

ATTENTION CONTROL:
THE ROLE OF MEMORY MAINTENANCE AND INTELLIGENT DISENGAGEMENT ON
THE WANDERING MIND

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DEDICATION

I would like to dedicate this thesis to all of those who have helped me throughout my journey. My family has been a consistent source of strength throughout my life, and I could not ask for a better support system. To my dad, Uzoma, thank you for demonstrating what it means to be hardworking and resilient. To my mom, Michelle, thank you for always showing me how to be a thoughtful, caring, and loving person. My brother, Cajete, has always been an exemplary role model of what it means to be an older brother. Much appreciation goes to my grandma, Doreen, for being the kindest person that I have ever known and for being one of my greatest sources of inspiration. I have thoroughly enjoyed our many fishing trips, and I look forward to many more. I love you all beyond what I can put into words.

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ABSTRACT

Mind-wandering is a common part of everyday experience, but not all mind-wandering may reflect the same underlying processes. In particular, moments of off task thought that are reported in response to an external probe may differ from moments that people notice and report on their own. The present study examined whether these two forms of mind-wandering are differentially related to attention control, working memory capacity, and fluid intelligence. Participants completed a battery of cognitive tasks designed to assess these broader abilities, along with sustained attention tasks that measured both externally probed and self-detected mind-wandering. Composite measures of attention control, working memory capacity, and fluid intelligence were used to predict each type of mind-wandering, and additional analyses examined how each type related to objective markers of sustained attention performance. The results showed that probe-caught mind-wandering was reliably associated with lower attention control and lower working memory capacity which is consistent with the view that it reflects failures to maintain task goals over time. By contrast, self-caught mind-wandering showed a more complex pattern. Although observed relations were directionally consistent with the prediction that working memory capacity would be negatively related and fluid intelligence would relate positively to self-caught mind-wandering, these effects were small and did not reach statistical significance. At the behavioral level, probe-caught and self-caught mind-wandering showed different patterns of association with sustained attention performance. Taken together, these findings suggest that probe-caught and self-caught mind-wandering should not be treated as interchangeable measures. Probe-caught reports appear to provide a clearer index of lapses in sustained attention, whereas self-detected reports may reflect a more complex combination of attentional failure and the ability to notice that one's mind has drifted. These results highlight the importance of distinguishing between different forms of mind-wandering when studying individual differences in cognitive control.

CHAPTER ONE

INTRODUCTION

Executive functioning (EF) is essential for carrying out goal-directed behavior in everyday life. From reading comprehension to problem-solving, decision-making, and sustaining attention, humans rely on an incredibly complex, yet coordinated, set of control processes that allow organizing thoughts and actions in accordance with internal goals, rather than quick impulses and external distractions (Miller & Cohen, 2001; Miyake et al., 2000). Indeed, there is strong empirical evidence supporting the idea that various EFs facilitate performance across a wide range of higher order cognitive domains including working memory, reasoning, and the ability to control one's attention (Engle, 2002; Kane & Engle, 2003; McCabe et al., 2010). Importantly, the power of this association lies in the idea that individual differences in EF predict meaningful variability in academic achievement, everyday functioning, and real-world goal pursuit. However, it is always important to note that behavior observed in a tightly controlled lab setting may not always generalize to more complex real-world situations in which goals are often ill-defined, distractions are abundant, and attention must be constantly regulated over time.

Despite decades of research, there remains considerable debate regarding how executive control processes are best conceptualized and how they give rise to performance across domains such as working memory and general fluid intelligence. Most theoretical frameworks assume that executive control reflects a set of "domain-general" mechanisms that constrain and guide cognition, with prior research focusing on the individual constructs of working memory, attention, or intelligence in isolation, without considering how these abilities are inextricably linked. Herein lies the danger of interpreting any single task or construct as a pure index of EF.

That is, overlapping process, task-specific demands, and measurement constraints may complicate any straightforward interpretations of what these various EF tasks actually capture (Miyake et al., 2000; Kovacs & Conway, 2016). To that end, researchers in the field have long searched for more integrative frameworks that can reconcile attentional control, working memory, and higher-order reasoning within a unified executive control architecture (Burgoyne & Engle, 2020; Jacoby, 1991; Shipstead et al., 2016; Yonelinas & Jacoby, 2012). Consistent with this view, the present work adopts an attention control centric approach in which executive control is not merely one component among many others, but rather a core mechanism that supports both the maintenance of goal relevant information and the disengagement from no longer useful information (Burgoyne & Engle, 2020; Shipstead et al., 2016). To my knowledge, this study is among the first to test this dual pathway model (Burgoyne & Engle, 2020), particularly in relation to mind-wandering, which is a pervasive, yet theoretically informative, phenomenon that reflects moment-to-moment fluctuations in attentional engagement.

Attention Control

Attentional control (AC) is the ability to orchestrate thoughts, behaviors, and emotions in accordance with the internal goals of the mind, suppress habitual responses, and resist interference to maintain focus on the task at hand despite irrelevant information in the environment trying to capture our attention (Engle, 2002). AC is especially important during situations that require active maintenance of goals in the face of conflict that needs to be quickly resolved (Botvinick et al., 2001; Braver et al., 2007; Braver, 2012). In this view, AC is not simply

about “paying attention,” but more so about regulating the contents of consciousness in a goal-directed and consistent manner over time.¹

Numerous models of cognitive control now converge on the idea that prefrontal and anterior cingulate cortex regions play a central role in maintaining task goals, monitoring conflict, and effectively adjusting control settings (Carter et al., 1998; Macdonald et al., 2000; Miller & Cohen, 2001). Tasks such as the antisaccade, stroop, and sustained attention to response task (SART) are commonly used to index these abilities, as they require the suppression of natural response tendencies, resistance to distraction, and sustained goal maintenance over time (Hutchison, 2007; Kane et al., 2001; Macleod, 1991; Roberts et al., 1994; Robertson et al., 1997; Stroop, 1935; Welhaf et al., 2023). Latent variable approaches have demonstrated that such tasks load onto a common AC factor, despite their surface-level differences (Friedman & Miyake, 2004; Kovacs & Conway, 2016).

Nevertheless, the “task impurity problem” has troubled the research of EFs because any given task could tap into multiple overlapping cognitive processes, which makes it hard to specifically isolate constructs of interest (Miyake et al., 2000). Although the tasks previously mentioned intend to isolate specific cognitive processes, they also include task specific variance unrelated to the underlying construct of interest. For example, the stroop task depends not only on cognitive control but also engages color perception, the antisaccade task depends on visual acuity and oculomotor control, and complex span tasks require basic arithmetic ability and

¹ The terms attention control, cognitive control, executive functioning, and executive attention are often used interchangeably to refer to a closely related general set of top-down processes involved in goal-directed behavior. Indeed, an acknowledgement that these processes are nuanced and distinct is warranted, yet they are highly overlapping in theory and measurement. Here, I will mostly refer to these mechanisms as a domain-general “attention control” construct. While this assumption remains in contention (Rey-Mermet et al., 2025), the semantic debate regarding this is beyond the scope of the present study but has been discussed at length elsewhere (see Mashburn et al., 2023; Robison et al., 2026; Unsworth et al., 2024 for related comments on this).

spatial processing in addition to memorization. Although overlapping processes are expected, researchers have strongly encouraged that future studies conduct latent variable modeling and use composite scores from multiple tasks to reduce measurement error and isolate shared variance, which should allow EF to be investigated more accurately.

Maintenance and Disengagement Framework

A particularly influential and recent development in this literature is the proposal that AC supports two functionally distinct, but complementary, processes: maintenance and disengagement (Shipstead et al., 2016; Burgoyne & Engle, 2020). Central to their argument is that individual differences in working memory capacity and general fluid intelligence reflect different downstream outcomes of a common AC mechanism. In more detail, maintenance refers to the ability to keep goal-relevant information active in mind and resist interference over time. This process would most clearly be seen in working memory capacity tasks in which there are situations in which distractions or competing irrelevant representations must be suppressed. By contrast, disengagement refers to the ability to abandon no longer useful information, strategies, or solution paths in favor of more appropriate alternatives. This process would be especially important in reasoning and problem-solving contexts, as reflected by performance on general fluid intelligence tasks, in which progress depends on flexibly shifting away from previous unproductive approaches. One could assume that this AC-centric model has good explanatory power, but it leaves some aspects of behavior difficult to explain. In particular, how do moment-to-moment fluctuations in attention, such as mind-wandering, relate to these maintenance and disengagement processes? I suggest that mind-wandering may provide a unique opportunity to investigate how AC operates dynamically, rather than as a static trait.

Working Memory

Working Memory (WM) has been defined in many ways over the past several decades. Here working memory capacity (WMC) refers to the ability to temporarily hold a limited amount of information in mind that can be manipulated and used to execute current task demands and guide future behavior (Atkinson & Shiffrin, 1968; Baddeley & Hitch, 1974; Barrouillet et al., 2004; Cowan, 2001; Daneman & Carpenter, 1980; Engle, 2002). For an exhaustive review (see Cowan, 2017), it is important to note, however, that several influential frameworks have shaped the current thinking surrounding the study of WM. Early models emphasized storage buffers like the phonological loop and visuospatial sketchpad (Baddeley & Hitch, 1974), whereas later models highlighted the role of the focus of attention in selecting and sustaining active memory representations (Cowan, 2001; Engle, 2002). For the purposes of the present study, the focus will be on Engle's executive attention model that argues the ability to control one's attention is the key component underlying individual differences in WMC, not just the number of items that can be stored in memory. This model has yielded useful explanations as to why WMC predicts performance on a variety of attention tasks. Of note: although WM and AC are highly correlated, they should be interpreted as theoretically distinct constructs (Engle et al., 1999).

