Model: $R = .17$, $F(2, 713) = 10.80$, $p < .001$</i>			<i>Final Model: $R = .23$, $F(2, 759) = 20.23$, $p < .001$</i>		

Predicting the *Non-Judging of Experience* Facet. The final facet of mindfulness assessed by the FFMQ is *Non-Judging of Experience* (FFMQ-NJ). A multiple regression analysis predicting the FFMQ-NJ with the MW-D and MW-S, shown in Table 7, revealed a familiar finding, that only the semi-partial correlation of the MW-S and FFMQ-NJ, controlling for MW-D, was statistically significant; this finding indicates that spontaneous mind wandering is associated with a decreased ability to be non-judgmental of one’s experiences. The pattern of findings here is notable in that it closely echoes our observations with the FFMQ-A (having an attentive awareness of one’s experiences). In both cases we observed a significant zero-order correlation with the MW-D, but did not find a significant semi-partial correlation after controlling for the MW-S.

Table 7. Multiple regression testing for unique contributions to *Non-judging of experience* by deliberate mind wandering (MW-D), spontaneous mind wandering (MW-S) (Sample 1: $N = 716$, Sample 2: $N = 762$)

Dependent variable: Non-judging of experience

	Sample 1			Sample 2		
	<i>sr</i>	<i>t</i>	<i>p</i>	<i>sr</i>	<i>t</i>	<i>p</i>
MW-D	-.03	0.77	.441	.03	0.90	.367
MW-S	.32	9.39	< .001	.29	8.36	< .001
	<i>Final Model: $R = .36$, $F(2, 713) = 51.65$, $p < .001$</i>			<i>Final Model: $R = .33$, $F(2, 759) = 45.54$, $p < .001$</i>		

Correlations with Combined MW-S and MW-D

In recent work, Mrazek et al. (2013) developed and validated a trait-level scale of mind wandering (the Mind-Wandering Questionnaire; MWQ) that was intended to index the frequency of mind wandering “irrespective of whether mind-wandering is deliberate or spontaneous” (p. 2). One important question to ask when considering the aforementioned analyses is what would happen if, rather than separate deliberate and spontaneous mind wandering, a researcher were to combine the two into one “overall” measure of mind wandering, thus treating mind wandering as a unitary construct. To shed some light on this question, we calculated the average of the combined reports of both spontaneous and deliberate mind wandering for each participant and correlated these overall reports of mind wandering with the five facets of the FFMQ. The Pearson product-moment correlation coefficients for overall mind wandering and all five facets of the FFMQ are presented in Table 8. As can be seen in Table 8, all of the facets of the FFMQ were significantly correlated with overall mind wandering. Of particular importance, however, is the negative correlation of overall mind wandering and the FFMQ-NR facet. The reason that this is noteworthy is because when conflating deliberate and spontaneous mind wandering, we miss out on the details surrounding MW-D’s association with non-reactivity (FFMQ-NR); indeed, recall that the MW-D was found to be significantly positively associated with the FFMQ-NR after controlling for the MW-S, whereas the combined measure of mind wandering demonstrates a negative relation with the FFMQ-NR. Thus, this practice of conflating deliberate and spontaneous mind wandering would result in limited conclusions about the relation of mind wandering and non-reactivity to inner experiences, and would completely mask the real underlying associations of deliberate and spontaneous mind wandering with non-reactivity.

Table 8. *Pearson Product-Moment Correlation Coefficients of FFMQ Measures with Overall Mind Wandering (combining MW-D and MW-S) (Sample 1: N = 716, Sample 2: N = 762)*

	Non-reactivity	Observing	Awareness	Describing	Non-judging
Overall Mind Wandering (Sample 1)	-.12**	.18***	-.51***	-.13**	.29***
Overall Mind Wandering (Sample 2)	-.11**	.18***	-.50***	-.17***	.29***

Note. *** $p < .001$, ** $p < .01$, 2-tailed

Study 1 Discussion

The results of Study 1 demonstrate that (1) deliberate and spontaneous mind wandering are dissociable and (2) conflating deliberate and spontaneous mind wandering might lead to underspecified and sometimes even false conclusions. Critically, we observed that, whereas spontaneous mind wandering was uniquely and negatively associated with difficulty taking a non-reactive stance toward internal experience (i.e., the FFMQ-NR), deliberate mind wandering was uniquely and positively associated with the same trait. We also observed that both spontaneous and deliberate mind wandering uniquely predicted an increased propensity to observe and/or attend to one's sensations, perceptions, thoughts, and feelings (the FFMQ-O). In addition, and perhaps most importantly, we showed that the correlation of "overall" (conflated) mind wandering with the FFMQ-NR was negative, even though deliberate mind wandering was, on its own, shown to positively correlate with this variable. Thus, on the basis of the overall correlation alone, one would be led to draw limited conclusions about the relation of mind wandering and non-reactivity. In fact, in smaller (more typical) samples, one might not even be

able to detect a relation of overall mind wandering and non-reactivity (or some variable of interest) because deliberate and spontaneous mind wandering might be oppositely associated with the variable of interest, and their combination will dampen the overall correlation.

To date, numerous researchers of mind wandering (including ourselves) have inferred that reports of mind wandering are reflective of 1) *unintentional* shifts in thought away from a focal task and/or 2) *failures of executive control* (e.g., Kane et al., 2007; Killingsworth & Gilbert, 2010; McVay & Kane, 2010; Seli, Cheyne, & Smilek, 2013; Smallwood & Schooler, 2006; but see Smallwood, 2013). One necessary assumption underlying this view is that individuals who are high in trait-level mind wandering engage in mind wandering because they cannot stop themselves from doing so. However, based on the present results, we suggest that trait-level reports of mind wandering might not exclusively capture spontaneous, unintentional thoughts, but might instead also include those that are deliberate. Thus, we suggest that if researchers seek to examine and understand the role of unintentional, spontaneous mind wandering, then it is paramount that they dissociate spontaneous from deliberate mind wandering.

In treating mind wandering as a non-uniform experience that can differ in terms of intentionality, the present work is consistent with and extends upon other work that has construed mind wandering as a heterogeneous – rather than a homogeneous – construct (Smallwood & Andrews-Hanna, 2013). In their recent article, Smallwood and Andrews-Hanna highlighted some of the contradictory findings in the extant literature on mind wandering. They then moved on to argue that these contradictions have arisen because there are multiple types of mind wandering that vary on the basis of their content, and that these different types of mind wandering might have their own unique consequences and associates. As an example of one such contradiction, they point to the fact that, whereas some research has argued that mind wandering

is a *detrimental state* associated with negative outcomes such as depression and unhappiness (e.g., Killingsworth & Gilbert, 2010), other work has shown that mind wandering can, at times, be conceived of a *beneficial state*, as it has been associated with positive outcomes such as increased creativity (Baird et al. 2012) and increases in one's propensity to plan future events (Baird, Smallwood, & Schooler, 2011). According to Smallwood and Andrews-Hanna, the foregoing contradiction likely resulted because researchers have focused on different types of mind wandering without constraining their interpretations to the specific type under investigation. For instance, it is possible that mind wandering that involves positively-valenced content might be associated with beneficial outcomes, whereas mind wandering that involves negatively-valenced content might be associated with detrimental outcomes. If, however, researchers do not distinguish between these different types of mind wandering then it is inevitable that contradictions will arise because these different types of mind wandering will share different associates.

While Smallwood and Andrews-Hanna (2013) argue that distinguishing between types of mind wandering on the basis of content might resolve contradictions in the literature, it also seems likely that distinguishing between spontaneous and deliberate types of mind wandering might likewise resolve some contradictions. Whereas Smallwood and Andrews-Hanna suggest that mind wandering episodes might differ in content, our additional suggestion is that episodes of mind wandering might differ in terms of process (relating to spontaneous versus deliberate mechanisms). Indeed, episodes of spontaneous and deliberate mind wandering might, at times, both consist of identical trains of thought (i.e., the content can be exactly the same), but these types of mind wandering would nevertheless be distinct in that one would be engaged with intention, and the other without intention. For example, as noted in the previous paragraph, mind

wandering has been referred to both as a beneficial state (e.g., it is associated with future planning; Baird et al., 2011) and detrimental state (e.g., it can be a cause of unhappiness; Killingsworth & Gilbert, 2010). When considering this apparent contradiction, it is plausible that future planning might be associated with deliberate, controlled mind wandering, whereas unhappiness might be the result of ruminative, unwanted mind wandering that occurs spontaneously. In this case, what might appear to be a contradiction would merely be the result of different types of mind wandering – each of which involves distinct cognitive processes – yielding different outcomes.

The present findings are also relevant to studies showing that people can exhibit some degree of control over their levels of mind wandering (see Bernhardt, Smallwood et al., 2014; Levinson, Smallwood, & Davidson, 2011; Smallwood, Ruby, & Singer, 2013; Thomson, Besner & Smilek, 2013). For instance, Thomson et al. (2013) showed that people more frequently mind-wander during easier congruent Stroop trials than during harder incongruent Stroop trials, and that, in both cases, people are able to effectively adjust their levels of mind wandering to prevent any noticeable costs on performance. Based on these results, Thomson et al. posited that, as task difficulty varies, people are able to adjust their level of mind wandering, which thereby allows them to optimize both their performance on the task as well as their level of mind wandering (for a similar suggestion, see also Levinson et al., 2011). Given that, by definition, deliberate mind wandering is under one's control, whereas spontaneous mind wandering is not under one's control, the present findings suggest that in the abovementioned studies, the manner in which people might be adjusting their levels of mind wandering is by specifically regulating their levels of deliberate (as opposed to spontaneous) mind wandering.

Although here we explored the unique contributions of deliberate and spontaneous mind wandering at a *trait level*, it will be important for future research to examine these types of mind wandering at a *state level*, as participants are completing a given task (see Shaw & Giambra, 1993), where there is also the possibility that experiences of mind wandering might be spontaneous and deliberate. An implicit assumption made by numerous researchers studying mind wandering is that their participants are motivated to perform well on the tasks that they are given in the laboratory and that they do their best to refrain from engaging in task-unrelated thought. However, because research on mind wandering often involves exceptionally monotonous and boring tasks, it might very well be the case that many participants seek to “escape” the task and to alleviate boredom by deliberately engaging in mind wandering. If this is in fact the case, then this will pose a serious problem for researchers; indeed, it may be the case that the majority of research purported to examine unintentional, spontaneous shifts in attention has in fact been inadvertently examining the mental behaviour of the unmotivated, deliberately mind-wandering participant. We therefore believe that our deliberate and spontaneous mind-wandering scales, as well as their state-level counterparts, will prove to be important tools for elucidating the nature of mind wandering both in laboratory and real-world settings.

Study 2:

The following work has been published in *Psychonomic Bulletin & Review* (Seli, Smallwood, Cheyne, & Smilek, 2015).

Mind wandering seems to be a prototypical feature of attention-deficit/hyperactivity disorder (ADHD). However, an important emerging distinction of mind-wandering types hinges on whether a given episode of mind wandering reflects a failure of executive control (spontaneous mind wandering) or the engagement of controlled processes for internal processing (deliberate mind wandering). Here we distinguish between spontaneous and deliberate mind wandering and test the hypothesis that symptoms of ADHD are associated with the former but not the latter. We assessed ADHD symptomatology and everyday levels of deliberate and spontaneous mind wandering in two large non-clinical samples ($Ns = 1,354$). In addition, to provide converging evidence, we examined rates of deliberate and spontaneous mind wandering in a clinically-diagnosed ADHD sample. Results provide clear evidence that spontaneous, but not deliberate, mind wandering is a central feature of ADHD symptomatology at both the clinical and non-clinical level. We discuss the implications of these results for understanding both ADHD and mind wandering.

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurobehavioral disorder characterized by inattention, impulsivity, and hyperactivity (Barkley, 1997; Douglas, 1983; Hinshaw, 1994). Of all the behavioural disorders of childhood, ADHD is the most commonly diagnosed, with a strikingly high prevalence rate of 5-10% (Polanczyk & Rohde, 2007). Although ADHD has long been thought to be a disorder of childhood, a growing body of research has shown that ADHD impairments can persist into adulthood (Barkley, Fischer, Edelbrock, & Smallish, 1990; Mannuzza et al., 2011), with an estimated adult-ADHD prevalence rate of 4.4% (Kessler et al., 2006). Given that ADHD is associated with problems of attention and concentration, it is perhaps not surprising to learn that it has been linked to a host of impairments, including problems with (1) executive control (Nigg, Butler, & Huang-Pollock, 2002), (2) academic performance (e.g., DeShazo, Lyman, & Klinger, 2002; Fergusson & Horwood, 1995; Hinshaw, 1992), (3) familial and marital relationships (e.g., Johnston et al., 2012), (4) occupational functioning (Barkley & Fischer, 2011), and (5) sustained attention (Barkley, 1997), to name a few. Thus, understanding ADHD, as well as its causes and consequences, has been an important focal point for many clinical researchers over the past few decades.

In a contemporary independent line of research, there has been an increasing amount of work examining the construct of mind wandering, which is often defined as the unintentional shifting of attention toward internal thoughts (e.g., Smallwood & Schooler, 2006; Smallwood et al., 2007). Reminiscent of certain ADHD symptoms, mind wandering involves distraction by internal thought and inattention to focal tasks (Smallwood & Schooler, 2006), and has been associated with (1) impulsivity (Cheyne, Solman, Carriere, & Smilek, 2009), (2) poor sustained attention (Seli, Carriere, Levene, & Smilek, 2013; Seli, Cheyne, & Smilek, 2013), and (3)

hyperactive behaviour (i.e., fidgeting; Seli, Carriere, et al., 2013), all of which are key characteristics of ADHD. Moreover, like ADHD, mind wandering has been linked to (1) poor academic performance (Risko et al., 2012; Szpunar, Khan, and Schacter, 2013), (2) elevated response variability (Seli, Carriere, et al., 2013; Seli, Cheyne, & Smilek, 2013), (3) failures of executive control (Kane et al., 2007), and (4) difficulties in the workplace (Knowles & Tay, 2002). While these findings are consistent with the hypothesis that mind wandering is a central feature of ADHD, research on these two topics has progressed relatively independently over the years and, to date, there have been few studies examining the role of mind wandering in the larger symptomatology of ADHD (Shaw & Giambra, 1993; Franklin et al., in press).

Although the aforementioned evidence and argument provide grounds to hypothesize that mind wandering is a central feature of ADHD, counterarguments are provided by recent research that has reported that at least some aspects of mind wandering are linked to patience (Smallwood, Ruby, & Singer, 2013), controlled processing (Gorgolewski et al., 2014), and premeditation (Smallwood, Nind, & O'Connor, 2009), all of which are often thought to be antithetical to ADHD characteristics. Moreover, mind wandering has been linked to a *reduction* in external distraction (Barron, Riby, Greer, & Smallwood, 2011), whereas ADHD is thought to be associated with *greater* distraction from external sources (Barkley, Koplowitz, Anderson, & McMurray, 1997).

Given the foregoing, one important question to ask is: why might it be the case that some correlates of mind wandering are consistent with ADHD symptomatology, whereas others are not? In answering this question, it is important to note that “mind wandering” is an umbrella term for the myriad mental experiences that people have that are not directly related to the external environment or focal tasks. Indeed, Smallwood and Andrews-Hanna (2013) have argued

that mind wandering is a heterogeneous experience and that the functional outcomes associated with the experience will depend in part on features of particular episodes, such as content (see also Seli, Carriere, & Smilek, in press). To date, there is evidence that mind wandering can vary on a number of dimensions including its: (1) temporal nature (Smallwood, Nind, & O'Connor, 2009), (2) topical stability (Ottaviani, Shapiro, & Couyoumdjian, 2013), (3) valence (Ruby, Smallwood, Engen, & Singer, 2013), (4) depth of decoupling (Seli, Carriere, Thomson, et al., 2014; Smallwood, Beach, Schooler, & Handy, 2008), (5) level of awareness (Schooler, 2002; Smallwood, McSpadden, & Schooler, 2007), and (6) intentionality (Carriere, Seli, & Smilek, 2013; Seli, Carriere, & Smilek, in press). Given the heterogeneous nature of mind wandering episodes, along with the hypothesis that different dimensions of mind wandering will be associated with different functional outcomes (Seli, Carriere, & Smilek, in press; Smallwood & Andrews-Hanna, 2013), it is perhaps unsurprising that there is a less than perfect correspondence between the experience of “mind wandering,” defined broadly, and the notion of distracted inattention in ADHD.

