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THEORETICAL REVIEW

On the relation of mind wandering and ADHD symptomatology

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Abstract 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.

Keywords Attention-deficit/hyperactivity disorder · ADHD · Mind wandering · Spontaneous mind wandering · Deliberate mind wandering

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Attention-deficit/hyperactivity disorder (ADHD) is a neurobehavioral disorder characterized by inattention, impulsivity, and hyperactivity (Barkley, 1997; Douglas, 1983; Hinshaw, 1994). Of all the behavioral 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. 2005). 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 behavior (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 (but see 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 considering 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), 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 % 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 % 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 who scored in the top 10 % on the CR-C reported more spontaneous, but not deliberate, mind wandering than participants in the non-clinical group who scored in the bottom 10 % on the CR-C.

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 of spontaneous and deliberate mind wandering, which precluded analyses examining the independent contributions of these two types of 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.

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 clinically 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 four-item Mind Wandering: Deliberate (MW-D) scale and the four-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 the short-form screener of the ASRS can be used as a diagnostic screening criterion for ADHD (Krause et al., 2006), and previous research has found that this screener outperforms for 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 four or more of the six 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, here we report only the results of the continuous-scoring method (the results of the dichotomous scoring system are reported in full in the supplementary materials).

Results

In this section, 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 rates of deliberate and spontaneous mind wandering in our Clinical ADHD sample as well as our Non-Clinical Control sample, seeking to determine whether the results are consistent across the different analyses.

Non-Clinical samples

Descriptive statistics and Pearson product-moment 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 1). In both samples, the MW-S regression

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

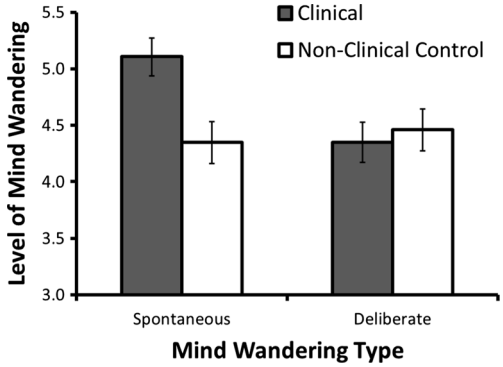

Fig. 2 Mean levels of deliberate and spontaneous mind wandering for the Clinical ADHD and Non-Clinical samples. Error bars are one standard error of the mean

coefficients were significant and relatively large, and the semi-partial correlations with the ASRS appeared to be strikingly linear (see Fig. 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 Fig. 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.

Clinical sample

Having demonstrated that spontaneous, but not deliberate, mind wandering was consistently 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 Fig. 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

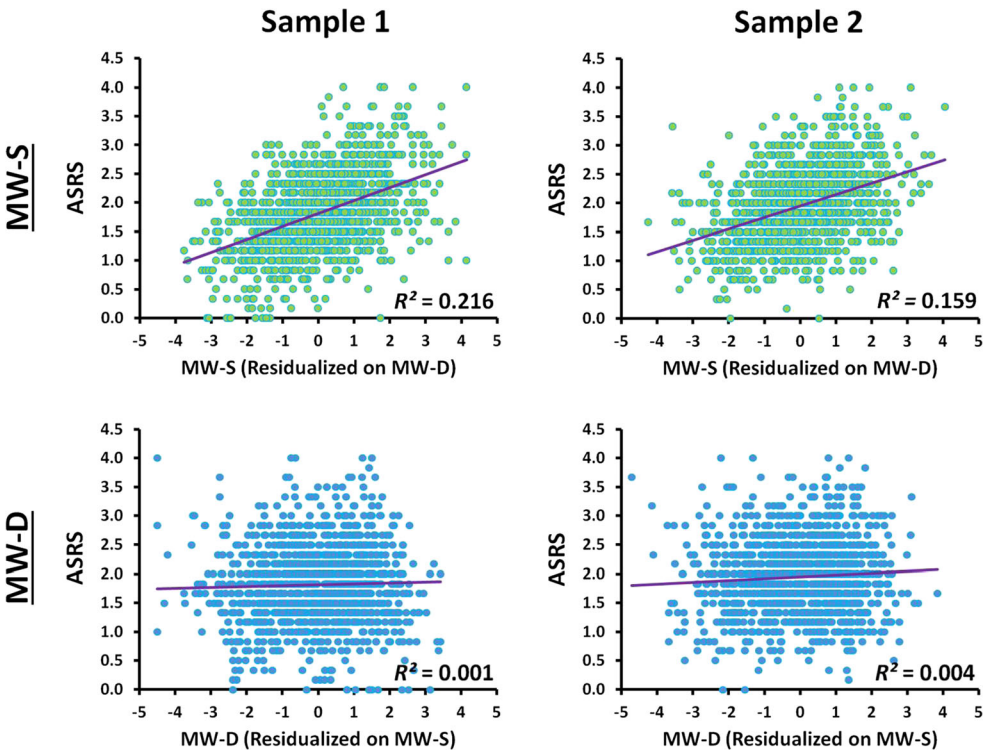

Fig. 1 Scatterplots showing the unique relations of the MW-S (top row) and MW-D (bottom row) with the ASRS, for samples 1 (left column) and 2 (right column)

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 ADHD 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.

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 (see supplementary materials), 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 in fact 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 with 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 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.

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