Critically, it is the active maintenance of information that is especially important under conditions of interference. This is because interference can disrupt the encoding and retrieval of information from long term memory, requiring active maintenance to keep goal relevant information accessible (Kane et al., 2001). Moreover, WM is reliably measured using simple and complex span tasks. Complex span tasks like the operation span, symmetry span, and rotation span involve recalling the correct serial presentation of a small number of items like letters,

words, or shapes that were presented alongside an irrelevant secondary task like solving math problems in between memory items (Foster et al., 2015; Redick et al., 2012; Unsworth et al., 2005). As such, complex span tasks demand both storage capacity and active processing, thus complex span tasks may better capture higher order cognitive abilities (Conway et al., 2005). For the purposes of this paper, the focus will be on the processes of maintenance and disengagement, which can be conceptualized as downstream outcomes of a broader AC system. In this view, AC facilitates both the maintenance of goal relevant information and resistance to interference, as captured by WMC, and the disengagement from irrelevant or no longer needed information that supports reasoning and problem solving, as captured by general fluid intelligence. This AC-centric model, put forth by Shipstead et al. (2016) and further developed by Burgoyne and Engle (2020), reformulates prior WMC-centric models by suggesting that maintenance and disengagement are not properties only in WMC per se, but rather reflect distinct control processes derived from the regulation of attention.

General Fluid Intelligence

Cattell (1971) identified an intelligence factor (g) that comprises fluid intelligence and crystallized intelligence, in which crystallized intelligence has to do with the broad knowledge that one accumulates over the course of their life and general fluid intelligence (gF) refers to one's ability to reason, solve novel problems, and detect abstract relations independent of prior knowledge. Tasks such as Raven's advanced progressive matrices, letter sets, and number series are commonly used to measure gF because they require relational integration, rule discovery, and flexible strategy shifting (Ekstrom, 1976; Raven, 1983; Thurstone, 1938).

Historically, WMC and gF have strongly correlated with each other (Ackerman et al., 2005; Beier & Ackerman, 2005; Kane et al., 2005; Oberauer et al., 2005). However, there remain disparate findings regarding which cognitive mechanisms account for this shared variance. Prior studies have suggested that the relationship between WMC and gF can be attributed to the amount of items an individual can hold in memory (Carpenter et al., 1990). However, some researchers support the idea that their shared variance is rather explained by one's ability to control their attention (Engle et al., 1999; Heitz et al. 2005). Supporting this view, Burgess et al. (2011) demonstrated that neural mechanisms of interference control underlie the relationship between WMC and gF, suggesting that domain-general processes, rather than storage capacity alone, are central to reasoning performance. Relatedly, Unsworth et al. (2014) proposed a more fragmented account of this, in which performance on WMC and gF tasks reflect the combined influence of capacity limits, attentional control, and long-term memory retrieval. From this perspective, gF is not reducible to any single mechanism, but depends on coordinated control processes that regulate the access, maintenance, and disengagement from information already in memory. This view aligns with process overlap theory (Kovacs & Conway, 2016) that explains fluid intelligence performance not as a unitary ability, but rather arising from the overlap among multiple EFs including updating, shifting, and inhibition. This overlap in constructs may explain why previous findings in studies attributed poor performance to low WMC when actually it could be due to unmeasured variation in gF, specifically in tasks that involve strategic and flexible attention switching (Burgoyne et al., 2021). Importantly, evidence from cognitive training studies further constrains capacity-based interpretations of gF. For example, Redick et al. (2013) found no evidence that WM training produces reliable improvements to gF, despite

relative improvements on the tasks themselves. This finding suggests that gF is unlikely to be explained solely by storage capacity and instead reinforces the view that stable control processes such as interference resolution, strategy selection, and flexible disengagement play a central role in reasoning abilities. Other researchers assert that it is not just the ability to hold goals in mind when completing problems on the task that is important, but instead the ability to acquire, reuse, and maintain solution strategies among similar problem sets for future use (Verguts & De Boeck, 2002). Therefore, Verguts and De Boeck put emphasis on the ability to learn and put into practice solution strategies during intelligence tasks that are crucial for explaining the association between WMC and gF.

Recent models of gF suggest that fluid intelligence is due to domain-general processes like updating, shifting, and inhibition that are all closely related to AC. Another essential aspect of gF is the ability to combine multiple related items at the same time, which are prominent in gF tasks like Raven's advanced progressive matrices, letter sets, and number series (Ekstrom, 1976; Thurstone, 1938; Raven, 1983). This idea called relational integration put forth by Halford et al. (2007) is critical to tasks requiring observing patterns, abstract reasoning, evaluating rules, and testing out new hypotheses to acquire solutions. Thus, these operations rely on not only holding information in mind (maintenance), but also filtering out incorrect rules or information that is no longer needed to support task goals (disengagement). This could allow a view into the adaptive role that disengagement plays in these tasks.

Some researchers have even proposed pupil size changes to be a marker of intelligence (Tsukahara & Engle, 2021). Their reasoning is that pupil dilation is strongly reflective of activity of the locus coeruleus, a nucleus in the brainstem, largely responsible for the release and

synthesis of norepinephrine to modulate networks in the brain associated with attention, arousal, and alertness. Using the maintenance and disengagement framework, they show that pupil size is more correlated to gF than to WMC. Because pupil dilation is a reliable proxy of locus coeruleus-norepinephrine activity, they argue that pupil size should also be closely related to disengagement rather than maintenance. However, other researchers have cautioned against this interpretation of suggesting that pupil dilations are reflective of intelligence levels (see Unsworth et al., 2021, for a critical reply to Tsukahara & Engle, 2021). Taken together, these findings support a view of gF not as simple reflection of one cognitive ability or prior knowledge, but as indicative of reflexive, control-dependent cognition with a keen emphasis on the ability to disengage from ineffective strategies or behaviors.

Mind-Wandering

In recent years, Mind-Wandering (MW) has become a re-emerging topic of interest in cognitive psychology (see Smallwood & Schooler, 2015 for a review). MW refers to internal or external unrelated thoughts that may occur while performing a task (McVay & Kane, 2010; Smallwood & Schooler, 2006). MW has been estimated to occupy around 30-50% of our waking hours as humans (Killingsworth & Gilbert, 2010) and around 25% of the time students report not paying attention to in-class lectures, which has brought renewed urgency to understand its cognitive mechanisms and consequences (Brown, 1927; Kane et al., 2007; Szpunar et al., 2013).

From a theoretical standpoint, several influential frameworks attempt to explain why MW occurs. One account proposes that MW reflects perceptual decoupling, whereby perceptual input from external stimuli is reduced to bias and reorient attention towards internally generated thoughts (Smallwood & Schooler, 2006; Smallwood, 2013). In line with this, the current

concerns theory (Klinger, 1999) suggests that emotionally or motivationally salient concerns may draw one's attention inward, resulting in perceptual decoupling from the current task and consequently lead to poorer task performance. A complementary view, the executive control hypothesis (Smallwood & Schooler, 2006), suggests that MW in and of itself requires executive control resources, assuming that maintaining internally generated thoughts can be conceptualized as cognitively demanding. Additionally, the executive failure hypothesis posits that the executive control system is unable to inhibit internal or external distractions because there are a limited amount of attentional resources available to an individual (McVay & Kane, 2010). As such, the failure and concerns theory suggests that MW occurs because those with poorer executive control are unable to prevent concerns, whether generated by themselves or noticed in the environment, from capturing their attention (McVay & Kane, 2009, 2010, 2012). Indeed, research has shown that those individuals with better executive control abilities report far fewer episodes of negatively valenced MW during periods of sustained attention (Banks & Welhaf, 2022).

Neuroimaging work further suggests that MW is associated with increased activity in the default mode network (DMN), along with dynamic interactions in frontoparietal control networks (Andrews-Hanna et al., 2014; Christoff et al., 2009; Smallwood et al., 2012). Brain regions within the DMN are involved in MW and play a role keeping the mind at rest and engaging in internal thoughts. Regions within the DMN experience increased activation during MW episodes specifically as attention shifts from stimuli in the external environment to more internally related thoughts like action planning for the future and autobiographical memories (Andrews-Hanna et al., 2014; Smallwood et al., 2012). This neural explanation occurs because of

the complex interaction between the areas associated with cognitive control. Specifically, the frontoparietal control network modulates the focus of attention, lending support to the idea that it may allow the mind to wander when task demands are low but can inhibit MW when demands are high (Smallwood et al., 2012). Together, this suggests that AC might help determine whether DMN activity produces MW that is either advantageous or detrimental.