Of the aforementioned dimensions of mind wandering, one that is particularly relevant to the relation of mind wandering and ADHD symptoms is whether the mind wandering in question is deliberate or spontaneous. Research has shown that mind wandering can occur deliberately, with intention, or spontaneously, without intention (Carriere, Seli, & Smilek, 2013; Giambra, 1989; Seli, Carriere, & Smilek, in press; Shaw & Giambra, 1993). Importantly, it is the spontaneous, unintentional shifting of attention that seems closely relevant to ADHD symptomatology given that such experiences seem to reflect difficulties in controlled processing, problems with inhibiting distracting information, and unintentional task inattention (Carriere et al., 2013; Seli, Carriere, & Smilek, in press; Seli, Carriere, Xu, et al., under review). Deliberate,

intentional shifts, on the other hand, seem not to reflect problems in inhibiting distracting information, but instead reflect the willing engagement of thought, which is perhaps indicative of controlled processing (Carriere et al., 2013; Seli, Carriere, & Smilek, in press; Seli, Carriere, Xu, et al., under review). Thus, considering these subtypes of mind wandering in the context of ADHD, a more nuanced hypothesis is that spontaneous, but not deliberate, mind wandering is associated with ADHD.

The hypothesis that spontaneous, but not deliberate, mind wandering is associated with ADHD is supported by a study conducted by Shaw and Giambra (1993), in which the authors examined the frequency of spontaneous and deliberate mind wandering in three groups: (1) college students who self-reported that they had been diagnosed with ADHD during childhood, (2) a non-clinical group of students who were not previously labeled as having ADHD, but who scored in the top 10 percent on a questionnaire-based measure of ADHD (i.e., the Characteristics Rating-Child questionnaire; CR-C), and (3) a non-clinical group of students who were also not clinically labeled as having ADHD, and who scored in the bottom 10 percent on the CR-C. Participants completed a simple vigilance task for which they were instructed to make responses (button presses) to frequently presented small xs and to withhold responses to infrequently presented large Xs. Throughout the task, participants were intermittently presented thought probes that asked them to report whether, at any point since the previous probe, they had engaged in mind wandering, and if so, whether it was engaged spontaneously (without intention) or deliberately (with intention). The results showed that participants who were diagnosed with ADHD reported more spontaneous, but not deliberate, mind wandering relative to the other two groups. Moreover, participants in the non-clinical group reported more spontaneous, but not

deliberate, mind wandering than the group with no prior history of ADHD and scoring low on the measures of ADHD symptoms.

Although Shaw and Giambra's (1993) findings provide initial evidence for the hypothesis that ADHD is associated with spontaneous, but not deliberate, mind wandering, there are several important limitations of their study. First, they had relatively small sample sizes in each of their conditions (e.g., 13 participants in the ADHD condition). Second, Shaw and Giambra exclusively examined mind wandering occurring in the context of a boring vigilance task, which may not readily generalize to everyday scenarios in which the tasks people perform are, on the whole, arguably less boring. Third, Shaw and Giambra did not assess the potential independent (or unique) contributions of deliberate and spontaneous mind wandering in predicting ADHD. Although not discussed in detail in their article, the mind-wandering data that Shaw and Giambra collected were ipsative in nature; that is, in cases where participants' reported mind wandering, they were forced to indicate that their mind wandering was *either* spontaneous or deliberate (i.e., a "forced-choice" scale was used). As a result, there was a structurally-forced negative correlation between spontaneous and deliberate mind wandering, which precluded analyses examining the independent contributions of spontaneous and deliberate mind wandering.

The Present Study

Building on Shaw and Giambra's (1993) seminal work, in the present study we assessed ADHD symptomatology and trait-level mind-wandering propensity (both deliberate and spontaneous) in two very large non-clinical samples ($Ns = 1,354$). This design allowed us to extend Shaw and Giambra's study in the following three ways. First, it allowed for greater power to detect stable effects while also allowing for the possibility of replication across independent samples. Second, it allowed us to assess *everyday tendencies* to engage in both deliberate and

spontaneous mind wandering (i.e., mind wandering at the trait level) to determine whether the previously observed relation of spontaneous mind wandering and ADHD symptoms generalizes to everyday experiences of mind wandering. Third, it provided us the opportunity to explore the possibility that spontaneous and deliberate mind wandering might independently predict ADHD symptoms. To this end, we conducted a large survey study in which undergraduate psychology students completed online questionnaires assessing (1) trait levels of deliberate mind wandering (assessed with the Mind Wandering: Deliberate scale; MW:D; Carriere et al., 2013), (2) trait levels of spontaneous mind wandering (assessed with the Mind Wandering: Spontaneous scale; MW:S; Carriere et al., 2013), and (3) ADHD symptomatology (assessed with the short-form screener of the Adult ADHD Self-Report Scale v1.1; ASRS).

In addition to assessing non-clinical ADHD symptomatology via the ASRS screener, we also asked participants to report whether they had ever been clinically diagnosed with ADHD. Of all of the participants, 69 reported previous diagnoses. Thus, we also examined trait-level mind wandering propensity in this clinical group of individuals, seeking to determine whether they too reported higher levels of spontaneous (but not deliberate) mind wandering relative to a control sample matched on age and sex.

Study 2 Method

Participants

To allow for replication of our findings, we analyzed data from two separate non-clinical samples of undergraduate psychology students at the University of Waterloo. Each of the two samples consisted of 1,354 participants (mean age was 22.44 and 22.41 years for samples 1 and 2, respectively, with 985 females in sample 1, and 917 females in sample 2), all of whom completed every item of each questionnaire included in the study. Also included among the

scales of interest (i.e., Mind Wandering: Spontaneous (MW-S), Mind Wandering: Deliberate (MW-D), and the Adult ADHD Self-Report Scale v1.1; ASRS) were various other questionnaires that were of interest to other researchers, but that were not analyzed for the present study. Collectively, these questionnaires were given to participants in the first month of classes, and the order of presentation of the questionnaires was randomized across participants. Participants were therefore unaware of the relatedness of our scales. Participants received partial course credit for completing the questionnaires.

As noted above, of the 2,708 participants who completed our study, we identified a group of 69 individuals who reported that they had, at some point in their past, been clinically diagnosed with ADHD (mean age was 21.38, with 44 females; hereafter referred to as the Clinical ADHD Sample). For purposes of comparison, we created a group of 69 control participants (who had not been diagnosed with ADHD) matched on age and sex. This procedure was conducted on a case-by-case basis whereby each of the 69 participants in the Clinical ADHD sample was randomly paired with a control participant (i.e., one of the 2,639 participants who did not report having been clinically diagnosed with ADHD) of the same age and sex.

Measures

Deliberate and Spontaneous Mind Wandering. We used the 4-item Mind Wandering: Deliberate (MW-D) scale and the 4-item Mind Wandering: Spontaneous (MW-S) scale to index deliberate and spontaneous mind wandering, respectively (Carriere et al., 2013). The MW-D includes items that are related to intentional mind wandering, such as: “I allow my thoughts to wander on purpose,” whereas the MW-S includes items that are related to unintentional mind wandering, such as: “I find my thoughts wandering spontaneously.” Both scales are scored using a seven-point Likert scale.

The Adult ADHD Self-Report Scale v1.1. We measured ADHD symptoms using the short-form screener of the Adult ADHD Self-Report Scale v1.1 (ASRS), which consists of a checklist of six symptoms that, according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (DSM-IV), correspond to the presentation of ADHD symptoms in adults (Adler et al., 2006; Kessler et al., 2005). Each symptom in the screener includes a five-point Likert scale with possible responses ranging from 0 (Never) to 4 (Very Often). Whereas the complete ASRS scale consists of a checklist of 18 symptoms, scores on the six symptoms found in short-form screener of the ASRS can be used as a diagnostic screening criterion for ADHD (Krause et al., 2006), and previous research has noted that this screener outperforms the full ASRS, therefore making it more preferable than the full 18-item scale (Kessler et al., 2005).

Traditionally, to assess ADHD symptomatology via the ASRS screener, participants' ratings on each of the six symptoms are used to determine whether the symptom described is present or absent (i.e., each symptom is treated as existing on a dichotomous scale). For example, the first item of the ASRS screener is "How often do you have trouble wrapping up the final details of a project once the challenging parts have been done?" To this item, participants can respond: "Never," "Rarely," "Sometimes," "Often," or "Very Often." In the case of this particular item, a response of "Sometimes," "Often," or "Very Often" indicates the presence of that symptom, whereas responses of "Rarely" and "Never" indicates the absence of that symptom. According to the ASRS instructions, participants who present with 4 or more of the symptoms are at risk of ADHD and should consider taking part in a follow-up assessment with a clinician.

Although, as noted, the dichotomous-scoring method is traditionally used when assessing ASRS responses, some researchers have recently argued for the utility of assessing ADHD

symptoms along a continuum, rather than dichotomously (Overbey, Snell, and Callis, 2011; Whalen et al., 2003). In the case of the ASRS screener, this can be achieved by simply averaging each participant's responses to the symptoms presented in the checklist.

In the present study, we assessed ADHD symptoms using both of the aforementioned scoring methods to demonstrate that our findings are not dependent on the method of scoring used. Importantly, we find that the results are consistent across these two scoring methods. Thus, for the sake of both clarity and brevity, below we report only the results of the continuous-scoring method.

Study 2 Results

In the section that follows, we begin by examining the relations of mind wandering (both deliberate and spontaneous) and ADHD in our two Non-Clinical samples. Following these analyses, we examine these relations in our Clinical ADHD sample, seeking to determine whether the results are consistent across the different samples.

Non-Clinical Samples

Descriptive Statistics and Correlations. We first examined the descriptive statistics for the MW-D, MW-S, and the ASRS in our two Non-Clinical samples. The mean scores on the MW-D (Sample 1: $M = 4.43$, $SD = 1.44$; Sample 2: $M = 4.57$, $SD = 1.44$), MW-S (Sample 1: $M = 4.23$, $SD = 1.47$; Sample 2: $M = 4.32$, $SD = 1.37$), and ASRS (Sample 1: $M = 1.81$, $SD = 0.65$; Sample 2: $M = 1.94$, $SD = 0.62$) all showed good consistency across both samples. Next, we examined the Pearson product-moment correlation coefficients for all measures. As has been shown in previous studies (Carriere et al., 2013; Seli, Carriere, & Smilek, in press), the MW-D and MW-S were moderately positively correlated across our two samples, $r = .39$ (Sample 1) and $r = .40$ (Sample 2; both $ps < .001$). Additionally, and consistent across both samples, we

observed a positive relation of both the MW-D and ASRS, $r = .23$ (Sample 1) and $r = .25$ (Sample 2; both $ps < .001$), and the MW-S and ASRS, $r = .52$ (Sample 1) and $r = .47$ (Sample 2; both $ps < .001$), indicating that individuals showing greater levels of ADHD symptoms experience higher levels of both deliberate and spontaneous mind wandering.

Regression Analyses. Given that the MW-D and MW-S were moderately correlated with one another across our two samples, we next sought to determine their unique contributions to ASRS scores. Thus, for each sample, we conducted a multiple regression analysis predicting ASRS with the MW-D and MW-S (see Table 9). In both samples, the MW-S regression coefficients were significant and relatively large, and the semi-partial correlations with the ASRS appeared to be strikingly linear (see Figure 1). On the other hand, the semi-partial correlation of MW-D and ASRS was non-significant in Sample 1 ($F_{change}(1, 1,351) = 1.833, p = .176$), although in Sample 2 its inclusion in the multiple regression analysis did result in a significant, if modest, boost in predictive power over the MW-S alone ($F_{change}(1, 1,351) = 7.658, p < .006$) (see Figure 1). It is, however, worth noting that in Sample 2, the inclusion of the MW-D only accounted for an R^2_{change} of .004, and that this considerably small increase in predictive power was significant only because of the very large sample. Thus, the results of the regression analyses indicate that, whereas spontaneous mind wandering is strongly independently related to ADHD symptoms, deliberate mind wandering is, at best, very weakly associated with such symptoms.

Table 9. Multiple regression testing for unique contributions to ASRS by deliberate mind wandering (MW-D) and spontaneous mind wandering (MW-S) (Sample 1: $N = 1,354$, Sample 2: $N = 1,353$)

Dependent variable: ASRS

	Sample 1			Sample 2		
	<i>sr</i>	<i>t</i>	<i>p</i>	<i>sr</i>	<i>t</i>	<i>p</i>
MW-D	.03	1.35	.176	.07	2.77	.006
MW-S	.47	19.93	<.001	.40	16.61	<.001
	<i>Final Model: R = .52, F(2, 1351)</i> = 250.01, $p < .001$			<i>Final Model: R = .47, F(2, 1351)</i> = 191.57, $p < .001$		

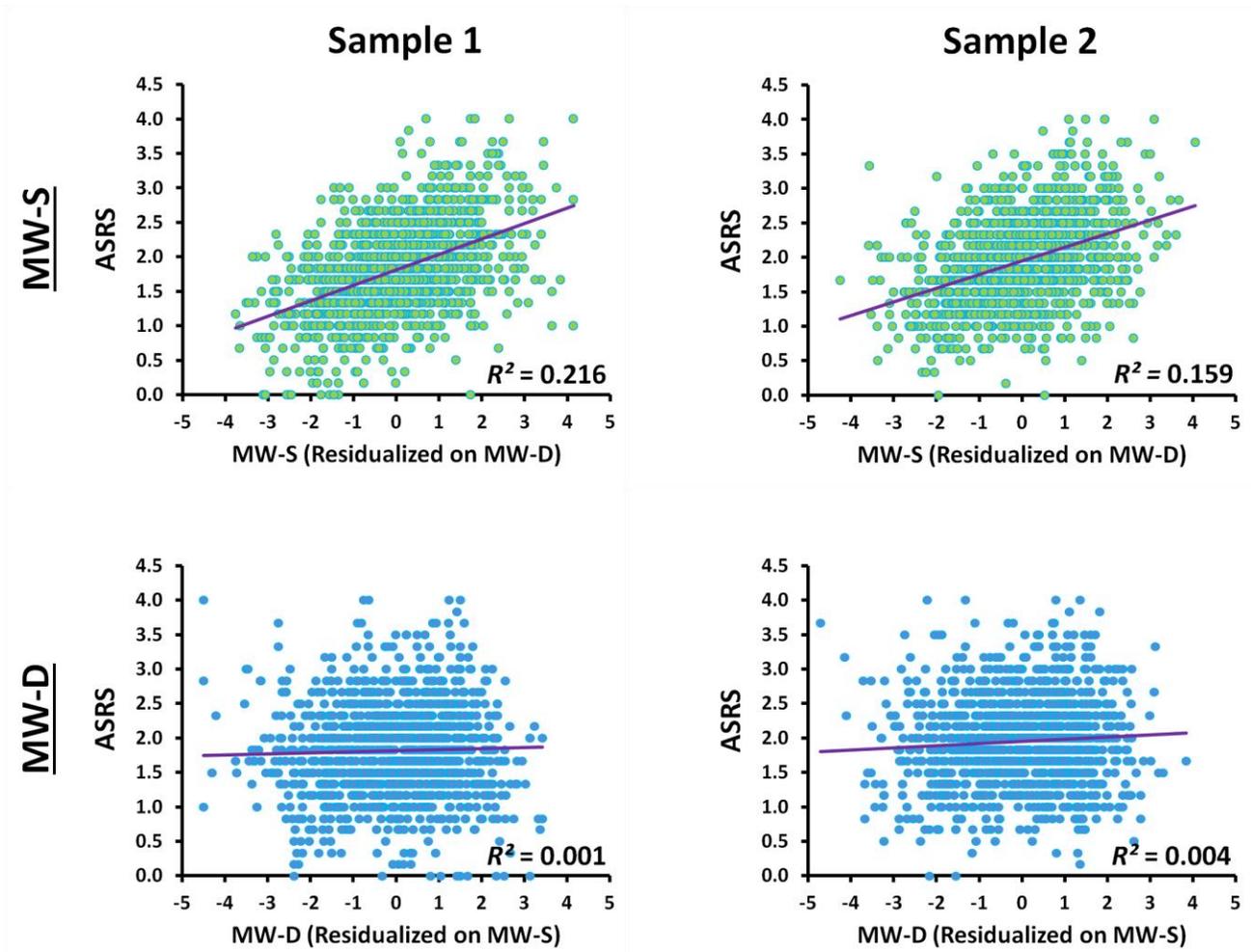


Figure 1. Scatterplots showing the unique relations of the MW-S (top row) and MW-D (bottom row) with the ASRS, for samples 1 (left column) and 2 (right column).

Clinical Sample

Having demonstrated that spontaneous, but not deliberate, mind wandering was consistently and uniquely associated with ADHD symptomatology in two large Non-Clinical samples, we next sought to determine whether this same pattern of results would emerge when comparing mind-wandering rates across a clinical ADHD group of participants and a control group of Non-Clinical participants who were matched on age and sex.

Deliberate and Spontaneous Mind Wandering. Mean reports of deliberate and spontaneous mind wandering for each Sample (Clinical and Non-Clinical) are presented in Figure 2. To determine whether reports of these two types of mind wandering differed across the two samples, we conducted a 2 by 2 mixed Analysis of Variance (ANOVA) with Sample as the between-subjects factor and Mind-Wandering Type (Deliberate vs. Spontaneous) as the within-subjects factor. The analysis yielded a significant main effect of Mind-Wandering Type, $F(1, 136) = 5.22, MSE = 1.37, \eta_p^2 = .04, p = .024$, but a non-significant effect of Sample, $F(1, 136) = 2.35, MSE = 3.05, \eta_p^2 = .02, p = .127$. There was, however, a significant interaction, $F(1, 136) = 9.49, MSE = 1.37, \eta_p^2 = .07, p = .002$. Given that the MW-S and MW-D were again found to be moderately correlated across each of our samples ($r = .25$ and $r = .50$ for the Clinical and Non-Clinical samples, respectively), we followed-up on this interaction by conducting two separate Univariate Analyses of Covariance (ANCOVAs) in which we examined the rates of each of the two types of mind wandering across our two samples while statistically controlling for the influence of other type of mind wandering. First, we examined rates of spontaneous mind wandering across our two samples while controlling for the influence of deliberate mind wandering. Thus, Spontaneous Mind Wandering was entered as the dependent variable, Sample as the fixed factor, and Deliberate Mind Wandering as a

covariate. The analysis yielded a significant effect of Deliberate Mind Wandering, $F(1, 135) = 22.63$, $MSE = 1.86$, $\eta_p^2 = .14$, $p < .001$. Moreover, there was a significant effect of Sample, $F(1, 135) = 11.80$, $MSE = 1.86$, $\eta_p^2 = .08$, $p = .001$, indicating that, when controlling for Deliberate Mind Wandering, individuals in the Clinical sample still showed significantly higher levels of Spontaneous Mind Wandering ($M = 5.13$) than those in the Non-Clinical sample ($M = 4.33$). Next, we examined rates of Deliberate Mind Wandering across our two samples while statistically controlling for the influence of Spontaneous Mind Wandering. Here, Deliberate Mind Wandering was entered as the dependent variable, Sample as the fixed factor, and Spontaneous Mind Wandering as the covariate. Results revealed a non-significant effect of Sample, $F(1, 135) = 2.73$, $MSE = 1.95$, $\eta_p^2 = .02$, $p = .101$, indicating that rates of Deliberate Mind Wandering were equivalent across the Clinical sample ($M = 4.20$) and Non-Clinical sample ($M = 4.61$), even when controlling for the influence of Spontaneous Mind Wandering. Importantly, these findings are consistent with those obtained when examining mind-wandering rates and ADHD symptomatology in our two large Non-Clinical samples, and thus provide further evidence to support the claim that spontaneous, but not deliberate, mind wandering is a central feature of ADHD symptomatology.

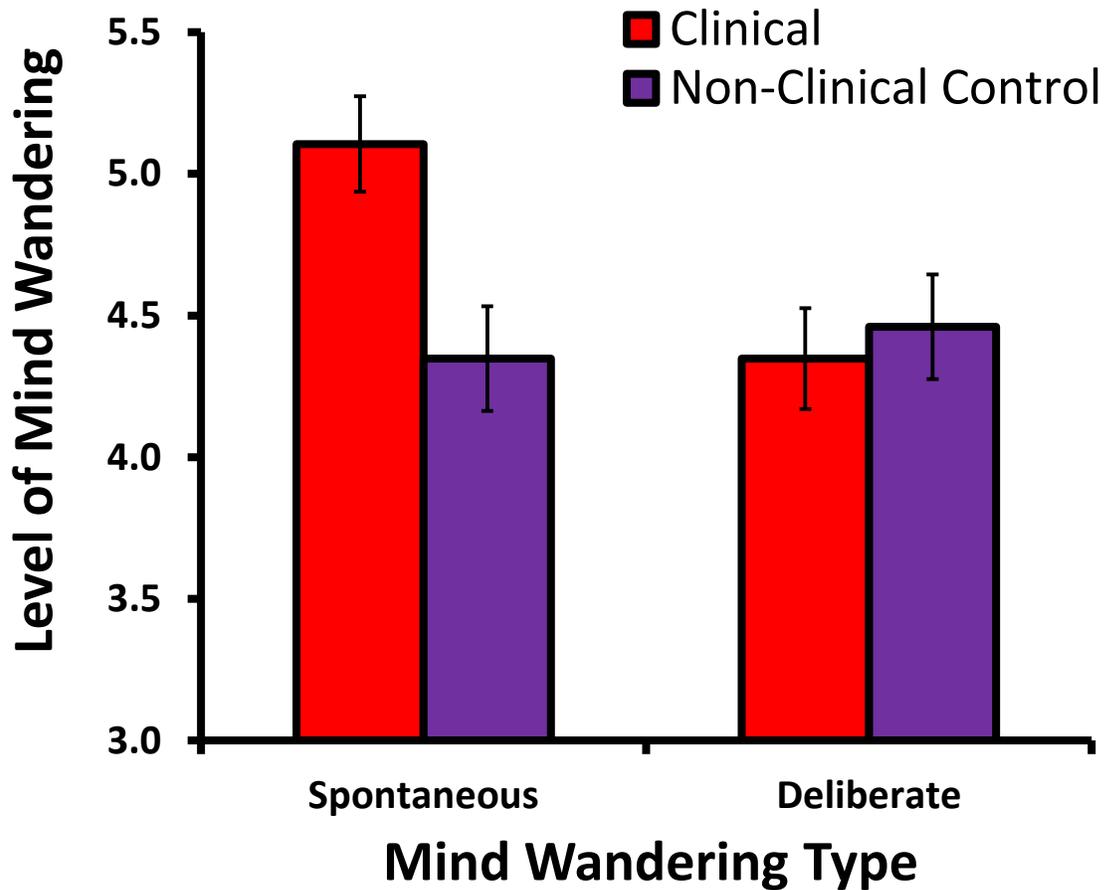


Figure 2. Mean levels of deliberate and spontaneous mind wandering for the Clinical and Non-Clinical samples. Error bars are one standard error of the mean.

Study 2 Discussion

The results of the present study are consistent with Shaw and Giambra’s (1993) finding that spontaneous, but not deliberate, mind wandering is associated with ADHD symptoms. Critically, given that (1) our results replicated across two very large samples, (2) similar results were observed irrespective of which scoring system was used for the ASRS, and (3) results were consistent across clinical and non-clinical populations, the present study clearly demonstrates the robustness of this important theoretical relation, and in doing so circumvents recent concerns regarding the reliability of psychological research (e.g., Pashler &

Wagenmakers, 2012). In addition, our results extend Shaw and Giambra's work providing evidence that: (1) the observed relation of spontaneous mind wandering and ADHD symptoms holds when examining spontaneous mind wandering as reported for everyday settings (i.e., at the trait level), (2) this remains the case when statistically controlling for levels of deliberate mind wandering, and (3) the relation of spontaneous mind wandering and ADHD symptoms is strikingly linear, suggesting that indexing ADHD symptoms along a continuum, rather than as a dichotomous split, might provide a more sensitive measure of the associates of ADHD, as has been recently proposed (Overbey, et al., 2011).

In addition to the foregoing, the results of the present study indicate that, in considering possible methods of intervention for ADHD, it will be important for researchers to specifically focus on identifying ways to reduce unintentional, spontaneous shifts in attention, rather than broadly-measured "inattention," which includes the experience of deliberate disengagement with the external environment. Indeed, given that deliberate mind wandering was found to be, at best, very weakly associated with ADHD symptoms (although inconsistently across our two samples), a focus on reducing unwanted, unintentional, and spontaneous mind wandering seems to be warranted in future investigations.

The present results appear to overlap in interesting ways with recent work by Franklin et al. (in press), who observed a positive relation of probe-caught mind wandering and ADHD symptomatology in an adult sample. One particularly intriguing finding from their study was that participants who reported high levels of ADHD were also more likely to report a lack of awareness of their mind wandering as it occurred. In linking Franklin et al.'s work to the present findings, it seems a plausible hypothesis that spontaneous, uncontrolled mind wandering is more likely to occur in the absence of awareness than deliberate mind wandering.

Of course, awareness and control need not completely overlap with one another in that it is theoretically possible that an individual can, for example, engage in spontaneous mind wandering while being completely aware of the fact that (s)he is mind wandering. On the one hand, then, these results suggest the possibility that it is a *lack of control* over one's mind wandering that is the critical factor involved in explaining the sometimes detrimental consequences of this form of internal distraction. On the other hand, however, it is possible that the critical factor is not one's level of control over mind wandering, but is instead one's *level of awareness* of mind wandering. Alternatively, perhaps ADHD is specifically associated with mind wandering that is characterized both by a lack of control and a lack of awareness. Critically, what this suggests is that the frequency at which one engages in overall mind wandering may not be the key factor involved in producing attention-related deficits, but that instead control over, and/or awareness of, mind wandering may be important.

While the results of our study have important implications for researchers interested in studying ADHD symptomatology, more generally, our observed association of spontaneous mind wandering and ADHD provides evidence in support of the recently proposed view that it is inappropriate to treat mind wandering as a, unitary, or homogeneous experience (e.g., Seli, Carriere, & Smilek, in press; Smallwood & Andrews-Hanna, 2013). While initial empirical and theoretical work has treated mind wandering as a homogeneous state, recent work has established that different experiential categories (or dimensions) of mind wandering can be identified. For instance, as noted in the Introduction, some recently identified dimensions of mind wandering include its temporal focus (Smallwood, Nind, & O'Connor, 2009), level of awareness (Schooler, 2002), and valence (Ruby et al., 2013), to name a few. In each case, these dimensions have been shown to predict unique variance in independent outcomes such as

neural activity (Gorgolewski et al., 2014), mood (Ruby et al., 2013), and, in the present case, ADHD symptoms. Thus, the acknowledgment of a multiplicity of states within the construct of mind wandering might well explain one of the fundamental paradoxes of mind wandering: namely, that for some individuals, mind wandering is a source of unhappiness and error (Killingsworth & Gilbert, 2010; McVay & Kane, 2009; respectively), and for others, a source of creativity and constructive thought (Baird et al., 2012; Kaufman & Singer, 2011).

Finally, we acknowledge the possibility that one limitation of the present findings is that we indexed participants' subjective reports of trait-level mind wandering and ADHD symptomatology, and that other measures might lead to different findings than those observed here. However, with respect to our measure of mind wandering, we note that previous studies (Franklin et al., in press; Shaw & Giambra, 1993) have already shown that ADHD is associated with probe-caught mind wandering, suggesting some degree of generality of the present findings. Furthermore, with respect to our measure of ADHD, we note that we not only collected participants' subjective reports using a standard clinical tool (i.e., the ASRS), but we also asked them whether they have received a clinical diagnosis of ADHD. The fact that we obtained participants' reports about their clinical diagnoses goes some way toward allaying the concern that our results are simply attributable to the particular measures employed in the present study. While replication of the present findings with various measures will be useful, our results present good evidence to suggest a link between trait-level spontaneous mind wandering and ADHD, and should therefore provide fruitful ground for future research on the topic.

Having demonstrated that *trait-level* deliberate and spontaneous mind wandering are dissociable experiences that sometimes differentially relate to critical variables of interest, I next moved on to examine *state-level* deliberate and spontaneous mind wandering, seeking to determine whether these in-the-moment experiences are likewise dissociable, and whether there is practical utility in distinguishing between these two types of cognitive experiences (i.e., whether they are differentially associated with certain variables of interest).

Study 3

The following work has been published in the *Journal of Experimental Psychology: Learning, Memory, & Cognition* (Seli, Cheyne, Xu, Purdon, & Smilek, 2015).

Researchers of mind wandering frequently assume that (1) participants are motivated to do well on the tasks they are given, and (2) task-unrelated thoughts (TUTs) that occur during task performance reflect *unintentional*, unwanted thoughts that occur despite participants' best intentions to maintain task-focus. Given the relatively boring and tedious nature of most mind-wandering tasks, however, there is the possibility that some participants have little motivation to do well on such tasks, and that this lack of motivation might in turn result in increases specifically in *intentional* TUTs. In the present study, we explored these possibilities, finding that individuals reporting lower motivation to perform well on a sustained-attention task reported more intentional relative to unintentional TUTs compared to individuals reporting higher motivation. Interestingly, our results indicate that the extent to which participants engage in intentional versus unintentional TUTs does not differentially relate to performance: both types of off-task thought were found to be equally associated with performance decrements. Participants with low levels of task-motivation also engaged in more overall TUTs, however, and this increase in TUTs was associated with greater performance decrements. We discuss these findings in the context of the literature on mind wandering, highlighting the importance of assessing the intentionality of TUTs and motivation to perform well on tasks assessing mind wandering.

A basic assumption underlying human psychological research is that most participants are at least moderately motivated to perform acceptably on laboratory tasks. Indeed, there is a tradition of concern in psychology that participants may often be overly motivated to perform well on laboratory tasks, at least in the sense of producing desirable results for the researcher (i.e., demand characteristics; e.g., Orne, 2009; Saegert, Swap, & Zajonc, 1973). It is thus standard procedure in psychological research to attempt to conceal the underlying hypothesis from participants lest they, in their zeal to be ‘good’ participants, produce false positives. Somewhat less concern and systematic analysis has been evident regarding unmotivated, malingering participants, though some (e.g., Webster & Sell, 2007) have expressed concerns regarding low levels of motivation in participants, particularly when participation is associated with course credit. Researchers sometimes try to address such concerns by attempting to induce extrinsic motivation through monetary incentives (for a review see Deci, Koestner, & Ryan, 1999), though these are often sufficiently modest as to arguably induce reactance rather than motivation. Other studies attempt to assess the level of motivation by directly asking participants about their motivation to be attentive, do well, conform to instructions, and the like (e.g., Unsworth & McMillan, 2013). This latter point is of particular importance as laboratory tasks vary in their intrinsic interest as well as their apparent pragmatic relevance to the “real world,” or to the participants themselves. It is thus a reasonable assumption that participants will vary in their judgment of the deep importance or utter triviality of the study of many psychological processes, and that this, in turn, will be associated with varying levels of motivation.