Indeed, considerable research has demonstrated that MW is associated with poorer performance on sustained attention, memory, and comprehension tasks (McVay & Kane, 2012; Robison et al., 2020; Thomson et al., 2014; Unsworth & McMillan, 2013; Unsworth & Robison, 2016). In such cases, task-unrelated thoughts (TUTs) distract focus away from goal-relevant actions. This lack of goal maintenance allows TUT intrusions to occupy the focus of attention. McVay & Kane (2009, 2010) showed that low WMC individuals experience more spontaneous MW than high WMC individuals, and this WMC difference is especially pronounced under high task demands. This finding suggests failure of controlled attention, rather than a lack of appropriate memory resources.

Furthermore, it is important to note that MW is not a unitary phenomenon and can be classified into two distinct types: spontaneous or intentional. Spontaneous MW refers to unintentional and unconscious shifts in attention away from a task or stimulus. This type of MW occurs without conscious control and is often triggered by unrelated internal thoughts or external distractions. In spontaneous MW, daydreaming may occur, and individuals may begin to notice their mind shifting focus without their own intention and awareness. Spontaneous MW is often associated with upregulation of the DMN, which is most often linked to self-referential thinking and unsolicited thought generation (Kucyi & Davis, 2014). In contrast, intentional MW involves

the effortful and deliberate ability to disengage from the current task demands or external environment stimuli to direct attention towards internally generated thoughts and memories. Whereas spontaneous MW occurs involuntarily, intentional MW is consciously triggered with the hypothesized aim of aiding in problem solving, creativity, reallocating cognitive resources away from the task at hand, and mentally refreshing. Specifically, intentional MW would prompt an individual to engage in thoughts related to future oriented planning, purposeful reflection of past events, or encourage exposure to novel thoughts and ideas to support and guide future performance, behaviors, and intentions (Baird et al., 2011; Mooneyham & Schooler, 2013; Murray et al., 2024; Seli et al., 2016). One might expect that intentional MW could indicate the disengagement from no longer relevant information and could be an interesting avenue for investigation.

MW is commonly assessed using two subjective methods: probe-caught and self-caught. Both methods are designed to capture fluctuations in attention and the occurrence of TUTs during tasks, but they differ depending on participants' meta-awareness and the timing of MW detection. Smallwood and Schooler (2006) demonstrated the probe-caught method by periodically inserting externally triggered probes during a task. So, at random intervals participants are asked to report the content of their thoughts immediately prior to the probe. This method is well-suited to capture attentional lapses as it does not rely on participants' self-monitoring or awareness (McVay & Kane, 2010). In contrast, the self-caught method asks participants to press a designated key whenever they notice their mind has wandered away from the task. Schooler et al. (2004) demonstrated that the self-caught method depends on meta-awareness and is more likely to capture MW episodes in which individuals are consciously

aware. Interestingly, the self-caught method reflects both the occurrence of MW and the participant's ability to detect and report the shift in attention, which could lend itself useful in distinguishing between intentional and unintentional episodes of MW. Here, I argue that MW should not be viewed solely as a failure of cognition. In fact, I propose somewhat of the opposite of the traditional deficit view. Instead, I argue that some instances of MW, particularly when self-detected, may reflect adaptive disengagement processes that are closely related to reasoning ability and executive control. This framework aligns with AC accounts that distinguish between maintenance and disengagement and motivates the present investigation of how individual differences in WMC and gF relate to differential expressions of MW.

Previous Methodological Concerns

Notable methodological concerns among the relationship between WMC and MW arise and are important for theoretical consideration, especially regarding the findings of previous literature. In particular, probe-caught and self-caught thought probes can influence each other when used in the same session or tasks. Seli et al. (2013) found that probes increased participants' meta-awareness such that frequent probe-caught prompts seemed to increase participants' monitoring of their own internal attentional state, leading to inflated self-caught MW rates afterwards. Effectively, frequent self-caught MW probes made participants more vigilant of their internal state, which could have primed participants to become better at catching themselves mind-wandering when presented with MW probes in later tasks. Results from a later paper by Seli et al. (2015) revealed that the order in which probe-caught and self-caught prompts are administered may have impacted frequencies of MW. That is, probe-caught prompts first could heighten participants' introspective awareness in later tasks. Relatedly, self-caught probes

given first may inflate or limit later probe-caught MW reports as participants may have increased vigilance over their internal attentional state and may tend to over-report later frequencies of MW. Additionally, studies by Schooler et al. (2004) and McVay and Kane (2009) demonstrated that participants who were instructed to engage in self-caught MW reported higher frequencies of TUTs in probe-caught measures, likely because the self-caught instructions boosted self-monitoring and raised levels of introspective focus. The current study aims to address these potential methodological concerns, carry-over effects, and demand characteristics that may partly explain the nature of the mixed findings within the literature.

The Present Study

The literature reviewed here leads to a coherent, but under tested, framework that AC supports both maintenance (indexed by WMC) and disengagement (indexed by gF). In my view MW provides a valuable behavioral window into these dynamic control processes. To my knowledge, this study is the first to investigate these relationships within a single design using both probe-caught and self-caught measures of MW independently. So, rather than treating MW as a common cause of attention failures, here I position MW as an outcome of how attention is deployed across tasks with varying demands and shaped by individual differences in cognitive control, maintenance, and disengagement. Thus, individuals with stronger maintenance abilities should exhibit fewer probe-caught instances of MW and better WMC performance, whereas individuals with stronger disengagement abilities may report more self-caught MW, yet show better performance on gF tasks that require flexible strategy shifting.

Notably, prior work has raised concerns that combining both probe-caught and self-caught methods within a single task can introduce order and carryover effects that confound

estimates of MW frequency. To address these concerns, the original semantic sustained attention task that was roughly forty minutes long with probe-caught and self-caught methods combined was divided into separate blocks: one probe-caught only and one self-caught only, with block order counterbalanced across participants. This design allows each method of assessing MW to be examined in relative isolation, while also leveraging both approaches to test whether they differentially relate to maintenance abilities in WMC and disengagement abilities in gF. Taken together, the present study aims to extend and build upon the current understanding of MW by embedding it within an AC framework of maintenance and disengagement.

Research Questions

1. Does attention control predict individual differences in working memory capacity and general fluid intelligence, consistent with the idea that AC supports both maintenance and disengagement processes?
2. Do individual differences in WMC and gF differentially predict the frequency of MW as measured by probe-caught and self-caught methods during sustained attention?
3. Are spontaneous (probe-caught) and self-detected (self-caught) reports of MW differentially related to maintenance and disengagement abilities?

Hypotheses

I reasoned that if AC supports both maintenance of goal-relevant information and the disengagement from no longer useful information, then individual differences in WMC and gF should show dissociable relationships with different aspects of MW. First, I predict that higher WMC will be associated with lower rates of probe-caught MW. This prediction follows from the idea that WMC primarily reflects maintenance ability. As such, individuals that are better able to

sustain task goals over time and resist interference should experience fewer instances of spontaneous attentional lapses when probed unexpectedly. Second, I hypothesize that once variance associated with WMC is accounted for, higher gF will be associated with increased rates of self-caught MW. Whereas stronger maintenance abilities should reduce the likelihood that MW occurs in the first place, stronger disengagement abilities should facilitate noticing off task thought once it has occurred and support returning attention to the task. Thus, after partialling out variance due to WMC, individuals higher in gF should be more likely to self-detect episodes of MW. Third, I expect that AC will predict performance across both WMC and gF tasks, consistent with the view that AC is the common top-down control mechanism supporting both maintenance and disengagement. However, the relationships between MW and cognitive performance are expected to differ by probe type: probe-caught MW should be more strongly related to maintenance failures and WMC, whereas self-caught MW should be more strongly related to disengagement abilities and gF. Importantly, I do not assume that self-caught MW will necessarily reflect better or worse performance overall. Rather, self-caught MW may reflect individual differences in meta-awareness and strategic monitoring, such that its relationship with performance and ability measures could perhaps vary in magnitude or even direction. Thus, the present study investigates whether MW is best understood not simply as a failure of cognition, but as a dynamic outcome of how controlled attention, maintenance, and disengagement are deployed across tasks. However, at present, the answers to these questions remain largely unknown.

CHAPTER TWO

METHODS

Participants

A total of 166 participants were recruited from Montana State University's SONA systems subject pool in exchange for partial course credit. Although demographics information is not reported here, the typical age range of this sample is 18-25 years old, around 55% female and 45% male, and is comprised of mostly White individuals. The target sample size was determined via an a-priori power analysis conducted using G*Power, using a small to medium effect size estimate ($f^2 = 0.10$, $\alpha = .05$, power = .95) in a linear multiple regression model. The estimated target sample size ($n = 203$) aligns reasonably well with prior studies' sample sizes. This study was not preregistered. The study was approved by the Institutional Review Board at Montana State University (IRB Protocol #_2025-2238-EXEMPT).

Procedure

Participants completed the experiment in one session, lasting approximately two hours. After providing informed consent and completing a demographics questionnaire, participants then completed a battery of cognitive tasks indexing controlled attention, mind-wandering during sustained attention, working memory capacity, and fluid intelligence. In separate blocks, both probe-caught and self-caught MW prompts were embedded within the SART to assess the frequency and nature of attentional lapses. During probe-caught blocks, participants were intermittently asked whether their thoughts were focused on the task or on things not related to the task at hand. Everything remained the same during the self-caught version, except

participants were instructed at the beginning of the experimental trials to press the ‘c’ key every time they notice their attention had drifted away from the task with no automatically triggered probes appearing.