Although the concern that participants might exhibit very different levels of motivation during laboratory tasks is arguably important for most (if not all) studies of human psychology,

one area of psychological research in which this concern is particularly relevant is the study of mind wandering. Mind wandering has been commonly conceptualized as task-unrelated thoughts (i.e. TUTs) that often occur *spontaneously, without intention* (e.g., Baars, 2010; Carciofo, Du, Song, & Zhang, 2014; He, Becic, Lee, & McCarley, 2011; Klinger, 2009; Kane & McVay, 2013; Mason et al., 2007; McVay & Kane, 2010; O’Callaghan, Shine, Lewis, Andrews-Hanna, & Irish, 2014; Seli, Cheyne, & Smilek, 2013; Smallwood, O’Connor, Sudbery, & Obonsawin, 2007; Smallwood, McSpadden, & Schooler, 2007; Smallwood & Schooler, 2006; Zavagnin, Borella, & De Beni, 2014). Importantly, the assumption that TUTs reported in laboratory studies often occur without intention is conceptually critical as research on mind wandering is itself often motivated by an interest in the occurrence of TUTs that are beyond the control of participants; that is, TUTs that occur despite participants’ best efforts to remain engaged with their task (e.g., He et al., 2011; Kane & McVay, 2013; McVay & Kane, 2010; Seli, Cheyne, & Smilek, 2013; Smallwood & Schooler, 2006).

However, that at least some of the TUTs occurring during laboratory tasks are deliberate or intentional (rather than spontaneous/unintentional) has been previously reported in several studies (Carriere, Seli, & Smilek, 2013; Seli, Carriere, & Smilek, 2014; Forster & Lavie, 2009; Seli, Smallwood, Cheyne, and Smilek, in press; Shaw & Giambra, 1993). An early study by Shaw and Giambra (1993), for example, examined rates of what they referred to as “spontaneous” and “deliberate” TUTs in individuals diagnosed with attention-deficit/hyperactivity disorder (ADHD) and in healthy controls. Participants completed a vigilance task in which they were presented a series of large and small ‘X’s, and were instructed to make a button press upon presentation of each small ‘x’ and to refrain from making a button press when presented with a large ‘X’. Throughout the task, participants were

asked to report whether they had experienced any TUTs. In particular, upon presentation of intermittent ‘thought probes’ (a beep), participants were instructed to report any instances of either unintentional (spontaneous) or intentional (deliberate) TUTs that had occurred since the termination of the previous probe. On the whole, participants reported that they deliberately engaged in TUTs roughly 58% of the time that a probe was presented. Importantly, these results suggest that, although mind-wandering researchers often assume that the TUTs indexed in their studies are reflective of “mind wandering” – formally defined as internally-focused unintentional thought – many of these thoughts believed to reflect mind wandering might instead reflect intentionally engaged task-unrelated thought.

Keeping in mind the aforementioned results, let us return to consideration of the potential role of motivation on performance in studies of mind wandering. If one considers the participant who deliberately engages in TUTs during laboratory tasks, one reasonable hypothesis is that this participant would, if questioned on the matter, report low levels of motivation to perform well on the task given to him. Indeed, it would seem incongruous for a highly motivated participant to intentionally engage in off-task thought, since doing so would presumably result in performance decrements. On the other hand, if we consider the participant who is highly motivated to perform well on her task, and to thus refrain from engaging in TUTs, it is reasonable to assume that if this participant does engage in off-task thoughts, these thoughts will occur unintentionally, as this participant would arguably be motivated to refrain from engaging in off-task thought. If these assumptions are valid, then they suggest the interesting possibility that TUTs associated with low motivation might be qualitatively different from TUTs that occur despite higher levels of motivation.

Although motivation and deliberate mind wandering would seem to be obviously intimately related, to the best of our knowledge the relation between motivation and intentionality of TUTs has not yet been examined. However, a recent study (Unsworth and McMillan, 2013) did examine motivation and TUTs during a reading comprehension task, and, to this end, had participants read half of a chapter from a college-level political science textbook. While reading, participants were occasionally presented thought probes to assess whether they were mind wandering (i.e., engaged in task-unrelated thought) just prior to the presentation of each probe. After completing the reading task, participants were given a reading-comprehension test on the material they had just read, followed by two questions assessing their motivation to do well on the reading-comprehension test. Critically, Unsworth and McMillan reported that the relation of motivation and task performance (in this case, reading comprehension; e.g., Humphreys & Revelle, 1984; Pintrich & DeGroot, 1990; Struthers, Perry, & Menec, 2000) was fully mediated by TUTs: Participants who had lower levels of motivation were more likely to engage in TUTs during the reading task, and in turn, this increased propensity to engage in off-task thought negatively predicted test performance.

Whereas Unsworth and McMillan (2013) were primarily interested in predictors of reading comprehension rather than the conceptual and theoretical implications of their finding for mind-wandering research in general, their results suggest that motivation is potentially an important variable to consider in all studies of mind wandering. Indeed, as noted, many mind-wandering researchers have expressed interest in unintentional TUTs that occur despite people's best intentions to focus on their external environment (e.g., He et al., 2010; Kane & McVay, 2013; McVay & Kane, 2010; Smallwood et al., 2007; Smallwood & Schooler, 2006); that is, TUTs that occur unintentionally when participants are highly motivated to perform well

and to refrain from engaging in off-task thought. However, given the finding that low motivation is predictive of high levels of TUT, there is the possibility that many studies of mind wandering have instead, or in addition, assessed intentional off-task thought that occurs when participants have little motivation to remain attentive to, and perform well on, the task. Thus, the previously observed relations of mind wandering and task performance might well be driven primarily by participants who have low motivation to engage in the tasks we give them, and who, consequently, intentionally engage in off-task thought.

In the present study, we explored this possibility by assessing TUTs (both intentional and unintentional), task performance, and motivation in a sustained-attention task: the Metronome Response Task (MRT; Seli, Cheyne & Smilek, 2013). For this task, participants are presented a continuous series of tones and are instructed to respond synchronously with each tone (via button press) such that each response is to be made at the exact time at which each tone is presented. To perform well on the MRT, participants must continually attend to the temporal structure of the task to anticipate the presentation of each upcoming tone. Variability in response times to the tones is thus taken as an indicator of failures of sustained attention, with increased response variability reflecting poorer sustained attention (Seli, Carriere, Thomson, et al., 2014; Seli, Carriere, Levene, & Smilek, 2013; Seli, Cheyne, & Smilek, 2013; Seli, Jonker, Solman, Cheyne, & Smilek, 2013). Throughout the MRT, we sampled participants' thoughts by intermittently presenting thought probes to which participants could respond: (1) focused on the task, (2) intentionally thinking about task-unrelated thoughts, or (3) unintentionally thinking about task-unrelated thoughts.

We first sought to determine whether, as reported by Shaw and Giambra (1993), participants frequently engage in intentional TUTs during a sustained-attention task (i.e., the

MRT). We then analyzed the relations among motivation and TUTs (overall as well as intentional and unintentional). Next, we examined the relations among motivation and TUTs (both intentional and unintentional) and performance on the MRT. Finally, we sought to replicate Unsworth and McMillan's (2013) finding that the relation of motivation and performance was fully mediated by overall TUT rates, and extended this work by also examining the possible differential roles that intentional and unintentional mind wandering might play in the complex relationship of motivation, TUTs, and performance.

Study 3 Method

Participants

Participants were 166 undergraduate students enrolled in psychology courses at the University of Waterloo. Two participants did not report any mind wandering and thus did not contribute data to any analyses examining the proportion of mind wandering that was intentional/unintentional (i.e., "Proportion Intentional"; see Results section). For the sake of simplicity in reporting the results, we excluded these participants' data from all analyses below. Importantly, however, the inclusion of these participants' data did not affect any of the results reported here.

Apparatus

Stimulus presentation was controlled by an Acer Aspire AX1930-ES10P desktop computer. The MRT program was constructed using E-Prime 1.2 software (Psychology Software Tools Inc., Pittsburgh, PA). Auditory stimuli were presented to participants via Sony MDR-XD200 Stereo Headphones. We report all measures collected in our study.

The Metronome Response Task (MRT)

The MRT (Seli, Cheyne, & Smilek, 2013) is a sustained-attention task requiring participants to attentively monitor a sequence of tones in order to provide a key-press response in synchrony with the periodic metronome tones. The rationale behind the task is as follows: If one's attention lapses at any time during task completion, then the estimation of when the tone will occur will be affected and thus the timing of one's responses will become more variable.

In the present study, each MRT trial began with 650 ms of silence followed by the presentation of a tone (lasting 75 ms) and a further 575 ms of silence. Thus, the total trial duration was 1300 ms. Participants were instructed to respond (i.e., "press the spacebar") synchronously with each tone so that their responses were made at the exact time at which each tone was presented. Participants first completed 18 practice trials intended to familiarize them with the task, after which they completed 900 experimental trials. One thought probe was randomly presented in each block of 50 trials, for a total of 18 probes. Upon presentation of each probe, the MRT stopped and participants were asked to indicate (via key press) whether they were, just prior to the onset of the probe, (1) on task, (2) intentionally thinking about task-unrelated thoughts, or (3) unintentionally thinking about task-unrelated thoughts. After providing a response to each thought probe, participants were instructed to press the spacebar to resume the MRT.

MRT Measures

Rhythmic-Response Times (RRTs; Seli, Cheyne, & Smilek, 2013) were calculated on each trial as the difference between the onset of each tone and the associated button press. The mean RRT thus indexes the extent to which participants approximate the onset of the tone. Variability in RRTs is, however, the primary measure of interest yielded by the MRT, and

hence we computed an RRT variance score by first categorizing RRTs in 5-trial moving windows over the task duration. Within each 5-trial window, we then computed the variances of the observed RRTs and averaged these variance scores for an overall measure of RRT variance (see Seli, Carriere, et al., 2013; Seli, Jonker, Cheyne, Cortes, & Smilek, in press). To minimize problems of contamination in variance resulting from the disruptive nature of the thought probes, we excluded from our variance calculations all RRTs collected five trials after each probe. RRT variance values were normalized using a natural logarithm transformation (see Seli, Cheyne, & Smilek, 2013).

Task Motivation

Immediately following the MRT, participants were presented a single-item question asking them about the extent to which they were motivated during the task. Specifically, participants were asked “How motivated were you to perform well on the task?” (Unsworth & McMillan, 2013). The anchor ratings for this question were 1 (*not motivated at all*) and 7 (*very motivated*), and participants indicated their level of motivation by making a key-press.

Study 3 Results

Descriptive statistics for all measures are presented in Table 10. As can be seen in Table 10, all measures were approximately normally distributed, and skewness and kurtosis values were within an acceptable range (i.e., skewness < 2 and kurtosis < 4; Kline, 1998).

First, we were interested in examining the proportion of overall TUTs that was engaged intentionally. As can be seen in Table 10, and consistent with Shaw and Giambra’s (1993) findings, here we found that a considerable proportion of TUTs (.41) reported by participants was engaged intentionally.

Table 10. Descriptive Statistics for All Measures ($N = 164$)

Measure	<i>M</i>	<i>SD</i>	Range	Skew	Kurtosis
Overall RRT Variance	8.37	0.74	6.81-10.72	.549	.596
Overall TUTs	.61	0.25	.06-1	-.362	-.813
Intentional TUTs	.26	0.22	0-1	1.029	.549
Unintentional TUTs	.34	0.20	0-.94	.469	-.194
Proportion of TUTs that was					
Intentional	.41	0.27	0-1	.274	-.704
Motivation	3.66	1.47	1-7	-.106	-.658

Note. Overall RRT variance = Overall Rhythmic Response Time variance; Overall TUTs = the proportion of thought probes to which participants reported engaging in TUT; Intentional TUTs = the proportion of thought probes to which participants reported intentionally engaging in TUT; Unintentional TUTs = the proportion of thought probes to which participants reported unintentionally engaging in TUT; Proportion of TUTs that was Intentional ($prop(I/TUT)$) = the proportion of overall TUTs that was engaged intentionally; Motivation = Self-reported motivation to do well on the MRT.

Next, we sought to explore the relations among Motivation and Proportion of Overall TUTs, as well as Motivation and Proportion of TUTs that was Intentional. To clarify, the computation of the Proportion of TUTs that was Intentional – denoted as $prop(I/TUT)$ – involved dividing the number of intentional TUT reports by the number of reports of intentional plus unintentional TUTs (i.e., overall TUTs). We chose to focus on $prop(I/TUT)$ because the dependencies inherent in the ipsative nature of intentional and unintentional mind wandering reports precluded directly comparing intentional and unintentional mind wandering reports. Consistent with previous work (Unsworth & McMillan, 2013), we found a significant negative relation of Motivation and Overall TUTs, $r(164) = -.48, p < .001$, indicating that individuals who were less motivated to do well on the MRT engaged in more TUTs. Critically,

we also observed a significant negative relation between the Prop(I/TUT) and Motivation, $r(164) = -.21, p < .01$, demonstrating that, as motivation to do well on the task decreased, the proportion of overall TUTs that were intentional increased (see Table 11 for Pearson Product-Moment correlations of all measures).

Table 11. *Pearson Product-Moment Correlations of All Measures (N = 164)*

	Overall TUTs	Intentional TUTs	Unintentional TUTs	Proportion of TUTs that was Intentional	Motivation
Overall RRT Variance	.31**	.18*	.19*	.03	-.25**
Overall TUTs		.65**	.50**	.21**	-.48**
Intentional TUTs			-.33**	.80**	-.42**
Unintentional TUTs				-.65**	-.12
Proportion of TUTs that was Intentional					-.21**

Note 1. ** $p < .001$, * $p < .05$

Note 2. Overall RRT variance = Overall Rhythmic Response Time variance; Overall TUTs = the proportion of thought probes to which participants reported engaging in TUT; Intentional TUTs = the proportion of thought probes to which participants reported intentionally engaging in TUT; Unintentional TUTs = the proportion of thought probes to which participants reported unintentionally engaging in TUT; Proportion of TUTs that was Intentional (prop(I/TUT)) = the proportion of overall TUTs that was engaged intentionally; Motivation = Self-reported motivation to do well on the MRT.

Given that participants reported that a considerable number of their TUTs were engaged intentionally, there is the possibility that in other studies of mind wandering that do not distinguish between intentional and unintentional TUTs, participants' reports of TUTs are composed of both intentional and unintentional TUTs. To explore this possibility, we

compared the overall rate of TUTs in the present study to the overall rate of TUTs from a previously published study that used the MRT, but that did not distinguish between intentional and unintentional TUTs (Seli, Carriere, Thomson, et al., 2014, Study 1; $N = 74$)¹. Results of an independent samples t -test indicated that the Overall TUT rate in the present study ($M = .61$, $SD = 0.25$) was not significantly different from the overall TUT rate in Seli and colleagues' study ($M = .62$, $SD = 0.22$), $t(236) = 0.47$, $SE = 0.03$, $p = .64$, $d = .07$. This finding is consistent with, though not a direct test of, the hypothesis that when reporting unspecified TUTs, participants may be reporting both intentional and unintentional TUTs. Thus, studies that do not distinguish between intentional and unintentional off-task thought may well be conflating these two types of thought.

In our next set of analyses, we examined the relation of TUTs (both the proportion of Overall TUTs and $\text{prop}(I/TUT)$) and performance on the MRT (i.e., overall RRT Variance). As expected, we found that individuals who reported more Overall TUTs also showed increased RRT Variance (i.e., poorer performance), $r(164) = .31$, $p < .001$. We did not, however, observe a significant relation of RRT Variance and $\text{Prop}(I/TUT)$, $r(164) = .03$, $p = .71$. To determine whether these two correlations were significantly different from one another, we conducted a Williams test, finding that the correlations were indeed significantly different each other, $t(161) = 2.97$, $p < .01$. Critically, these findings suggest that participants who frequently engage in TUTs will show performance decrements, but that the type of TUT engaged (i.e., intentional or unintentional) does not differentially relate to task performance. Unintentional and intentional TUTs therefore had similar negative consequences for MRT task performance.

¹ Instead of distinguishing between intentional and unintentional TUTs, Seli, Carriere, Thomson, et al. (2014) simply asked participants to report whether they were (1) focused on the task, or (2) thinking task-unrelated thoughts. Notably, the MRT in both the present study and Seli and colleagues' study consisted of the same number of trials (i.e., 900 trials in each study), and the same number of thought probes (i.e., 18). Thus, the TUT rates across the two studies should be comparable.

To follow-up on this finding and further test the claim that unintentional and intentional TUTs have similar negative consequences for task performance, we next conducted a within-subjects analysis in which we examined RRT variability associated with reports of (1) being on task, (2) unintentionally engaging in TUTs, and (2) intentionally engaging in TUTs. Specifically, as in previous work (e.g., Seli, Cheyne, & Smilek, 2013), we examined RRT variability on the 5 trials preceding each of the three types of probe reports. If unintentional and intentional TUTs do indeed have similar negative consequences for task performance, then we ought to find that the variance associated with periods of intentional and unintentional TUTs are not statistically different. To explore this possibility, we conducted a repeated-measures ANOVA examining the variance associated with each of the three Probe Reports (i.e., on task, unintentional TUTs, intentional TUTs) (28 of the 166 participants did not report at least one instance of each type of probe response and were therefore excluded from the following analyses). Results revealed a significant effect of Probe Report, $F(2, 274) = 7.12$, $MSE = 0.37$, $p = .001$, $\eta_p^2 = .05$. Follow-up paired-samples t -tests revealed that the variance associated with periods of intentional ($M = 8.51$) and unintentional TUT ($M = 8.39$) was greater than variance associated with on-task periods (8.23; both $ps < .014$). We did not, however, observe a significant difference in variance associated with the two types of TUT ($p = .129$)².

Lastly, we sought to replicate Unsworth and McMillan's (2013) finding that the relation of motivation and task performance is fully mediated by overall TUT rates. Thus, we

² As in previous work, we also used linear trend point estimation to impute missing data, which allowed us to conduct a repeated-measures ANOVA while using the full sample. Importantly, this analysis yielded the same pattern of results showing that variance associated with periods of unintentional and intentional TUTs was significantly greater than variance associated with periods of on-task performance ($ps < .027$), and no difference in variance associated with periods of unintentional and intentional TUTs ($p = .406$).

conducted a hierarchical regression analysis in which we predicted RRT Variance with Motivation (model 1) and Proportion of Overall TUTs (model 2) (see Table 12). As can be seen in Table 12, model 1, Motivation was found to significantly negatively predict RRT Variance ($r = -.25$), indicating that individuals who reported higher levels of Motivation to do well on the MRT tended to outperform those reporting lower levels of motivation (as indicated by lower levels of RRT Variance). When entering Overall TUT rate for the second model of the regression analysis, however, Motivation was no longer a significant predictor of RRT Variance. On the other hand, Overall TUT rate was found to significantly and positively predict RRT Variance on model 2. In a separate Maximum Likelihood analysis we explored the mediation effect of overall TUTs only, and found essentially identical coefficients for these variables to those in model 3 of Table 12. In addition, significant indirect effects of Motivation were observed, *Standardized Coefficient* = $-.12$, $p < .002$. Thus, these findings are consistent with Unsworth and McMillan's finding that the relation of task-based motivation and task performance is fully mediated by people's overall levels of TUT.

To extend Unsworth and McMillan's (2013) work, we explored the possibility that the extent to which people's TUTs consist of intentionally-engaged off-task thought (versus unintentionally-engaged off-task thought) might play an important role in predicting task performance (RRT variance). Thus, in the third model of the hierarchical regression analysis, we entered prop(I/TUT). As can be seen in Table 12, model 3, the inclusion of this variable in the model did not add to the prediction of RRT Variance. Put differently, when controlling for people's overall level of motivation and overall TUT rates, the proportion of TUTs that was engaged intentionally (or unintentionally) did not predict MRT performance. Consistent with

results reported above, this finding provides evidence that it is not the type of TUT that determines task performance, but is instead the overall rate of off-task thought.

Table 12. Hierarchical multiple regression analysis testing for unique contributions to Overall RRT Variance by Motivation (model 1), Proportion of Overall TUTs (model 2), and the Proportion of Overall TUTs that was Intentional (model 3) ($N = 164$)

Dependent variable: Overall RRT Variance

	<i>B</i>	<i>S.E.</i>	β	<i>t</i>	<i>p</i>	R^2_{Δ}	p_{Δ}
<i>Model 1</i>							
Motivation	-0.12	0.04	-.25	3.23	.002		
						0.06	0.002
<i>Model 2</i>							
Motivation	-0.06	0.04	-0.13	1.49	.139		
Overall TUT	0.76	0.26	0.25	2.95	.004		
						0.05	0.004
<i>Model 3</i>							
Motivation	-0.07	0.04	-0.13	1.56	.120		
Overall TUT	0.78	0.26	0.26	3.01	.003		
Intentional/Overall TUT	-0.14	0.21	-0.05	0.68	.496		
						0.00	0.496

Study 3 Discussion

In the present study, we assessed the intentionality of TUTs reported during a sustained-attention task (the MRT), as well as participants' motivation to perform well on the task and overall task performance. Consistent with previous work on the topic (e.g., Shaw & Giambra, 1993), and contrary to commonly held assumptions in the literature on mind wandering, we found that a considerable number of the TUTs reported during the MRT were engaged intentionally. We also found that participants who reported lower levels of motivation to perform well on the MRT engaged in more overall TUTs and more intentional relative to unintentional TUTs during the task compared to those reporting lower levels of motivation. Having established that participants do indeed frequently engage in intentional TUTs, we then compared TUT rates from the present study to those from a previously reported study (Seli, Carriere, Thomson, et al., 2014) to explore the possibility that other studies of mind wandering that do not distinguish between intentional and unintentional TUTs might be inadvertently conflating these two types of thought. Results indicated that overall TUT rates were not significantly different across these two studies, thereby providing evidence consistent with the view that, when reporting unspecified TUTs, participants may be reporting TUTs that are both intentional and unintentional. Next, we turned our focus to the relations between TUTs and task performance, finding that individuals reporting more overall TUTs performed more poorly on the task, and critically, that the type of TUT engaged (intentional or unintentional) did not differentially affect task performance (moreover, these results were obtained at the within-subjects levels). Finally, we sought to replicate Unsworth and McMillan's (2013) finding that the relation of motivation and task performance is fully mediated by TUTs, and found support for this view. Extending this work, we also found that the proportion of TUTs that was

intentional did not significantly predict task performance, which provided evidence that unintentional and intentional TUTs have similar, and perhaps indistinguishable, negative consequences for task performance.

The present findings have theoretical and methodological importance for studies of mind wandering. As noted earlier, many researchers of mind wandering have expressed theoretical interest in TUTs that specifically occur (1) unintentionally, and (2) when participants are motivated to do well on their tasks (e.g., Baars, 2010; Carciofo et al., 2014; Cohen, 2013; He, et al., 2011; Klinger, 2009; Kane & McVay, 2012; Mason et al., 2007; McVay & Kane, 2010; O'Callaghan et al., 2014; Seli, Cheyne, & Smilek, 2013; Smallwood & Schooler, 2006; Zavagnin et al., 2013). It appears likely, however, that commonly used thought probes index both unintentional TUTs as well as intentional TUTs (perhaps resulting from low levels of motivation to do well on laboratory tasks). Thus, in future work researchers would do well to regularly ensure that they directly identify these differences so that they are not conflated with their intentional counterpart. Moreover, the results of the present study suggest that studies of mind wandering ought to regularly consider including indices of motivation given that participants are evidently not always highly motivated to do well on the tasks given to them. By indexing participants' levels of motivation to perform well on laboratory tasks, it is possible to statistically control for motivation differences across participants, thereby allowing for the examination of the consequences of mind wandering independently of motivation, which has been shown here to be directly related to both mind wandering and task performance. In considering the foregoing points, it should be noted that in the present study we assessed participants' motivation after they completed the task (as done in Unsworth & McMillan, 2013). Thus, there is the possibility that participants' motivation reports were

influenced by their TUT rates. In particular, participants reporting high rates of intentional TUTs may have been inclined to in turn report lower motivation. Although it is not clear how direction of causality might be addressed via self-reports, experimental manipulations of task interest or incentives affecting motivation would seem to be required. In any case, it seems likely that the covariation of motivation and mind wandering might well be bidirectional.

One important implication from the present study is that it may be difficult or impossible in some contexts to distinguish between intentional and unintentional mind wandering based on performance alone. In the present study, although performance was related to the overall TUT rate, it was not related to the type of TUT (intentional vs. unintentional). There remains the possibility, however, that the effects of the two different types of TUT on performance may depend on context. Consider, for example, the last time you listened to a presentation that contained some material with which you were already familiar. When the speaker began to cover familiar ground, you may have intentionally engaged in TUTs, allowing these thoughts to persist until the speaker began to cover material that was less familiar to you. Importantly, if tested on the content of the presentation, it is reasonable to assume that your performance would not suffer as a result of your engagement in intentional TUTs because you were able to restrict these thoughts to segments of the presentation that contained familiar material. In contrast, unintentional TUTs, which are by definition not under strategic control, would more likely occur at inopportune times during the presentation, and would thus be associated with performance costs. In this example, then, whereas unintentional TUTs would be associated with poorer task performance, intentional TUTs would share no such association with performance. However, irrespective of whether the intentionality of TUTs does in fact, as speculated here, differentially influence performance in a given context, it is advisable to

collect subjective reports of intentional and unintentional TUTs, especially if the goal is draw conclusions only about unwanted episodes of mind wandering.

Contextual factors might also play a critical role in determining the relative prevalence of intentional and unintentional bouts of mind wandering. One such important contextual factor might be *task difficulty*. As suggested by the foregoing example about mind wandering during a presentation, people may be more likely to engage in intentional TUTs when task demands are low (e.g., when presented with familiar material) than when task demands are high (e.g., when presented with unfamiliar material). Another important contextual factor might be the level of *interest*. Unsworth and McMillan (2013) have shown that individuals reporting higher interest in a task in turn reported higher levels of motivation, and consequently engaged in fewer TUTs. Similarly, in assessing mind wandering in everyday life, Kane et al. (2007) observed that individuals tended to mind-wander more when they engaged in boring or unpleasant activities, which would likely be rated by participants as uninteresting. Given the present finding that individuals reporting higher motivation engaged in fewer intentional TUTs, it is a reasonable hypothesis that interest might indirectly influence intentional TUT rates via its influence on motivation, with higher levels of interest being associated with higher levels of motivation, and hence fewer intentional TUTs. Yet another relevant contextual factor might be age. Compared to younger adults, older adults tend to report the same task as being more difficult, show more interest the task, and engage in fewer TUTs (Jackson and Balota, 2012; Jackson Weinstein, & Balota, 2013). If increases in perceived task difficulty and interest are indeed associated with fewer intentional TUTs, then older adults – who tend to perceive tasks as more difficult and more interesting than do

younger adults – might reduce their engagement in intentional TUTs, which might in turn result in overall lower TUTs relative to younger adults.

In considering the intentionality of TUTs within the broader literature on mind wandering, one important note to make is that the conceptual distinction between unintentional and intentional TUT bears some resemblance to the distinction between TUTs that occur with and without awareness (Smallwood, McSpadden, et al., 2007; Smallwood, McSpadden, Luus, & Schooler, 2008; Smallwood, McSpadden, & Schooler, 2008). It seems reasonable that people might be mostly aware of their intentional bouts of TUT, at least initially, and mostly unaware of their unintentional bouts of TUT, except perhaps near the end of an episode. The simple observation that people can self-catch their TUTs without being prompted by a probe (e.g., Schooler, Reichle, and Halpern, 2004) suggests that the episode may have begun without intention, but was nevertheless brought into awareness at some point. Consistent with this view, Schooler (2002), in his review on meta-awareness, stated that “it is unclear whether lacking intention is equivalent to lacking awareness” (p. 340). Although there might be considerable overlap between intentionality and awareness, we consider these as distinct concepts that need to be further evaluated and compared in future research.

The present results suggest that distinguishing between intentional and unintentional TUTs will be important for future research, and that this more nuanced approach to the study of TUTs has the potential to open up additional questions obscured by the conflation of mind-wandering types. However, we suspect that as more work focuses on the intentionality of TUTs, it will become apparent that some episodes of TUT include *both* intentional and unintentional segments. For example, an individual may decide deliberately to engage in TUTs because of a lack of motivation, or to alleviate boredom, and so forth, and this might in turn

lead to spontaneous (unintentional) thoughts. On the other hand, TUTs might occur unintentionally, yet upon realizing that one's thoughts have drifted inwardly away from the external environment, one might deliberately allow the continuation of mind wandering. In some cases, it may therefore become difficult (if not impossible) for the participant to distinguish deliberate from spontaneous mind wandering. Nevertheless, in future work assessing the level of intentionality of TUT, it might be beneficial to provide participants the opportunity to report the experience of task-unrelated thinking that is comprised of both intentional and unintentional elements, as such experiences (if reportable) may be associated with different performance outcomes than experiences in which people are either exclusively intentionally or unintentionally engaging in TUTs.

Study 3 Concluding Remarks

An implicit assumption often made by mind-wandering researchers is that individual differences in task performance and mind-wandering rates assessed in laboratory settings are representative of differences in people's attentional abilities. However, the more fundamental assumption upon which this assumption rests is that participants are equally motivated to perform well on the laboratory tasks that we give them. The results of the present study suggest that, rather than exclusively indexing attentional abilities per se, studies of mind wandering may also be assessing the indirect effects of motivation on task performance. Indeed, here we found that individuals who reported lower levels of motivation to perform well on the MRT also engaged in more TUTs, which was in turn associated with poorer task performance. Thus, we suggest that differences in task-based motivation ought to be measured and statistically controlled for so that meaningful conclusions about attentional abilities per se can be drawn.

Importantly, it should be noted that the argument that deliberate, task-unrelated thought does not, according to common conceptualizations, qualify as mind wandering need not imply that this dimension of thought is uninteresting, or that it is simply a nuisance variable that must be controlled. Indeed, in recent work, some researchers have made an explicit shift in focus from mind wandering, defined as unintentional task-unrelated thought, to all types of self-generated thought (e.g., Smallwood & Andrews-Hanna, 2013), providing intriguing insights into the nature of human thinking. However, those researchers who are strictly interested in measuring mind wandering, *conceptualized as unwanted, unintentional* thought, must begin to account for intentional thought so they do not conflate this type of thought with mind wandering. Indeed, distinguishing between intentional and unintentional mind wandering will lead to a greater conceptual and theoretical clarity in the field, and will ultimately facilitate progress in the field of mind wandering.

Study 4

The following work is currently under review (Seli, Wammes, Risko, & Smilek, under review).

Highly motivated students often exhibit better academic performance than less motivated students. However, to date, the specific cognitive mechanisms through which motivation increases academic achievement are not well understood. Here we explored the possibility that mind-wandering mediates the relation between motivation and academic performance, and, additionally, we examined possible mediation by both *intentional* and *unintentional* forms of mind-wandering. We found that participants reporting higher motivation to learn in a lecture-based setting tended to engage in less mind-wandering, and this decrease in mind-wandering was in turn associated with greater retention of the lecture material. Critically, we also found that the influence of motivation on retention was mediated by both intentional and unintentional types of mind-wandering. Not only do the present results advance our theoretical understanding of the mechanisms underlying the relation between motivation and academic achievement, they also provide insights into possible methods of intervention that may be useful in improving student retention in educational settings.