Although probe-caught and self-caught methods differ in how MW is reported, caution is warranted in causally interpreting each probe type as cleanly mapping onto spontaneous versus intentional MW. Nevertheless, to further discriminate intentionality, participants were asked to classify their episodes of MW as either intentional or spontaneous, following procedures similar to those used by Seli et al. (2016) and Welhaf et al. (2025). This design enables the examination of how individual differences in AC and cognitive abilities relate to the frequency and type of MW during sustained attention.²

WMC was measured using the shortened versions of the Automated Operation Span (AOSPAN; Unsworth et al., 2005) and Symmetry Span (Unsworth et al., 2009) tasks. AC was measured using the Antisaccade (Hallet, 1978; Kane et al., 2001) and Sustained Attention to Cue task (SACT; Draheim et al., 2023). Mind-wandering was measured during the (SART) Sustained Attention to Response Task (Roberts et al., 1997; Welhaf et al., 2025). Additionally, gF was measured using Number Series and Letters Sets as used in previous research (Ekstrom et al., 1976; Thurstone, 1938). Composite scores were calculated for each set of tasks that are assumed to capture the broader constructs of interest. Detailed task descriptions and scoring procedures are provided in the materials section.

² Although measures of mind-wandering intentionality were collected within each probe type during the SART, those findings are not reported in the present paper because they deviate from the primary research questions the researcher aimed to answer here and because no a priori predictions were made regarding intentional vs spontaneous mind-wandering.

To address potential carry-over effects between probe-caught and self-caught methods that may have complicated prior interpretations, the instructions given to participants were task specific and were not revealed to the participants until right before each relevant task. Table 1 depicts how participants were randomly assigned to one of two counterbalanced task orders.

Table 1. Task Order

Version A	Version B
1. Antisaccade	1. Sustained Attention to Cue Task
2. Automated Operation Span	2. Symmetry Span
3. Number Series	3. Letter Sets
4. Self-Caught SART	4. Probe-Caught SART
5. Sustained Attention to Cue Task	5. Antisaccade
6. Symmetry Span	6. Automated Operation Span
7. Letter Sets	7. Number Series
8. Probe-Caught SART	8. Self-Caught SART

Note. SART = Sustained Attention to Response Task.

This counterbalancing ensured that half of the participants completed the self-caught SART earlier in the session and the probe-caught SART later in the session, whereas the other half of participants experienced the reversed order. This design was implemented to reduce reactivity and priming effects associated with repeated MW measurement and to minimize contamination among probe types. MW was assessed during the SART using independent probe-caught only and self-caught only blocks. The number of probes was kept to the minimum necessary to reliably sample MW while reducing the likelihood that probes themselves would

unduly disrupt ongoing task performance, as recommended by prior research (Robison et al., 2019; Welhaf et al., 2023).

This study uses a within-subjects individual differences design in which all participants completed each task with naturally occurring individual differences in executive functioning and mind-wandering frequencies among participants which will be leveraged to examine relationships among these constructs.

Materials

WMC Measures:

Automated Operation Span Task (AOSPAN; Unsworth et al., 2005) – The Automated Operation Span task asks participants to solve basic math problems while concurrently remembering sequences of unrelated letters. For each trial, an arithmetic problem appears on screen like $(6 \times 3) + 5 = 21$. Once the participant determines the solution to the problem, they are instructed to click the mouse at which time they determine whether the solution was correct by choosing either true or false. Next, a letter appears briefly until the next trial. Participants are instructed to remember the sequence of letters presented until they are tested on it. Set sizes range from three to seven and at test participants are asked to recall the letters in the serial order that they were presented in. The sum of all correctly recalled letters in their serial position and math performance served as the dependent measure.

Symmetry Span (Symm Span; Unsworth et al., 2009) – The symmetry span task asks participants to discriminate whether visual patterns presented on a grid are symmetrical or not while concurrently having to remember the serial locations of red squares presented in a matrix. A visual pattern would appear at which point the participants were instructed to determine

whether the pattern was vertically or horizontally symmetrical. Once they had clicked to determine whether it was symmetrical or not, then a matrix would appear with independent grid locations filled in with rapidly appearing red squares in different locations. Set size ranged from 3 to 7. At test, participants are asked to remember the sequence of the red squares that were previously presented. Correct symmetrical judgments and correct serial and spatial recall served as the dependent variable.

AC Measures:

Antisaccade Task (Hutchison, 2007; Kane et al., 2001; Unsworth et al. 2004) – In this task, participants are presented with a fixation cross (+) in the middle of the screen for either 1000 ms or 2000 ms (randomized). A white colored asterisk symbol (*) would then randomly appear on either the left or right side of the screen serving as a cue to participants to suppress their eye movements to that initial cue and instead quickly move their eyes to the opposite side of the screen to catch a quickly flashing target letter ‘Q’ or ‘O’ that is presented for 100 ms. Then, the target is quickly covered by a mask object (###). After reading the instructions, a series of practice trials followed, then the actual experimental trials began. Correct letter identification accuracy serves as the dependent variable.

Sustained Attention to Cue Task (SACT; Draheim et al., 2023) – This task is an accuracy-based measure of attention control. Participants were required to maintain attention at a spatially cued location over a variable delay interval and identify a quickly presented letter. Each trial began with a central fixation followed by a brief “Get Ready!” prompt. A circular visual cue was then presented for approximately 500ms to indicate the relevant spatial location and was subsequently removed from the display during the wait period. The critical manipulation in this

task is the variable wait time interval (either 0 or 2 to 12 seconds in 500ms increments), during which participants are required to maintain attention towards the previously cued location. After a delay, an array of letters was presented at the cued location for 250ms and then was quickly masked for 300ms. Then, the target letter appeared in the center of the array in a slightly darker font color than all the other surrounding non-target letters. The target and non-target consisted of the letters B, P, R. Participants responded by using the mouse to select the identity of the target letter from the available response options displayed on screen. The task consisted of three blocks of 22 trials (66 trials total) with no feedback provided. Accuracy of the proportion of correct responses served as the dependent variable. This updated version differs from the original task described by Draheim et al. (2021) in that the visual cue was not present during the delay interval, no distractor was present prior to stimulus onset, and the letter arrays were made less uniform across trials. Importantly, unlike the antisaccade task, the SACT requires participants to maintain attention at a pre-cued spatial location at a variable lag while resisting internal or external distraction.

Mind-Wandering Measures:

Sustained Attention to Response Task (SART; Welhaf et al., 2025) – Participants completed the semantic SART whereby participants were instructed to press the spacebar every time they saw a frequently occurring target stimuli (names of animals) for “go” trials and told to not press the spacebar on less frequently occurring non-target stimuli (names of vegetables) “no-go” trials. The proportion of go/no-go responses was around 90% go and 10% no-go. Each word was presented for 272 ms and then followed by a mask object (XXXXX). For the purposes of the

present analyses, I computed mean RT, the intra-individual RT standard deviation to correct “go” trials (RTsd), and d' which is a signal detection theory measure of accuracy.

Thought Probes – Thought probes were embedded within the SART to assess off-task thought during periods of sustained attention. Specifically, the SART was originally around 40 minutes long with intermixed probe-caught and self-caught probes. In order to examine the hypotheses, the task was split up into two 20-minute blocks, separately administered via counterbalanced task order with different probe types within each.

Probe-Caught Method – There were 240 trials in two blocks lasting approximately 20 minutes. Participants were presented with 30 externally triggered thought probes presented randomly after 50% of no-go trials. They were instructed at the beginning to respond to the option that best describes their mental state immediately before the probe appeared. The options were (1) Task Related, (2) Task Performance/Evaluation, (3) Off Task Neutral Content, (4) Off-Task Negative Content, (5) Off Task Positive Content. MW was assessed as the overall proportion of responses to options 3-5.

Self-Caught Method – There were 240 trials across two blocks lasting approximately 20 minutes. Participants were presented with the SART again, but this time they were instructed that they had to monitor their own attentional state and press the ‘c’ key anytime they noticed themselves having thoughts unrelated to the task. Once they pressed the ‘c’ key, a text box appeared asking them whether their off-task thoughts were positive, negative, or neutral. Once they had clicked an option the SART resumed on the next trial, meaning the trial did not repeat itself. Importantly, this was used to measure the meta-awareness that people do or do not have for tracking their own attentional engagement and disengagement.

gF Measures:

Number Series (Thurstone, 1938) – This task presents participants sequences of numbers. They were then given 5 response options and were asked to identify which digit produces the correct matching solution to complete the target pattern. Participants were given 3 minutes to solve 15 problems of increasing complexity. The correct number of items was the dependent measure.

Letter Sets (Ekstrom et al., 1976) – This task presents participants with five sets of strings of four-letter combinations. Participants are asked to identify which string of four-letter combinations did not follow the same pattern or rule as the other sets. Participants were given 3 minutes to solve 15 problems of increasing complexity. The total number of correct responses was the dependent variable.