Study 4

It has been well established that motivation is a key determinant of academic achievement, with more highly motivated students typically outperforming their less motivated colleagues (e.g., Pintrich, 1999; Schiefele, Krapp, & Winteler, 1992). However, to date, the specific cognitive mechanism(s) through which motivation influences academic achievement are not well understood, and only recently has research begun to systematically explore such mechanisms. A deeper understanding of these mechanisms will undoubtedly play a critical role in advancing theory and informing practice in a number of domains in psychology (e.g., education, attention, learning, and memory). Recently, it was suggested that the relation between motivation and academic performance is mediated by mind-wandering: Specifically, that poorly motivated students frequently engage in mind-wandering, which in turn results in poorer retention (Unsworth & McMillan, 2013). Here we further refine this theoretical proposal by examining whether the relation between motivation and retention might be differentially associated with *intentional* and *unintentional* forms of mind-wandering. In addition, we expand previous research on the relations among motivation, mind-wandering, and retention by examining the effects of these variables in a highly familiar, yet to date unstudied educational context; namely, during a lecture. Thus, the present investigation both advances our theoretical understanding of the mechanism(s) underlying the relation between motivation and academic achievement and generalizes this research to this highly familiar educational context.

In recent work, Unsworth and McMillan (2013) explored the effects of motivation and mind-wandering on reading comprehension in a laboratory setting. To this end, the researchers had participants read part of a chapter from a textbook, and while reading, participants were

occasionally presented with thought probes to assess whether they were mind-wandering or focused on the task. Following the reading task, participants were tested on the textbook material and were then presented two questions assessing their motivation to do well on the reading-comprehension test. Critically, the researchers found evidence that the well-established relation between motivation and task performance (in this case, reading comprehension; e.g., Humphreys & Revelle, 1984; Pintrich & DeGroot, 1990) was fully mediated by mind-wandering rates: Participants who reported lower levels of motivation were more likely to engage in mind-wandering during the reading task, and this increased propensity to engage in mind-wandering negatively predicted test performance (see also Seli, Cheyne, Xu, Purdon, & Smilek, 2015).

While Unsworth and McMillan (2013) have provided evidence consistent with the claim that mind-wandering mediates the relation between motivation and retention, their study focused on mind-wandering as a unitary construct. Recent research, however, has demonstrated that mind-wandering consists of at least two theoretically and empirically distinguishable “types.” Specifically, *unintentional* mind-wandering reflects a failure of executive control, whereas *intentional* mind-wandering reflects the engagement of controlled processes for internal processing. In recent work, these two types of mind-wandering have been shown to be differentially predictive of critical variables such as mindfulness (Carriere, Seli, & Smilek, 2013; Seli, Carriere, & Smilek, 2015), fidgeting (Seli, Carriere, et al., 2014), and attention-deficit/hyperactivity disorder symptomatology (Seli, Smallwood, Cheyne, & Smilek, 2015). What this suggests, then, is the possibility that the relation between motivation and retention might depend on the *type* of mind-wandering that is engaged in educational settings.

While we expect both intentional and unintentional mind-wandering will influence retention in an educational setting (e.g., Seli, Cheyne, et al., 2015), we predicted that these types of mind-wandering might be differentially related to motivation, and as such, that they may play different roles in mediating the relation between motivation and performance. Specifically, we thought that individuals reporting little motivation to attend to the lecture would frequently intentionally disengage from the lecture in the service of focusing on their lecture-unrelated thoughts. On the other hand, it seems reasonable to assume that people's levels of motivation might not be associated with their propensity to unintentionally engage in mind-wandering since such mental experiences are, by definition, not under the participants' control. Following from these predictions, we would expect that intentional mind-wandering would mediate the relation between motivation and performance, whereas unintentional mind-wandering would not.

Determining whether intentional and unintentional mind-wandering are uniquely related to motivation and test performance could also have important implications for interventions designed to improve learning. It is commonly assumed that mind-wandering occurs primarily without unintentionally, and that it represents a failure of executive control (e.g., Kane & McVay, 2012; McVay & Kane, 2010; Seli, Cheyne, & Smilek, 2013). If mind-wandering in educational settings is indeed primarily unintentional, then the focus of interventions might be on modifying the way in which material is presented, such that the delivery of the material is continually salient and exogenously draws attention. For instance, the focus might be on increasing the use of multi-media in lectures (Lenzner, Schnotz, & Müller, 2013). If, however, at least some of the mind-wandering that occurs in educational settings is engaged with intention, this finding would suggest that researchers and pedagogical

practitioners should also focus on methods of intervention aimed at reducing intentional, controlled mind-wandering (for instance, by increasing incentives to focus on the lecture rather than intentionally disengage from it).

While understanding the general relations among motivation, mind-wandering, and performance is of theoretical interest, understanding how these variables interact in lecture settings is particularly important. In Unsworth and McMillan (2013), the researchers focused specifically on reading comprehension. Here we extend this work to the lecture setting, which is one of the most common pedagogical formats. In a series of recent papers, researchers have begun to better understand the relation between mind-wandering and retention of lecture material (e.g., Risko et al., 2012; Farley et al., 2013; Szpunar, Khan, & Schacter, 2013). Similar to research examining reading comprehension, this work has revealed that mind-wandering is negatively associated with retention of lecture material. Critically, however, there has been no previous work investigating the relation between motivation, mind-wandering, and retention in lectures, and no research investigating different forms of mind-wandering (i.e., intentional vs. unintentional) in the lecture context.

In the present study participants viewed a video-recorded lecture, and at various points throughout the lecture, we presented thought probes that were used to identify periods of intentional mind-wandering, unintentional mind-wandering, and/or on-task focus. Following the lecture, we tested participants on their retention of the lecture material, after which they reported how motivated they were to perform well on the task. A series of correlation and mediation analyzes are performed to assess predictions with respect to the relation between overall, intentional, and unintentional mind-wandering, motivation, and lecture retention.

Study 4 Method

Participants. One-hundred and twenty undergraduate students enrolled in psychology courses at the University of Waterloo participated in exchange for partial course credit.

Stimuli. Participants viewed a video recording of a live lecture given in a lecture hall (the video was obtained from Open Yale Courses; <http://oyc.yale.edu/>). The lecture was roughly 25 minutes in length and focused on mortality decline in Europe from the 1500s to the 1900s.

Thought probes. Throughout the lecture, participants were randomly presented one thought probe in each of a succeeding series of 90-second blocks (16 probes). Upon presentation of each probe, the lecture was paused until a response was given. The probes asked participants to indicate whether they were just (1) focused on the task, (2) intentionally mind-wandering, and/or (3) unintentionally mind-wandering. Participants were allowed to select just one response, if appropriate (e.g., intentionally mind-wandering), or to select any combination of responses (e.g., intentionally and unintentionally mind-wandering) by using the mouse to click boxes placed beside each of the three response options. We used this method rather than forcing participants to choose only one response because, in the case of the forced-choice methodology, there is a structurally-forced negative correlation of the different report types (i.e., the data are ipsative), which precludes analyses examining the independent contributions of these different report types.

Retention of Lecture Material. Following the lecture, participants were presented nine multiple-choice questions about the content of the lecture. These were presented one at a time, in a randomized order. Participants were given as much time as needed to respond to

each question, and after providing a response, the next question appeared. Each question had four possible response options, only one of which was correct.

Motivation. Following the retention test, participants were presented a single-item question asking them “How motivated were you to perform well on the task?” (Unsworth & McMillan, 2013). The anchor ratings for this question were 1 (*not motivated at all*) and 7 (*very motivated*).

Procedure. Participants were seated in front of a computer monitor. They were instructed to attend to the lecture and to do their best to retain the material presented because they would be tested on this material. They were also told that, throughout the lecture, they would be presented with probes asking them to report whether they were on-task, intentionally mind-wandering, unintentionally mind-wandering, or any combination of these three reports. Following the lecture, the retention test was administered, followed by a single-item question asking about the participant’s motivation.

Measures. For each participant, we computed three thought-probe measures. These included the proportion of: (1) on-task reports, (2) intentional mind-wandering reports, and (3) unintentional mind-wandering reports. In addition, we computed each participant’s mean accuracy on the retention test by averaging their scores (1 for correct and 0 for incorrect) across the 9 multiple-choice questions. Finally, our measure of task-based motivation was the response to the single-item motivation question.

Study 4 Results

We present descriptive statistics for all measures in Table 13. As seen in Table 13, the skewness and kurtosis values for the proportion of intentional mind-wandering were beyond an acceptable range (i.e., skewness > 2 and kurtosis > 4; Kline, 1998). We therefore transformed

these data using a square-root transformation, which brought the skewness and kurtosis values into an acceptable range (post-transformation skewness = .46, and post-transformation kurtosis = -.73)³. In further examining Table 13, it is worth noting is that participants correctly responded to 63% of the retention test question, which was significantly higher than chance performance (25%), $t(119) = 19.48$, $SE = 0.38$, $p < .001$.

Table 13. *Psychometric Properties of All Primary Measures (N = 120)*

	Mean (SD)	Skewness ¹	Kurtosis ²
On-task	.737 (0.21)	-0.90	0.79
Intentional MW	.088 (0.12)	2.07	6.00
Unintentional MW	.239 (0.18)	0.87	1.47
Motivation	4.73 (1.35)	-0.58	0.90
Retention	.632 (.22)	-0.35	-0.69

Note. ¹Std. Error = .221, ²Std. Error = .438

Next, we examined the Pearson Product-Moment correlation coefficients for all primary measures. In addition, we were interested in exploring how overall mind-wandering (i.e., the proportion of reports of intentional mind-wandering, unintentional mind-wandering, and concurrent experience of intentional and unintentional mind-wandering) related to our primary measures. To clarify, anytime a participant reported any form of mind-wandering – be

³ In all subsequent analyses examining Intentional Mind-Wandering, the transformed data with corrected skewness and kurtosis levels were used.

it intentional, unintentional, or a combination of both – this contributed to the measure of overall mind-wandering. Results of the correlation analysis are presented in Table 14.

Table 14. *Pearson Product-Moment Correlations of All Primary Measures as well as Overall Mind-wandering (N = 120)*

	2	3	4	5	6
1. On task	-.57***	-.69***	-.81***	.31***	.44***
2. Intentional mind-wandering		.30***	.68***	-.26**	-.27**
3. Unintentional mind-wandering			.88***	-.23*	-.30***
4. Overall mind-wandering				-.29***	-.36***
5. Motivation					.18*
6. Retention					-

Note 1. *** $p < .001$, ** $p < .01$, * $p < .05$.

Consistent with previous research (Seli, Cheyne, et al., 2015), we observed a significant positive correlation between proportion of on-task reports and motivation, indicating that individuals who reported higher motivation to perform well on the task more frequently reported being focused on the task. We also observed a positive correlation between the proportion of on-task reports and accuracy on the retention test: Individuals reporting more periods of on-task focus were more likely to perform well on the retention test. Also of interest was the finding that both intentional and unintentional mind-wandering were negatively associated with accuracy on the retention test, as did overall mind-wandering. Lastly, we found that motivation was negatively associated with each type of mind-wandering (intentional and

unintentional) as well as overall mind-wandering, and, in addition, we observed a positive correlation between motivation and accuracy on the retention test.

Taken together, these results suggest the possibility that the association of motivation and task performance may be, as hypothesized, mediated by mind-wandering. Thus, in our next analysis, we formally tested this hypothesis by conducting a mediation analysis. To estimate indirect effects in our mediation models we used the PROCESS modelling tool (Hayes, 2012), set to Model 4, with 1000 bootstrap samples, and a 95% confidence level for confidence intervals. The mediation model with unstandardized regression coefficients is depicted in Figure 3. Critically, the indirect effect, .0153 [95% CI: .0052 - .0338], was significant (i.e., the 95% CI did not include 0) suggesting that the influence of motivation on task performance is mediated by mind-wandering.

Consistent with our hypothesis, the results of the mediation analysis indicate that mind-wandering is a mechanism through which motivation influences the retention of lecture material. Specifically, individuals reporting higher levels of motivation tend to less frequently engage in mind-wandering, which is in turn associated with improved retention relative to individuals reporting low motivation.

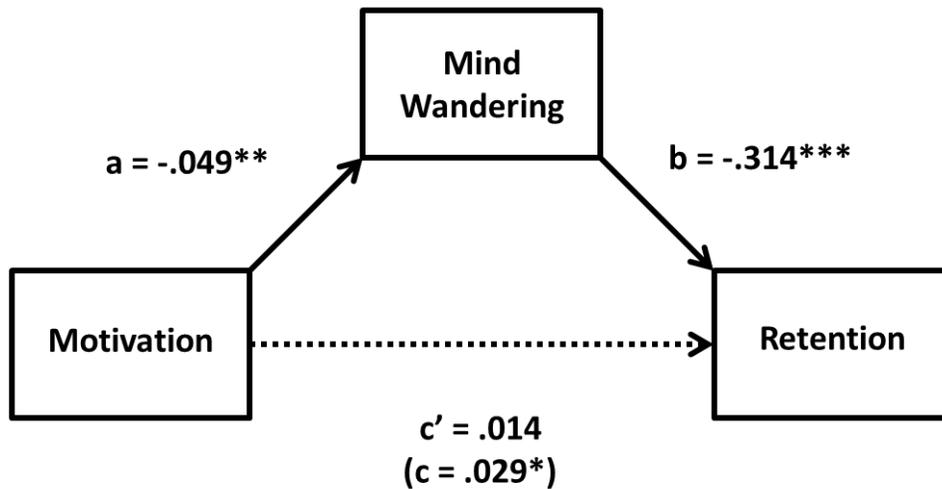


Figure 3. PROCESS mediation model depicting the relationship between self-reported motivation and retention of lecture material, with overall mind-wandering rate as a mediator. The direct effect of motivation on retention through mind-wandering is reported as c' , while the total effect of motivation on retention is in parentheses below (c). The significance of the coefficients is represented using the following notation: $*p < .05$, $**p < .01$, $***p < .001$.

Having found that the relation of motivation and retention is mediated by overall mind-wandering rates, we next wanted to examine the possibility that the relation of motivation and retention is mediated both by intentional mind-wandering and by unintentional mind-wandering. Intentional and unintentional mind-wandering were significantly correlated with one another, but we did not predict this to be a causal relation. Accordingly, rather than house both variables in the same mediation model, separate models were tested for each mind-wandering response. To be conservative in our analyses, when testing for indirect effects through one type of mind-wandering, the other type of mind-wandering response was included in the model as a covariate, acting on both the mediator and the outcome variable (retention).

We first turned our attention to intentional mind-wandering. The PROCESS modelling tool (Hayes, 2012) was used to estimate the indirect effect through intentional mind-wandering (controlling for unintentional mind-wandering). PROCESS was set to Model 4, with 1000

bootstrap samples, and a 95% confidence level for confidence intervals. The mediation model with unstandardized regression coefficients is depicted in Figure 4. The indirect effect through intentional mind-wandering was significant, .0060 [95% CI: .0005 - .0171] (Figure 4).