CHAPTER THREE

RESULTS

These data were imported, arranged, cleaned, and scored in R 4.5.2 using RStudio (R Core Team, 2026). Data wrangling and preprocessing were conducted primarily with the *tidyverse* suite of packages (Wickham et al., 2019). The descriptive statistics and correlation tables were generated using *psych* and *apaTables* (Revelle, 2024; Stanley, 2021). Task-level cleaning and scoring procedures for the attention, memory, and intelligence tasks were informed by common approaches used in the *englelab* package (Tsukahara, 2022), although several scoring scripts were adapted to accommodate the large structure of the E-Prime exports and the specific variables logged in each task. For the SART, cleaning and scoring approaches were informed by procedures detailed in R scripts provided in prior research (Welhaf et al., 2025). In particular, responses from the SART were aligned across stimulus and mask events to compute go-trial accuracy, no-go trial accuracy, response time indices, d' prime, and MW episodes for both the probe-caught and self-caught measures of the task.

Following task-level scoring, composite scores for AC, WMC, and gF were created by z-scoring relevant indicators and averaging them within the construct. Descriptive statistics and zero-order correlations were first examined at both the task and composite levels. Primary and exploratory multiple regression analyses were then conducted in IBM SPSS Statistics version 31.

Descriptive Statistics

Descriptive statistics for the primary dependent measures from each task are presented in Table 2. Overall, performance across AC, WMC, and gF tasks fell within plausible ranges and

showed adequate variability for an individual differences analysis. The complex span tasks, antisaccade accuracy, and SACT accuracy all exhibited distributions consistent with typical performance in a university sample. Number series and letter sets likewise showed sufficient variability to support correlational and regression-based analyses. For the mind-wandering measures, probe-caught MW rates demonstrated substantial between-subject variability, whereas self-caught MW reports were lower on average and more positively skewed. This suggests that many participants reported relatively few self-detected episodes of MW and a smaller number reported substantially more – as shown in Figure 1. Among objective SART performance metrics, values appear to be within normal limits. However, subjective MW reports – particularly the self-caught SART MW variable (SC SART MW) – was not within normal limits.³

³ Self-caught mind-wandering counts are often non-normally distributed because most participants report relatively few instances and a smaller number report substantially more. Because the self-caught mind-wandering variable in the present sample showed substantial positive skew and kurtosis, a log-transformed version of this variable was computed and used in follow-up analyses to better satisfy the assumptions of linear regression.

Table 2. Descriptive statistics for primary task variables.

Measure	N	M	SD	Skew	Kurtosis
Operation Span	162	54.01	14.08	-1.12	1.13
Symmetry Span	156	28.47	7.86	-0.27	-0.65
Antisaccade	161	0.75	0.15	-0.44	-0.82
SACT	158	0.87	0.12	-1.39	1.76
Number Series	161	7.75	2.50	0.31	1.86
Letter Sets	159	7.19	2.32	1.12	3.76
PC SART MW	163	0.43	0.21	0.12	-0.15
PC SART d'	163	1.67	1.34	-1.60	5.58
PC SART MEAN RT	163	487.42	103.69	.46	1.46
PC SART RT SD	163	197.51	98.72	2.19	6.38
SC SART MW	102	5.10	9.10	4.05	19.61
Log SC SART MW	102	.43	.47	.74	-.30
SC SART d'	102	1.69	1.07	-0.23	0.99
SC SART MEAN RT	102	489.87	99.46	.27	-.116
SC SART RT SD	102	193.66	113.32	2.25	5.73

Note. n = number of cases per variable. MW = Mind-Wandering. d' = signal detection sensitivity index. RT SD = intraindividual reaction time standard deviation. PC = Probe-Caught. SC = Self-Caught. SC SART MW is a count. PC SART MW is on a scale ($\frac{1}{30}$). Log SC SART MW = log transformed self-caught MW variable.

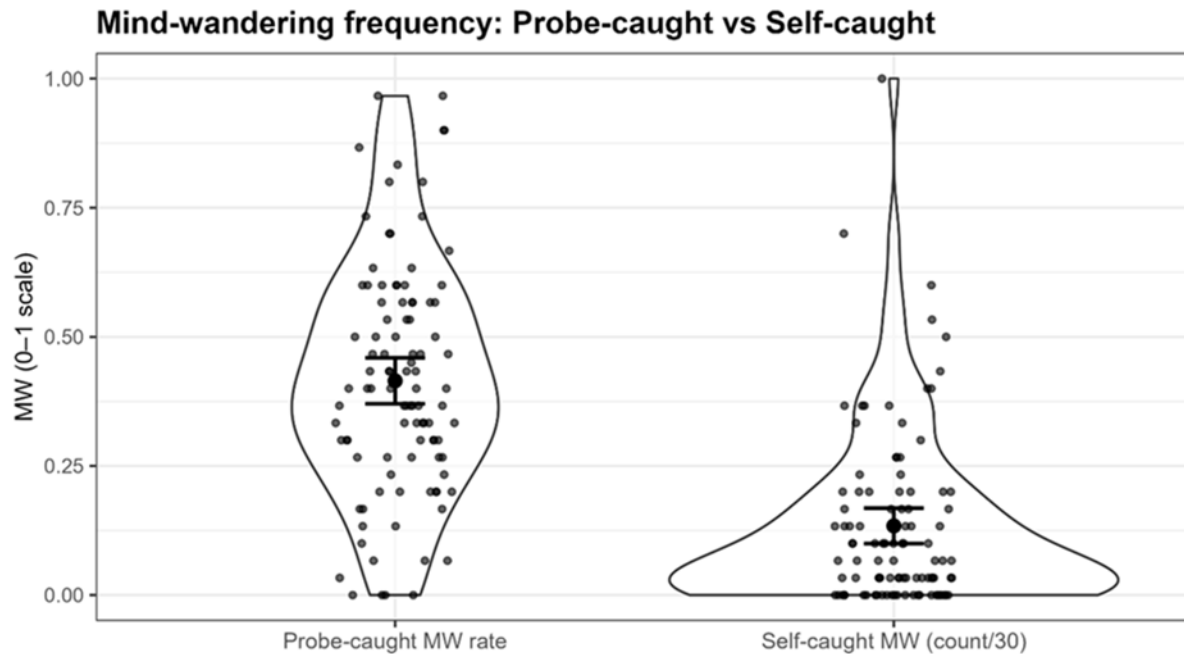


Figure 1. Depicts Frequency of Mind-wandering across each probe type.

Composite Construct Correlations

Zero-order correlations among the z-score composite constructs and the two MW measures are presented in Table 3. AC was positively associated with both WMC, ($r = .25, p < .01$), and gF, ($r = .35, p < .001$). WMC was also positively associated with gF, ($r = .21, p < .01$), indicating that the three composites were related in the expected direction while still retaining substantial nonshared variance. Of particular importance, probe-caught MW was negatively associated with AC, ($r = -.30, p < .001$), suggesting that individuals with better controlled attention reported fewer probe-caught episodes of MW. In contrast, probe-caught MW was not significantly related to either WMC or gF. Probe-caught MW was positively associated with self-caught MW, ($r = .31, p < .01$), indicating that individuals who reported more probe-caught MW episodes also tended to report more self-caught MW episodes overall. However, self-caught MW

was not significantly correlated with AC, WMC, or gF. Taken together, these correlations provide initial support for a robust association between AC and probe-caught MW, whereas any relationship between self-caught MW and broader cognitive abilities may depend on shared variance among performance predictors and is therefore better evaluated in linear regression models.

Table 3. Composite Construct Correlations.

Variable	1	2	3	4
1. AC				
2. WMC	.25*			
3. gF	.35**	.21*		
4. Probe-Caught MW	-.30**	-.001	-.07	
5. Self-Caught MW	.05	.011	.09	.31*

Note. * indicates $p < .01$. ** indicates $p < .001$. (2-tailed). Self-Caught MW is log-transformed.

Main Analyses

To test the a priori prediction that probe caught MW would be most strongly associated with maintenance related cognitive abilities, a multiple linear regression was conducted with episodes of probe-caught MW as the dependent variable and AC, WMC, and gF composite scores entered simultaneously as predictors. These results are displayed in Table 4. The overall model was significant, $F(3,92) = 5.21$, $p = .002$, and accounted for 11.7% of the variance in probe-caught MW rates as indicated by adjusted $R^2 = .117$. Among the independent variables,

only AC emerged as a significant unique predictor of probe-caught MW, ($\beta = -.40, p < .001$), such that higher AC was associated with lower probe-caught MW rates. In contrast, neither WMC, ($\beta = .08, p = .38$), nor gF, ($\beta = .06, p = .51$), uniquely predicted probe-caught MW. These results suggest that probe-caught MW is more closely related to AC broadly construed than to unique variance in WMC or gF once the shared variance among the three constructs is taken into account.

Table 4. Results of Regression for Cognitive Abilities Predicting Probe-Caught MW
95% CI

Variables	<i>b</i>	<i>LL</i>	<i>UL</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
AC	-.10	-0.16	-0.05	.03	-.40	-3.93	<.001
WMC	.03	-0.03	0.08	.03	.09	.88	.382
gF	.02	-0.04	0.07	.03	.07	.66	.512

Note. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

Dependent Variable: Probe-caught SART mind-wandering.

A second multiple linear regression was conducted to examine whether AC, WMC, and gF predicted instances of self-caught MW and those results are displayed in Table 5. The overall regression model was not significant, $F(3,92) = .478, p = .698, R^2 = .015$, adjusted $R^2 = -.017$. None of the three composite constructs emerged as significant unique predictors of self-caught MW episodes including AC ($\beta = .03, p = .792$), WMC ($\beta = -.03, p = .813$), or gF ($\beta = .12, p = .296$). Although the coefficients for WMC and gF were directionally consistent with the prediction that greater disengagement ability would relate to more self-detected MW, these

effects were not statistically significant. Thus, self-caught MW was not reliably associated with individual differences in AC, WMC, or gF in the present sample.

Table 5. Results of Regression for Cognitive Abilities Predicting Self-Caught MW
95% CI

Variables	<i>b</i>	<i>LL</i>	<i>UL</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
AC	.02	-0.10	0.13	.06	.03	.27	.792
WMC	-.02	-0.15	0.12	.07	-.03	-.24	.813
gF	.06	-0.06	0.18	.06	.12	1.05	.296

Note. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

Dependent Variable: Log-transformed self-caught SART mind-wandering.

Exploratory Analyses

In addition to testing the subjective measures of self-reported MW, objective measures of sustained attention task performance are also investigated as they relate to lapses of attention. These exploratory analyses were conducted to investigate if probe-caught and self-caught subjective indices of MW are equally valid as related to the objective measures of sustained attention performance. Correlations among the composite scores, SART performance metrics, and the two MW measures are presented in Table 6. At the performance level, AC ($r = .29$, $p < .001$), WMC ($r = .19$, $p < .05$), and gF ($r = .29$, $p < .001$), were positively associated with probe-caught SART d' . AC was also positively associated with self-caught SART d' ($r = .40$, $p < .001$), and WMC showed a smaller positive association with self-caught SART d' ($r = .22$, $p < .05$).

Additionally, gF was positively associated with probe-caught SART d' ($r = .29, p < .001$), but was not significantly related to self-caught SART d' ($r = .18, p > .05$).

With respect to response time variability, AC was negatively related to both probe-caught SART RT SD, ($r = -.31, p < .001$) and self-caught SART RT SD ($r = -.30, p < .01$), suggesting that AC was linked to more stable responding across both versions of the task. Interestingly, probe-caught MW was negatively associated with both probe-caught SART d' ($r = -.26, p < .001$), and self-caught SART d' ($r = -.38, p < .001$), and positively associated with both probe-caught SART RT SD ($r = .42, p < .001$), and self-caught SART RT SD ($r = .35, p < .001$). This indicates that greater off-task thought was generally related to poorer SART performance and increased reaction time variability. On the other hand, self-caught MW was weakly related to objective SART performance indices, showing a positive association with probe-caught MW ($r = .31, p < .01$), and a negative association with self-caught SART d' ($r = -.30, p < .01$), but little-to-no relationship with other SART performance measures. Taken together, these correlations suggest that probe-caught MW is more consistently tied to behavioral indices of sustained attention performance, whereas self-caught MW showed weaker and more selective relationships with task performance.

Table 6. Correlations Among Composite Scores, SART Performance Metrics, and Mind-Wandering Measures

Variables	1	2	3	4	5	6	7	8	9	10
1. AC										
2. WMC	.25**									
3. gF	.35***	.21**								
4. Probe-Caught SART d'	.29***	.19*	.29***							
5. Probe-Caught Mean RT	.09	.21**	.02	.13						
6. Probe-Caught RT SD	-.31***	-.10	-.19*	-.58***	.23**					
7. Probe-Caught MW	-.30***	-.001	-.07	-.26***	-.11	.42***				
8. Self-Caught SART d'	.40***	.22*	.18	.56***	.32**	-.54***	-.38***			
9. Self-Caught Mean RT	.14	.22*	.09	.32***	.63***	.02	.02	.40***		
10. Self-Caught RT SD	-.30**	-.18	-.19	-.43***	.01	.79***	.35***	-.65***	.10	
11. Self-Caught MW	.05	.01	.09	.15	.12	.09	.31**	-.30**	.13	.14

Note. * indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$. (2 tailed). Self-caught MW is log-transformed.

Exploratory Linear Regressions

Next, a series of multiple linear regressions were conducted to further explore the relationships between sustained attention performance and higher-order cognitive abilities. Specifically, performance metrics were collapsed across the self-caught SART and probe-caught SART to create composite scores of each. To examine whether broader cognitive abilities predicted overall sustained attention discrimination performance, a multiple linear regression was performed with composite SART d' (a signal detection theory-based measure of accuracy) as the dependent variable and AC, WMC, and gF entered simultaneously as predictors and is displayed in Table 7. Results revealed that the overall model was significant, $F(3,92) = 7.27, p < .001$, and the variables accounted for 16.5% of the variance in the composite SART d' sensitivity index as indicated by adjusted $R^2 = .165$. Both AC ($\beta = .30, p = .004$), and WMC ($\beta = .20, p = .042$), emerged as significant predictors of SART d' performance. This indicates that greater AC and WMC were associated with better overall SART signal-to-noise discrimination ability. In contrast, gF did not uniquely predict SART d' performance ($\beta = .10, p = .345$). Thus, across the two SART variants, performance accuracy as reflected by the signal detection theory d' prime sensitivity index appeared to be more closely related to maintenance-oriented control abilities than to unique variance in gF.

Table 7. Results of Regression for Cognitive Abilities Predicting Composite SART d' prime
95% CI

Variables	<i>b</i>	<i>LL</i>	<i>UL</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
AC	.35	.12	.59	.12	.30	2.96	.004
WMC	.27	.01	.54	.13	.20	2.06	.042
gF	.12	-.13	.36	.12	.10	.95	.345

Note. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

Dependent Variable: Composite SART d' prime.

A second exploratory multiple linear regression was conducted with composite SART mean RT as the dependent variable and AC, WMC, and gF entered simultaneously as predictors. The overall model was not significant, $F(3,92) = 1.89, p = .136$, adjusted $R^2 = .028$, indicating that the three predictors together did not account for a significant proportion of variance in overall SART response speed. At the level of individual predictors, WMC emerged as a significant positive predictor of composite SART mean RT ($\beta = .24, p = .026$), whereas AC ($\beta = .04, p = .703$), and gF ($\beta = -.07, p = .502$) were not significant. Thus, higher WMC was associated with longer mean response times across the two SART variants, although this effect should be interpreted with caution given the omnibus model was non-significant.

A third exploratory multiple linear regression was conducted with composite SART RT SD as the dependent variable and AC, WMC, and gF entered simultaneously as predictors as shown in Table 8. Composite SART standard deviation of reaction time served as an index of intraindividual variability in response speed, with higher values reflecting greater inconsistency in responding and, by extension, more variable attentional engagement across tasks. Results

revealed that the overall model was significant, $F(3,92) = 3.33$, $p = .023$, and together the predictors explained 6.8% of the variance in composite SART RT SD as indicated by adjusted $R^2 = .068$. Among the variables, only AC emerged as a significant unique predictor ($\beta = -.24$, $p = .024$), such that higher AC was associated with lower response time variability across the two SART variants. In contrast, neither WMC ($\beta = -.08$, $p = .427$) nor gF ($\beta = -.08$, $p = .436$), uniquely predicted composite RT variability. Importantly, AC was associated with more stable and consistent responding across the SART variants, whereas WMC and gF did not explain unique variance in RT variability beyond AC.

Table 8. Results of Regression for Cognitive Abilities Predicting Composite SART RT Variability

Variables	<i>b</i>	95% <i>CI</i>		<i>SE</i>	β	<i>t</i>	<i>p</i>
		<i>LL</i>	<i>UL</i>				
AC	-28.88	-53.80	-3.96	12.55	-.24	-2.30	.024
WMC	-11.11	-38.78	16.56	13.93	-.08	-.80	.427
gF	-9.97	-35.29	15.35	12.748	-.08	-.78	.436

Note. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

Dependent Variable: Composite SART Standard Deviation of Reaction Times.