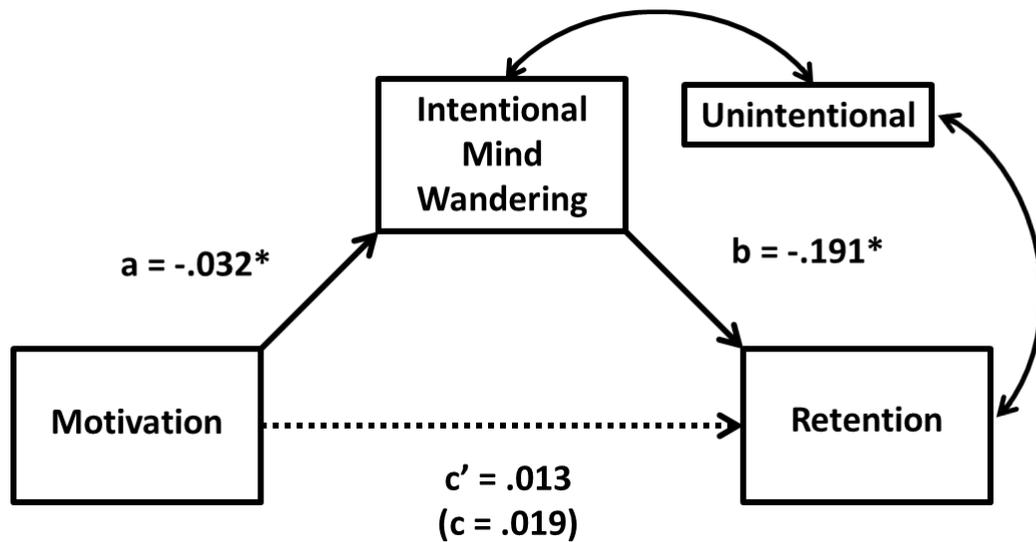


Figure 4. PROCESS mediation model depicting the relationship between self-reported motivation and retention of lecture material, with intentional mind-wandering rate as a mediator, and unintentional mind-wandering as a covariate on both the mediator (intentional mind-wandering) and the outcome variable (retention). The direct effect of motivation on retention through intentional mind-wandering is reported as c' , while the total effect of motivation on retention is in parentheses below (c). The significance of the coefficients is represented using the following notation: * $p < .05$, ** $p < .01$, *** $p < .001$.

The indirect effect through unintentional mind-wandering was analyzed in the same manner, with intentional mind-wandering included as a covariate. Note that the direct effect of motivation on unintentional mind-wandering was marginal ($p = .077$). However, critically, the indirect effect through unintentional mind-wandering, .0058 [95% CI: .0003 - .0218], was significant (i.e., the 95% CIs did not include 0; see Figure 5). In both models, the direct effect was not significant, $p = .368$, consistent with the notion that the effect of motivation on later

retention of lecture material was mediated by both unintentional and intentional mind-wandering.

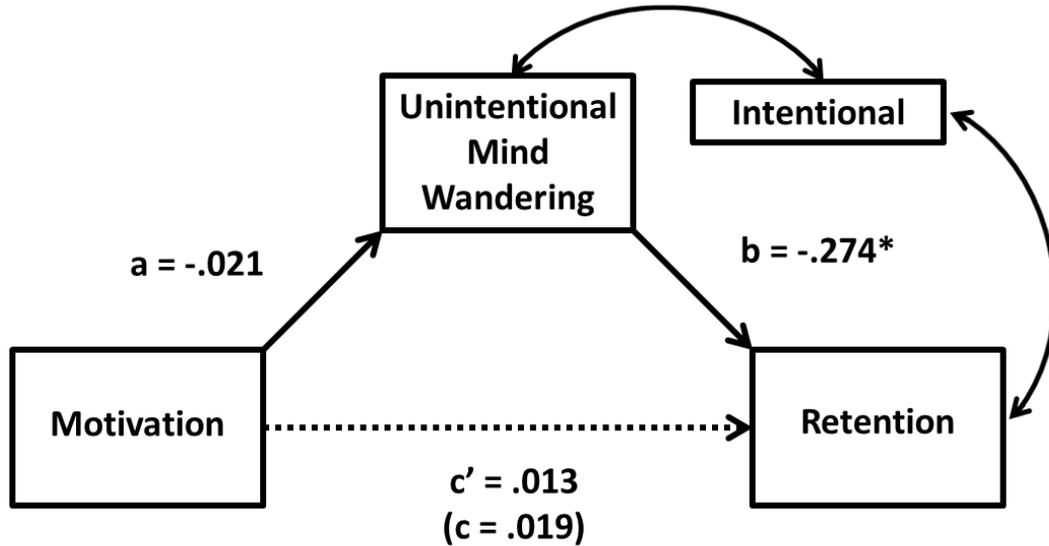


Figure 5. PROCESS mediation model depicting the relationship between self-reported motivation and retention of lecture material, with unintentional mind-wandering rate as a mediator, and intentional mind-wandering as a covariate on both the mediator (unintentional mind-wandering) and the outcome variable (retention). The direct effect of motivation on retention through unintentional mind-wandering is reported as c' , while the total effect of motivation on retention is in parentheses below (c). The significance of the coefficients is represented using the following notation: $*p < .05$, $**p < .01$, $***p < .001$.

Study 4 Discussion

Here we examined a recent proposal that motivation-triggered shifts of attention toward educational material may be a key mechanism through which motivation acts on academic performance. Consistent with this theoretical view, we found that individuals reporting higher motivation to learn in a lecture-based setting tended to engage in less mind-wandering, and this decrease in mind-wandering was in turn associated with greater retention of the lecture material. Critically, we also found that the influence of motivation on retention is mediated by both intentional and unintentional mind-wandering: Participants who reported higher levels of

motivation tended to engage in less intentional and unintentional mind-wandering, and reductions in each of these types of mind-wandering were associated with improved retention. Thus, the proposed link between motivation and retention through mind-wandering follows two independent paths: one through intentional mind-wandering and one through unintentional mind-wandering.

The discovery that motivation was negatively associated with *unintentional* mind-wandering and also mediated the relation between motivation and retention was particularly surprising. We had anticipated that motivation would be uniquely negatively associated with *intentional* mind-wandering as it would seem inappropriate for a highly motivated participant to frequently engage in intentional mind-wandering. At first blush, it is not obvious why motivation would be related to unintentional bouts of mind-wandering. However, upon consideration of this result, we reasoned that this relation may exist because (1) people who are highly motivated to do well are also more motivated to catch themselves mind-wandering and to terminate this process, and/or (2) being highly motivated results in greater on-task focus, which buffers people from intrusive, unintentional mental activity. Future work exploring the two theoretical paths through which motivation influences retention is likely to yield further insights into these important relations.

In addition to having important theoretical implications, the present results are of particular importance for pedagogical purposes. While efforts to minimize “mind-wandering” have specifically focused on reducing the occurrence of *unintentional* task-unrelated thoughts (e.g., Mrazek, Smallwood, & Schooler, 2012), the results of our study suggest that attempts to reduce *intentional* task-unrelated thoughts should also improve students’ retention of educational material. One possible way to reduce intentional mind-wandering may be to

frequently administer tests during lectures. Indeed, recent work (Szpunar et al., 2013) has demonstrated that intermittent testing during lectures reduces mind-wandering and improves learning, possibly because the testing episode provides feedback that helps counteract a student's typical overconfidence in his or her learning (Szpunar, Jing, and Schacter, 2014). As students who are overconfident in their knowledge of the lecture material might be particularly inclined to intentionally disengage from the lecture, the correction in confidence that comes with testing might have the impact of reducing intentional mind-wandering. Another potentially effective way to reduce intentional mind-wandering might be to simply inform students about the deleterious consequences of intentional mind-wandering and to encourage them to avoid disengaging intentionally. After all, by definition, intentional mind-wandering is under one's control.

Study 5

The following work is currently under review (Seli, Risko, & Smilek, under review).

There is sufficient evidence to indicate that state-level deliberate and spontaneous mind wandering are, at times, differentially associated with certain variables of theoretical interest to mind-wandering researchers. However, to date, no research has examined the possibility that deliberate and spontaneous forms of mind wandering can be differentially affected by an experimental manipulation. Such a demonstration would be of importance because (1) mind-wandering researchers frequently use experimental manipulations to influence rates of mind wandering, and (2) the conclusions drawn in these sorts of studies invariably assume the existence of a unidimensional construct of mind wandering (i.e., unintentional, spontaneous thought) without consideration of the possibility their manipulations are selectively influencing one type of mind wandering (e.g., deliberate) and not the other (e.g., spontaneous). Here, we examined the possibility that manipulating task difficulty across two conditions (an easy and a difficult condition) would produce different rates of deliberate and spontaneous mind wandering. Although results indicated that overall mind wandering did not differ across the easy and difficult conditions, we found the relative rates of deliberate and spontaneous mind wandering did: Participants in the easy condition experienced more deliberate and less spontaneous mind wandering relative to those in the difficult condition.

In recent years, there have been substantial advances in describing factors that lead to changes in mind wandering rates across situations. Perhaps the most abundant evidence for variation in mind-wandering rates across experimental manipulations comes from work demonstrating that individuals mind-wander more during easy relative to difficult tasks (e.g., Smallwood, Ruby, & Singer, 2013; Thomson, Besner, & Smilek, 2013). For example, mind wandering tends to be much higher while people read familiar high-frequency words than when they are required to read unfamiliar low-frequency words (Thomson et al., 2013). Other related research examining manipulations that affect mind-wandering rates has shown, for example, that mind wandering *increases* when (1) people's current concerns are cued (McVay & Kane, 2013), (2) negative mood is induced (Smallwood, Fitzgerald, Miles, & Phillips, 2009), (3) alcohol is consumed (Sayette, Reichle, & Schooler, 2009), and (4) stereotype-threat is elicited (Mrazek, Chin, et al., 2011). Conversely, research has also shown that mind wandering *decreases* when (1) people engage in mindfulness meditation training prior to completing a focal task (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013), (2) quizzes are interspersed during lectures (Szpunar, Khan, & Schacter, 2013), and (3) people are presented primes intended to elicit honesty (Vinski & Watter, 2012). Delineating the factors that influence mind wandering rates has been important because they provide valuable insights into the causes of mind wandering, as well as methods with which to reduce its occurrence.

The general assumption underlying the interpretation of the foregoing studies has been that the observed variations in mind wandering across situations involve spontaneous, unintentional episodes of mind wandering. However, recent research has arrived at a more nuanced understanding of mind wandering, demonstrating that overall mind wandering can be decomposed into spontaneous (unintentional) and deliberate (intentional) forms, and

importantly, that deliberate mind wandering can sometimes be a major component of overall levels of mind wandering (e.g., Carriere, Seli, & Smilek, 2013; Seli, Carriere, & Smilek, 2014; Seli, Cheyne, Xu, Purdon, & Smilek, 2015). This more nuanced understanding has called into question the widespread assumption that mind wandering is exclusively spontaneous (unintentional; e.g., Baars, 2010; Carciofo, Du, Song, & Zhang, 2014; Cohen, 2013; He, Becic, Lee, & McCarley, 2011; Klinger, 2009; Kane & McVay, 2012; Mason et al., 2007; McVay & Kane, 2010; O’Callaghan, Shine, Lewis, Andrews-Hanna, & Irish, 2014; Seli, Cheyne, & Smilek, 2013; Smallwood, O’Connor, Sudbery, & Obonsawin, 2007; Smallwood, McSpadden, & Schooler, 2007; Smallwood & Schooler, 2006; Zavagnin, Borella, & De Beni, 2014). Moreover, this understanding has important theoretical implications since existing theories treat mind wandering as reflecting unintended failures of control (e.g., Kane & McVay, 2012; McVay & Kane, 2010) and as being distinct from intentional thinking (e.g., Baars, 2010; Carciofo et al., 2014; Cohen, 2013; He et al., 2011; Klinger, 2009). It also raises the interesting possibility that previous demonstrations of variations in mind wandering across situations might have affected not only spontaneous mind wandering rates, as typically assumed, but rates of deliberate mind wandering as well.

In the present study we sought to examine the influence of a manipulation of task difficulty on deliberate and spontaneous types of mind wandering. To examine this issue, we employed a difficult and an easy version of the Sustained Attention to Response Task; SART; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). The “difficult” version consisted of the standard SART which requires repeated responding (key presses) to a series of randomly presented digits (1-9; GO stimuli) and withholding of that response when an infrequent (NOGO) stimulus appears (e.g., “3”). The “easy” version of the SART was designed such that

the occurrence of each NOGO digit was completely predictable. That is, the digits 1 through 9 were presented in sequential order; thus, unlike the Standard SART, each NOGO digit ('3') always followed the digit '2', which always followed the digit '1', and so forth. While these tasks yield a number of useful measures (Cheyne, Solman, Carriere, & Smilek, 2009), for present purposes the key measures of performance in both difficult and easy versions are (1) the proportion of time participants fail to withhold a response to the NOGO stimuli and (2) the speed of responding to GO stimuli (Robertson et al., 1997; Jonker, Seli, Cheyne, & Smilek, 2013; Seli, Cheyne, Barton, & Smilek, 2012). Critically, in both versions of the SART participants were also presented with thought probes asking them whether they were "on task", "mind wandering intentionally" or "mind wandering unintentionally."

The two variations of the SART were used to manipulate task difficulty because there is reason to suspect that variation in task demands might affect rates of both deliberate and spontaneous mind wandering. The rationale for this assumption is as follows: When completing an easy task – assuming the task is sufficiently easy so as to allow participant disengagement without much in the way of performance costs – it is reasonable to suspect that people may deliberately disengage from the task in service of mind wandering. Indeed, mind wandering can, at times, serve beneficial functions such as allowing people to make plans, problem solve, and so on (for a review of the benefits of mind wandering, see Mooneyham & Schooler, 2013). Thus, cases where people can afford to engage in mind wandering without incurring performance costs on their primary task, it is plausible that they might intentionally disengage from their primary task and turn their thoughts inwardly such that they can engage in the beneficial processes that are known to be associated with mind wandering. On the other hand, when completing a difficult task – assuming the task is sufficiently difficult so as to *not*

allow for disengagement without serious performance costs – people should engage in deliberate mind wandering less often since doing so would lead to serious performance costs. Taken together, the foregoing suggests that there should be more deliberate mind wandering in the easy relative to the difficult task.

In considering rates of spontaneous mind wandering across the easy and difficult tasks, one reasonable prediction is that participants completing the easy task will report less spontaneous mind wandering than those completing the difficult task. Indeed, as indicated above, the easy task should allow for what one might refer to as *strategic control*: That is, the deliberate engagement of mind wandering in cases where people are afforded the opportunity to mind-wander without incurring performance costs (because task demands are low). In a case where a task is made easier by allowing the use of strategic control, it is plausible that the engagement of such control might dampen the occurrence of spontaneous mind wandering, or, put differently, prevent spontaneous mind wandering from co-opting participants' available cognitive resources, since spontaneous mind wandering is believed to reflect a lack of control (e.g., McVay & Kane, 2010). On the other hand, given that the difficult task does not permit strategic control to the extent that the easy task does, participants should be less likely to engage strategic control over their mind wandering, which suggests that, when mind wandering does occur, it should more frequently be of the spontaneous type. Thus, we predict that there will be fewer reports of spontaneous mind wandering in the easy condition relative to the difficult condition because participants in the easy condition should engage more cognitive control, which should in turn minimize the occurrence of spontaneous, uncontrolled, thoughts.

Study 5 Method

Participants. Participants were 113 undergraduate students enrolled in psychology courses at the University of Waterloo.

The Standard Sustained Attention to Response Task (SART; Difficult). On each Standard SART trial, a single digit was presented for 250 ms in the centre of the monitor, after which time an encircled “x” mask was presented for 900 ms (total trial duration = 1150 ms). For each block of 9 trials, a single digit (1-9) was randomly chosen without replacement, and was presented in white on a black background. Thus, each of the digits appeared with equal frequency across the experimental trials. The digit sizes were randomly varied across all trials, with equal sampling of five possible font sizes (120, 100, 94, 72, and 48 points); this was to ensure that participants were not simply making their response decision on the basis of familiar features of a given stimulus. Participants were instructed to respond (by pressing the spacebar) to each GO digit (i.e., digits 1-2, and 4-9) and to withhold responses to each NOGO digit (i.e., 3). After 18 practice trials (containing 2 NOGO digits), participants completed 900 experimental trials (containing 100 NOGO digits).

The Sequential Sustained Attention to Response Task (SART; Easy). All details of the sequential SART were identical to those of the Standard SART, except that the series of digits was completely predictable. Specifically, the digits were presented in sequential order (1 through 9).