Predicting Probed and Self-Detected Mind-Wandering

To examine whether probe-caught MW was associated with behavioral markers of sustained attention performance, a multiple linear regression was conducted with probe-caught MW rates as the dependent variable and probe-caught SART d' , mean RT, and RT SD entered

simultaneously as predictors. The overall model was significant, $F(3,92) = 16.88, p < .001$, such that 33.4% of the variance in probed MW responses were explained by objective measures of sustained attention performance, as indicated by adjusted $R^2 = .334$. All three variables emerged as significant unique predictors as shown in Table 9. Probe-caught SART d' positively predicted probe-caught MW, ($\beta = .23, p = .042$). Probe-caught mean RT negatively predicted probe-caught MW, ($\beta = -.36, p < .001$). Finally, probe-caught RT SD positively predicted probe-caught MW rates ($\beta = .75, p < .001$). Thus, increased probe-caught MW was associated most strongly with increased response time variability, and to a lesser extent with faster mean response times, and higher d' values.⁴

Table 9. Results of Regression for Objective Indices of Sustained Attention Performance Predicting Probe-Caught MW

Variables	<i>b</i>	95% CI		<i>SE</i>	β	<i>t</i>	<i>p</i>
		<i>LL</i>	<i>UL</i>				
PC SART d'	.04	.001	.080	.02	.23	2.06	.042
PC SART	-.001	-.001	.001	.000	-.36	-3.61	<.001
MEAN RT							
PC SART	.002	.001	.002	.000	.75	6.42	<.001
RT SD							

⁴ Notably, the positive unique coefficient for d' was opposite in direction from the zero-order correlation between probe-caught MW and probe-caught SART d' , which had suggested that increased MW was associated with poorer task performance. This reversal likely reflects shared variance among the performance predictors, and particularly for the strong relationship between MW and RT variability. Therefore, the positive regression coefficient for d' here should be interpreted carefully as it likely implies a suppression effect rather than evidence that better signal-to-noise discrimination performance is associated with increases in MW.

Note. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

Dependent Variable: Probe-caught mind-wandering.

Lastly, a multiple linear regression was conducted to examine whether self-detected MW episodes were associated with objective sustained attention metrics of performance in the self-caught SART as displayed in Table 10. The overall model was significant $F(3,92) = 9.98, p < .001$, accounting for 21.1% of the variance in self-detected instances of MW as indicated by adjusted $R^2 = .211$. All three variables emerged as being significantly associated with self-detected MW. Self-caught SART d' was negatively related to self-caught MW ($\beta = -.33, p < .001$). Self-caught SART mean RT was positively related to self-caught MW ($\beta = .47, p < .001$). Additionally, self-caught SART RT SD was negatively associated with self-caught MW ($\beta = -.40, p = .004$). Thus, greater self-caught MW was uniquely associated with poorer discrimination performance, longer mean response times, and lower RT variability during the self-caught SART. Unlike probe-caught MW – which was associated with greater RT variability and faster responding during sustained attention – this overall pattern supports the prediction that self-caught MW is determined by both the occurrence of attentional lapses and the ability to notice and disengage from off-task thought once it occurs. This interpretation is also consistent with the fact that the unique negative association with RT variability was in the opposite direction from the corresponding zero-order correlation, suggesting that shared variance among the objective performance indicators may reflect separable influences of sustained attention lapses. These results are interpreted in more detail in the general discussion.

Table 10. Results of Regression for Objective Indices of Sustained Attention Performance Predicting Self-Caught MW

Variables	<i>b</i>	95% <i>CI</i>		<i>SE</i>	β	<i>t</i>	<i>p</i>
		<i>LL</i>	<i>UL</i>				
SC SART d'	-.33	-.46	-.20	.07	-.76	-5.07	<.001
SC SART	.002	.001	.003	.001	.47	4.18	<.001
MEAN RT							
SC SART	-.002	-.003	-.001	.001	-.40	-2.92	.004
RT SD							

Note. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

Dependent Variable: Log-transformed self-caught mind-wandering.

CHAPTER FOUR

DISCUSSION

The present study examined whether individual differences in MW could be understood within an AC-centric framework in which WMC and gF reflect partially distinct maintenance and disengagement processes, respectively. To that end, probe-caught and self-caught MW were assessed within separate instances of the semantic SART and I examined how these measures related to composite indices of AC, WMC, and gF. Several findings are discussed. First, probe-caught MW was reliably and negatively associated with AC, and controlled attention emerged as the only unique predictor of probe-caught MW when WMC and gF were entered simultaneously. Second, contrary to the a priori prediction, self-caught MW was not significantly predicted by AC, WMC, or gF – even when a log-transformed self-caught variable was used to address non-normality. Third, across exploratory analyses, SART accuracy performance from the d' sensitivity index and response time variability from the RT SD were more consistently related to AC and WMC than to gF, whereas the performance correlates of self-caught MW revealed a more complex and multiply-determined pattern. Together the present findings suggest that probe-caught MW is closely related to AC broadly construed, whereas self-caught MW likely reflects a more heterogeneous mixture of attentional lapses and metacognitive awareness processes.

Probe-Caught Mind-Wandering and Maintenance Failures

One of the primary findings from the present study was that probe-caught MW was most consistently related to breakdowns of controlled attention. Although the original theoretical framing emphasized maintenance processes indexed by WMC, the regression analyses

performed here demonstrated that probe-caught MW was uniquely predicted by AC rather than by WMC or gF once their shared variance was taken into account. At the zero-order correlation level, probe-caught MW was negatively associated with AC and associated with indices of poorer sustained attention performance, including increased RT variability and lower accuracy. These findings together suggest that probe-caught MW is best understood not simply as a byproduct of lower memory capacity, but more broadly as a marker of reduced attentional stability and weaker goal maintenance during continuous task performance.

This interpretation is broadly consistent with the executive failure account of MW, which proposes that off-task thought becomes more likely when individuals are unable to maintain task goals and prevent interference during ongoing processing (Kane & McVay, 2012; McVay & Kane, 2010). Probe-caught reports are especially useful in this framework because they do not depend on participants' ability to notice or report their own attentional lapses. Instead, they provide an externally prompted indicator of whether attention was on-task or off-task immediately before the probe is presented. As such, the probe-caught method may directly index the occurrence of unconscious attentional disengagement itself, rather than the meta-awareness of that particular disengagement. The present results align reasonably well with this distinction such that individuals with poorer controlled attention reported more probe-caught MW, and increased probe-caught MW was also associated with poorer SART performance. This was especially pronounced in increased response time variability, which is often interpreted as reflecting fluctuations in sustained attentional engagement.

Importantly, the fact that AC, rather than WMC, emerged as the strongest unique predictor does not necessarily contradict the broader maintenance account (Burgoyne & Engle,

2020). In fact, it may suggest that the aspect of maintenance that is most relevant to probe-caught MW is the domain-general attention control construct, rather than storage based working memory performance. That is, the present findings are still compatible with the idea that probe-caught MW reflects failures to maintain task goals and sustain attention over time. They provide additional evidence that these failures are captured most strongly by a broader latent control construct. In this sense, AC may represent the more proximal mechanism, whereas WMC may only relate to probe-caught MW insofar as it shares variance with controlled attention. This interpretation is also consistent with the positive associations among AC, WMC, and gF at the composite level, alongside the fact that AC retained unique predictive power for probe-caught MW in the multivariate model.

The behavioral performance findings further reinforce this interpretation. Probe-caught MW was associated with poorer sustained attention performance overall and was most strongly predicted by RT variability. This suggests that people who reported more probe-caught off task thoughts also showed more unstable responding across the SART. This may be particularly informative because RT variability is often taken as a marker of fluctuating attentional engagement, rather than a simple speed deficit (Welhaf & Kane, 2024a, 2024b). Thus, the present pattern supports that probe-caught MW may be less about strategic disengagement and more about the instability in maintaining task goals over time. Additionally, the positive unique coefficient for probe-caught d' in the multivariate regression should be interpreted carefully given that it ran opposite to the zero-order correlation and likely reflects shared variance among the predictors. The broader pattern of results nevertheless converges on the view that probe-

caught MW tracks moments in which attention is less consistently controlled and sustained (Miller & Unsworth, 2021; Unsworth et al., 2021).

Self-Detected Mind-Wandering as a Multiply-Determined Process

The second main finding from this study was that the predicted construct level relationship between self-caught MW and gF was in the expected direction but did not reach statistical significance. At the zero-order level self-caught MW was not associated with AC, WMC, or gF. Furthermore, even after accounting for the large positive skew and kurtosis of the self-caught MW variable by log-transforming it, none of the three composite variables emerged as reliable unique predictors. Thus, the specific a priori prediction that higher gF would uniquely relate to more self-caught MW (once shared variance with WMC was accounted for) was directionally observed in the present sample but the effects were small and did not reach statistical significance. However, this non-significant result should not be overlooked. The present study was motivated in part by the idea that self-caught MW may reflect a qualitatively different process than probe-caught MW. Specifically, rather than indexing only whether off-task thought has occurred, self-caught MW also depends on whether individuals are able to realize their attention has drifted elsewhere (Seli et al., 2015). Under that view, self-caught MW was expected to show a distinct pattern of relations with broader cognitive abilities like WMC being negatively related to self-caught MW whereas gF would be positively related once their shared variance was accounted for. That predicted directional pattern was in fact observed but their unique associations were not statistically significant. Accordingly, the present data do not provide strong evidence that individuals higher in gF reliably self-detect more episodes of MW in a straightforward or robust manner. At the same time, these findings should not be interpreted

to mean that the self-caught method of assessing MW is theoretically uninformative or practically ineffective. Rather, the pattern of findings suggests that self-caught MW reflects multiple component processes – which is consistent with the conceptual framework motivating this study.