Thought probes. Throughout both versions of the SART (i.e., the Standard and Sequential SARTs), mind wandering was sampled using intermittent thought probes. One thought probe was randomly presented in each block of 50 trials, for a total of 18 probes. When a probe occurred, the task temporarily stopped and the participant was presented with

the following instruction: “STOP! Which of the following responses best characterizes your mental state RIGHT NOW.” The possible response options were: (1) On task, (2) Intentionally mind wandering (3) Unintentionally mind wandering. Participants were instructed to respond to one of these options via key press (1-3), after which the SART resumed. After responding to each probe, the SART

Procedure. Participants were randomly assigned to complete either the Standard SART (Difficult condition) or the Sequential SART (Easy condition). They were then brought into the testing room and seated in front of a computer monitor. They were given instructions to familiarize them with the requirements of the SART (instructions were identical across both versions of the SART). Prior to beginning the experiment, they were also given detailed instructions regarding thought-probe responses. Participants were told that being on task meant that they were thinking about things related to the task (e.g. thoughts about their performance on the task, thoughts about the digits, or thoughts about their response), whereas mind wandering meant that they were thinking about something completely unrelated to the task (e.g. thoughts about what to eat for dinner, thoughts about plans with friends or about an upcoming test, etc.). They were given further instructions that, in the case that they experienced any mind wandering, they should indicate whether the mind wandering was engaged intentionally (deliberately) or unintentionally (spontaneously). Participants then completed a short 18 trial practice phase, followed by a single example of a thought probe. After the practice phase, they completed 900 experimental trials, with intermittent thought probes. Altogether, the experiment took approximately 25 minutes to complete.

Measures. Performance measures for later analysis included NOGO errors, GO-trial RTs, and mind wandering rates for each of the two types of mind wandering (i.e. deliberate

and spontaneous). NOGO errors occurred when participants failed to withhold their response to the digit 3. GO-trial RTs were the mean response latencies for all GO trials on which a response was made. Mind-wandering rates were calculated as the proportion of each type response provided (i.e., proportion deliberate and spontaneous mind wandering).

Study 5 Results

First, we were interested in determining whether the task difficulty manipulation was effective. Although, to this end, one could examine NOGO error rates across the Easy and Difficult versions of the SART, considerable research has demonstrated that the SART is susceptible to speed-accuracy trade-offs, which render NOGO error rates problematic (Seli, Cheyne, & Smilek, 2012; 2013; Seli, Jonker, Cheyne, & Smilek, 2013; Seli, Jonker, Solman, Cheyne, & Smilek, 2013). Specifically, it has been found that individuals who respond more slowly to GO trials tend to produce fewer NOGO errors. To account for speed-accuracy trade-offs in this study, we computed a skills index (mean NOGO-trial accuracy/mean GO-trial RT; e.g., Marquez, Zhang, Swinnen, Meesen, & Wenderoth, 2013) for each participant. This method produces a value that represents the participant's efficiency by accounting for both response speed and accuracy. A high score indicates strong performance on the task: A participant with a higher score has greater accuracy with a relatively faster response speed. As an example, if two participants were both responding at a mean speed of 500 ms, the participant with the higher skills index would have been more accurate in his/her responding, despite an equivalent response pace. The scores themselves are not meaningful values, but the relativity in the scores is meaningful. Because the value itself is not meaningful, and because the scores are very small values, we multiplied them by 1000 to reduce the number of decimal places.

Having computed skills-index scores for each participant, we next sought to determine whether participants in the Easy condition achieved a higher mean skills-index score than those in the Difficult condition: such a finding would indicate that the Easy version of the SART was indeed easier than the Difficult version. An independent-samples *t*-test indicated that skills-index scores were significantly higher in the Easy ($M = 2.80, SD = 0.41, N = 57$) than the Difficult ($M = 1.32, SD = 1.26, N = 56$) version of the SART, $t(111) = 8.42, SE = 0.18, p < .001, d = 1.77$, thereby confirming that the task-difficulty manipulation was effective.

Next, we examined the possibility that the relative proportions of Deliberate and Spontaneous mind wandering differed as a function of task difficulty. In particular, we expected to observe more Deliberate mind wandering in the Easy relative to the Difficult condition, and more Spontaneous mind wandering in the Difficult relative to the Easy condition. To examine this hypothesis, we conducted a 2 (Condition: Easy vs. Difficult) by 2 (Mind-Wandering Type: Deliberate vs. Spontaneous) mixed ANOVA with proportion of Report Type as the dependent variable (See Figure 6). The main effect of Condition was not significant, $F(1,111) = 0.63, MSE = 0.027, p = .429, \eta_p^2 = .01$. There was, however, a significant main effect of Report Type, $F(1,111) = 28.37, MSE = 0.40, p < .001, \eta_p^2 = .20$, indicating higher reports of Spontaneous than Deliberate mind wandering when collapsing across Condition. Most critically, there was also a significant Condition by Report Type interaction, $F(1,111) = 10.62, MSE = 0.40, p = .001, \eta_p^2 = .09$. To follow up on this interaction, we next conducted two independent-samples *t*-tests to determine whether there was, as predicted, (1) more Deliberate mind wandering in the Easy relative to the difficult condition, and (2) more Spontaneous mind wandering in the Difficult relative to the Easy condition. The first *t*-test indicated a significant difference in the proportion of Deliberate mind

wandering across the two Conditions, with more Deliberate mind wandering in the Easy than the Difficult condition, $t(111) = 2.15$, $SE = 0.07$, $p = .034$, $d = 0.41$. The second t -test indicated a significant difference in the proportion of Spontaneous mind wandering across the conditions, with higher proportions of Spontaneous mind wandering in the Difficult than the Easy condition $t(111) = 2.85$, $SE = 0.04$, $p = .005$, $d = 0.54$.

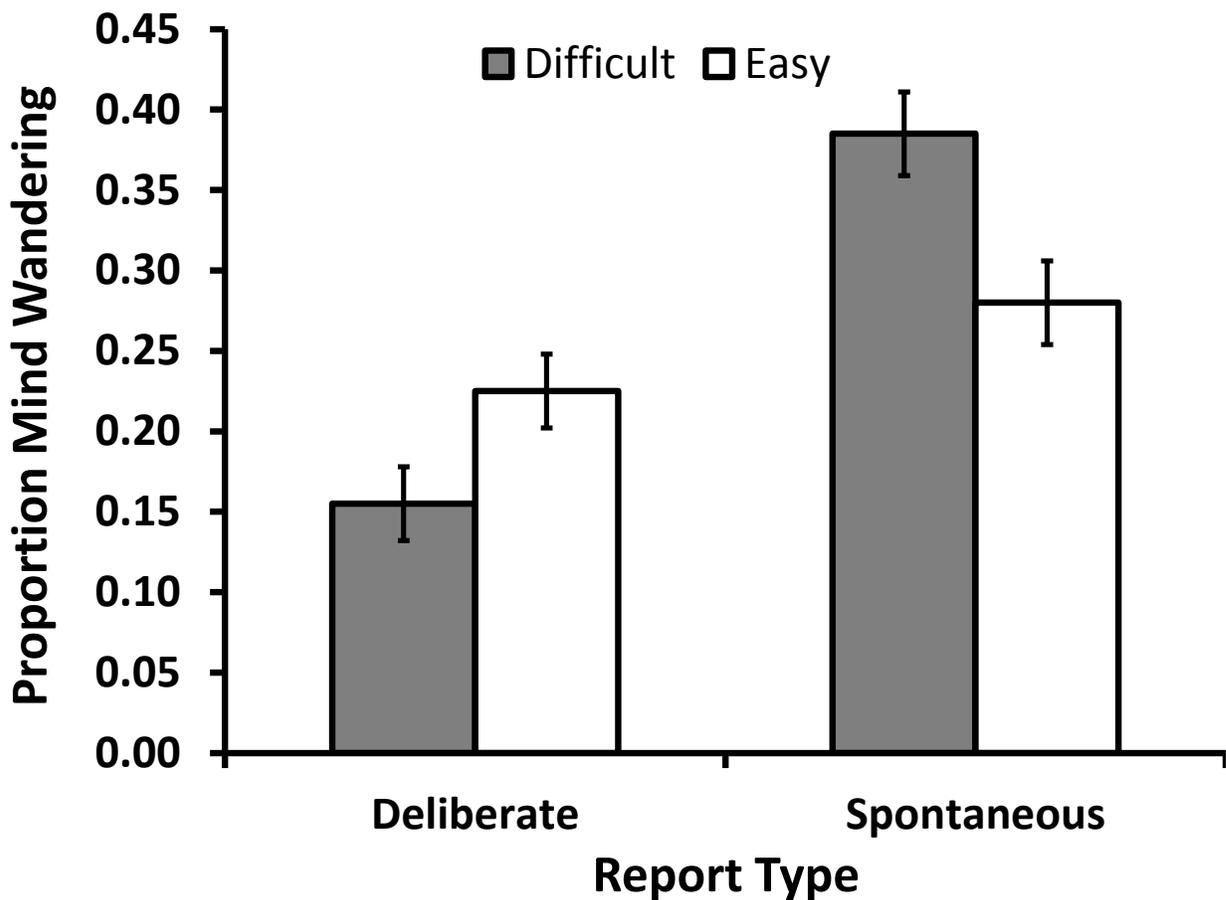


Figure 6. Proportion of Deliberate and Spontaneous mind wandering as a function of Condition (Easy vs. Difficult). Error bars are one standard error of the mean.

Study 5 Discussion

In the present study, although a manipulation of task difficulty did not result in varying rates of overall mind wandering across an easy and a difficult condition, it did produce very different distributions of the *type* of mind wandering engaged in each of these conditions. Specifically, results indicated higher levels of deliberate mind wandering and lower levels of spontaneous mind wandering in the easy relative to the difficult condition. This finding is of importance because it indicates that experimental manipulations can produce equivalent rates of overall mind wandering across conditions, but that the *type* of mind wandering engaged in each of these conditions might vary dramatically. Given recent evidence suggesting that the causes and consequences of deliberate and spontaneous mind wandering may be quite different in certain scenarios (e.g., Carriere et al., 2013; Seli, Carriere, & Smilek, 2014; Seli, Cheyne, et al., 2015; Seli, Smallwood, et al., 2015), it is clearly important for research to examine the relative proportions of these types of mind wandering in order to more effectively elucidate the causes and consequences of mind wandering.

In the majority of research reports on the topic, mind wandering is characterized as a unidimensional construct that reflects unintentional, internally-focused thought (e.g., Baars, 2010; Carciofo, Du et al., 2014; He et al., 2011; Klinger, 2009; Kane & McVay, 2012; Mason et al., 2007; McVay & Kane, 2010; O'Callaghan et al., 2014; Seli, Cheyne, & Smilek, 2013; Smallwood, O'Connor et al., 2007; Smallwood, McSpadden et al., 2007; Smallwood & Schooler, 2006; Zavagnin et al., 2014). Indeed, in their seminal work on the topic, Smallwood and Schooler (2006) defined mind wandering in opposition to deliberately engaged thoughts, such as goal-directed processing. However, consistent with previous work (e.g., Carriere et al., 2013; Seli, Carriere, & Smilek, 2014; Seli, Cheyne, et al., 2015; Seli, Smallwood, et al., 2015),

the present results demonstrate that a considerable proportion of reported episodes of mind wandering in fact reflects intentionally engaged thoughts. Thus, this result indicates that, in the case that researchers seek to maintain a unidimensional conceptualization of mind wandering as reflecting unintentional thought, it is clearly important that they isolate such thoughts by separating them from those that occur with deliberation; otherwise, there is the very real possibility that these thoughts will be conflated with those that are engaged with deliberation, which, according to such conceptualizations, would not qualify as mind wandering, per se.

As noted in the Introduction, considerable research has demonstrated that mind wandering varies as a function of task difficulty, with more mind wandering occurring during easy relative to difficult task (e.g., Smallwood, Ruby, & Singer, 2013; Thomson, Besner, & Smilek, 2013). The most widely accepted explanation of this common finding is that easy tasks require the employment of few executive resources for good performance, which therefore affords people the opportunity to mind-wander without incurring much in the way of performance costs; on the other hand, good performance on difficult tasks requires the employment of many executive resources, leaving few resources available to be devoted to mind wandering (thus, mind-wandering rates are low in difficult tasks; e.g., Smallwood & Schooler, 2006). Surprisingly, in the present study, despite the fact that the “easy” task was demonstrably easier than the “difficult” task, results did not reveal higher rates of overall mind wandering in the easy relative to the difficult condition, as has been frequently observed in the literature. In considering why this might have been the case, it is important to note that the reason the Sequential SART (i.e., the “easy” task) is in fact easier than the Standard SART (i.e., the difficult task) is because the former allows for strategic (controlled) processing whereas the latter does not. However, in most (if not all) studies examining mind wandering as

a function of task difficulty, the easier tasks require *less control* than the difficult tasks (e.g., Smallwood, Ruby, & Singer, 2013; Thomson et al., 2013). Thus, in the present case, it is plausible that performance was better in the easy task than in the hard task, not because the two tasks required different amounts of resources overall (indeed, the requirement to discriminate between GO digits and NOGO digits was the same across both tasks), but instead because, in the easy task, participants were afforded the opportunity to use their resources more strategically; indeed, this is evidenced by their improved performance and more opportunistic deliberate mind wandering. This interpretation opens up the interesting possibility that the relation of task difficulty and mind wandering may be more nuanced than initially conceived, and it may help to explain the seemingly contradictory finding that, in some cases, mind wandering is greater during difficult relative to easy tasks (e.g., Feng, D’Mello, & Graesser, 2013). Of course, to examine this possibility, future research will need to assess the intentionality of mind wandering, and to specifically examine the relative proportions of deliberate and spontaneous mind wandering across various conditions.

Concluding Remarks

In this series of studies, I have shown that (1) participants experience deliberate and spontaneous mind wandering at both the trait- and state-levels, and (2) these two types of mind wandering sometimes differentially associate with variables of theoretical interest (and are therefore dissociable), and (3) conflating these two types of mind wandering can mask the relative influence of each type of mind wandering, which can in turn lead to underdeveloped (or even incorrect) theoretical conclusions. The critical point raised by these findings is clear and requires little in the way of elaboration: The vast majority of mind-wandering researchers have assumed that their indices of mind wandering have exclusively homed in on unintentional, internally-focused thought, but the results of the present series of studies clearly suggests that this has not been the case. Put differently, the present results suggest that research on mind wandering has been unwittingly confounding intentional and unintentional types of internally-focused thought. Although this represents a serious problem for the literature on mind wandering, fortunately, the solution to this problem is straightforward: In future investigations on the topic, researchers should clearly distinguish between deliberate and spontaneous types of mind wandering – both at the trait and state level – and discuss results in terms of the individual contributions of these two separate modes of thinking.

Although the articulation of concern and subsequent exploration into the validity of a basic definition central to a sub-field was specifically and selectively applied to the area of mind wandering in this dissertation, the work outlined here has implications for psychology as a whole. That is, as it was found to be the case that an essential construct within the area of mind wandering was shown to be incomplete and in need of refining, despite the uncritical adoption and application of these terms by researchers in this area, one is left to ponder what

other central tenets of psychological theory may require more critical concern regarding their validity and articulation. Quine noted that "The less a science has advanced, the more its terminology tends to rest on an uncritical assumption of mutual understanding", and given the infancy of mind wandering relative to the broader field of psychological science, it seems reasonable to assume that issues such as those described here might be unique to the area. However, one should also consider that logical leaps can continually be made from faulty premises, and that without careful consideration, the field of psychological science may yet burgeon on using ill-informed and underspecified definitions, in turn rendering our advances inconsequential when the true nature of these concepts is eventually illuminated through critical analysis of the most basic issue of all: clearly and precisely agreeing on how to define the object of study. Accordingly, on the basis of my intellectual adventure described herein, I continually will advocate the questioning of the foundations of our science with the aim of attaining more clarity in our quest to understand our minds and how they wander.

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