Self-caught MW may be especially complex because it likely depends on meta-awareness and monitoring processes in addition to the occurrence of off-task thought itself. To self-report a lapse of attention, participants must notice their attention has drifted, evaluate that shift as task unrelated, and then decide to report it. This means that self-caught MW may reflect unique individual differences in meta-awareness. Task demands and task-related motivation may also shape self-caught MW in ways that add complexity to its interpretation. During the SART, participants must sustain attention over time while also deciding whether it is worthwhile to continue closely monitoring their internal attentional state. Under such conditions, self-caught reports may depend partly on the extent to which participants remain motivated to detect and correct their attentional lapses. Self-caught MW may therefore reflect an interaction between lapse occurrence, meta-cognitive monitoring, and task engagement. Participants who are more motivated to perform well may be more likely to notice and report any drift of attention away from the task, whereas participants with lower task engagement may either experience attentional lapses more often or fail to monitor those lapses consistently. Thus, self-caught MW may be multiply-determined in a way that obscures simple relations with broad cognitive composites.

One possibility is that self-caught MW reflects two competing influences. On the one hand, poorer goal maintenance abilities may afford more opportunities for lapses in sustained

attention (Kane & McVay, 2012; McVay & Kane, 2009, 2010, 2012), thereby increasing the number of occasions in which self-caught MW could, in principle, be reported. On the other hand, the ability to notice and disengage from off-task thought once it occurs might reflect more efficient monitoring and recovery processes and therefore operate differently once shared variance is accounted for. Critically, these two influences may not vary in the same direction. Individuals lower in maintenance abilities may experience off-task thought more often, but they also may be worse at noticing those lapses in real time. Conversely, individuals with better monitoring or disengagement related abilities may not experience off-task thought as frequently, but when they do, they may be more likely to detect and report it. If both processes contribute simultaneously, then instances of self-caught MW could fail to show a clear zero-order or multivariate association with any single broad construct. This interpretation may help explain why self-caught findings were weaker and more complex than the probe-caught findings. Probe-caught MW showed a relatively clear relationship with AC and with objective SART performance metrics. This is consistent with prior evidence suggesting that probed MW reports index sustained attention more directly (Kane et al., 2007; Welhaf et al., 2022). By contrast, self-caught MW did not map onto AC, WMC, or gF – even though the associated performance metrics suggested that it was meaningfully related to behavior during the self-caught SART itself. This view is also consistent with the longstanding distinction in the literature concerning TUTs and the differentiation between MW itself and the conscious awareness of MW. Accordingly, many studies have emphasized that individuals are not always aware of their own attentional state and that self-detected reports likely depend on meta-awareness in a way that automatically probed reports do not (Seli et al., 2015; Seli et al., 2016; Smallwood et al., 2008).

Separately, I was also interested in determining through exploratory analyses whether probe-caught and self-caught subjective indices are equally valid relative to objective sustained attention task performance. These data demonstrated the probe-caught and self-caught MW were positively related, but behaved differently with respect to objective task performance and cognitive abilities. Here, probe-caught MW was more consistently related to objective SART performance metrics, whereas self-caught MW was more weakly and selectively related to task performance. This further supports the conclusion that these two methods should not be treated as interchangeable indicators of the same underlying process.

Objective Indicators of Sustained Attention Performance

The exploratory analyses of objective SART performance aimed to make the role of broader cognitive abilities during sustained attention more clear. Across the SART objective performance indices, AC and WMC were positively associated with SART accuracy and controlled attention uniquely predicted lower RT variability. This pattern is broadly consistent with the view that successful performance in contexts requiring sustained attention depends heavily on the ability to maintain task goals and sustain stable attentional engagement over time (Burgoyne & Engle, 2020; Welhaf et al., 2025). In the present data, individuals with greater AC and (to a lesser extent) WMC showed better SART accuracy, which suggests that these constructs support the maintenance of task relevant responding across both SART variants. Likewise, the negative association between AC and composite RT SD indicates that greater controlled attention was related to more stable and less variable responding. These findings suggest that sustained attention performance is supported by active control processes that help keep attention aligned with task goals.

This interpretation is also consistent with prior work demonstrating that lapses in sustained attention are systematically related to individual differences in executive control (Unsworth et al., 2010). For example, McVay and Kane (2012) argued that extreme response time fluctuations and executive control failures are tied to the same broader maintenance related processes that often distinguish individuals higher (versus lower) in WMC. Similarly, some studies (Miller & Unsworth, 2021; Unsworth & Miller, 2021) have emphasized that individuals differ not only in the intensity of attention, but also in its consistency over time, such that more effective executive control is reflected in more stable task engagement and reduced trial-to-trial variability. The present results converge with that perspective. Here, AC was the clearest predictor of RT variability, which suggests that response consistency may be especially sensitive to the stability of controlled attention. In a similar fashion, Hutchison et al. (2020) showed that, when distinguishing task-set preparation from MW, individual differences in preparatory engagement could be tracked with both behavioral and physiological indices. Likewise, Hood et al. (2022) found that cue-evoked pupil responses under temporal certainty indexed meaningful individual differences in preparatory control. Taken together, these studies suggest that successful sustained attention performance is not merely about just being generally alert, but in fact depends on the extent to which individuals can proactively engage with upcoming task demands and, most importantly, maintain that engagement over time.

Notably, gF was less consistently related to objective SART performance indices than were AC and WMC. Although gF was positively associated with probe-caught SART d' at the correlation level, it did not uniquely predict composite d' , mean RT, or RT variability once AC and WMC were entered simultaneously. This suggests that the aspects of objective performance

in the SART may rely more on maintenance-oriented control processes than on flexible reasoning and disengagement mechanisms thought to underlie gF. Therefore, success in this sustained attention task appears to depend less on discovering new rules or shifting away from previously useful representations and more so about keeping a simple task rule continuously active across time.

Objective SART Performance Predicts MW Methods Differentially

The final set of exploratory analyses further clarified that probe-caught and self-caught MW were related to objective SART performance metrics in meaningfully different ways. For probe-caught MW, the strongest and most consistent predictor was RT variability. Increased probe-caught MW was associated with greater trial-to-trial inconsistency in responding and this relationship remained robust even when d' and mean RT were considered simultaneously. This supports the idea that probe-caught MW can provide a relatively direct behavioral marker of lapses in sustained attention. That is, participants who were more likely to report off-task thought when automatically probed also tended to show the type of unstable response patterns that are commonly assessed to reflect waning attentional engagement.

The pattern for self-caught MW was also informative, but notably more complex. Increased self-caught MW was associated with poorer d' , longer mean RT, and lower RT variability during the self-caught SART. However, this should not be taken to imply a simple causal relationship between self-caught MW and any single form of task failure. Instead, this pattern is more consistent with the view put forth here that it may not map cleanly onto any single behavioral or objective indicator of task performance, but might instead reflect the joint influence of attentional lapses, disengagement, and meta-awareness.

Meta-awareness and Rates of Mind-Wandering

Also of methodological importance is that participants reported substantially fewer MW episodes in the self-caught SART than in the probe-caught SART, despite the fact that behavioral indices across the two instances suggested comparable lapses of attentional engagement. This discrepancy suggests that individuals may frequently experience MW without being consciously aware of it, effectively pointing to limitations in their meta-awareness for detecting their own internal cognitive states. Notably, this pattern emerged regardless of individual differences in WMC or gF, indicating that even individuals high in these cognitive abilities may struggle to accurately monitor and detect their own attentional disengagement in real time. In the probe-caught SART, participants reported MW around 42% of the time, which is consistent with estimates from Kane et al. (2007) and Killingsworth & Gilbert (2010) ranging between 30-50%. However, when put on a scale (equivalent to the 30 probes presented in probe-caught) participants only self-detected and reported MW around 5% of the time during the self-caught administration of the SART. Although unfortunate, these findings are not unusual. Unsworth et al. (2021) also showed patterns that attentional lapse measures were positively skewed due to the low overall number of responses and responses that were zero-inflated. Relatedly, two studies (Allan Cheyne et al., 2009; Unsworth et al., 2021) found that metrics of sustained attention lapses were all correlated with each other and had shared variance as combined predictors, but were somewhat distinct in the sense that they accounted for unique variance in the dependent variables of interest. Thus, the apparent discrepancy between probe-caught and self-caught reports underscores that meta-awareness is not an inevitable consequence of MW itself, but

rather an additional process that may fail even when behavioral signatures of attentional lapses are clearly present.

Implications for a Maintenance and Disengagement Model

Taken together, the present findings are most consistent with an AC-centric framework in which maintenance related control processes are expressed most clearly in probe-caught MW reports and also in objective indices of sustained attention performance. In line with this framework, individuals with stronger goal maintenance appear to better sustain task-relevant processing and, as a result, report fewer externally probed lapses of MW. This pattern fits well with the view that maintenance functions to preserve task goals in an active state and to protect ongoing performance from intrusions by TUTs (Burgoyne & Engle, 2020; Shipstead et al., 2016). Self-caught MW, on the other hand, seems to reflect a hybrid construct that includes both breakdowns in maintenance and the subsequent ability to detect and recover from such breakdowns.

Alternative Explanations

One of my predictions was that probe-caught MW would be negatively related to WMC, because maintaining focus on task goals over time should prevent MW from occurring in the first place. To my surprise, the present results did not support this hypothesis. One possible explanation for why WMC did not uniquely predict lower rates of probe-caught MW responses once AC was entered into the model is that the variance WMC shares with MW may be largely accounted for by AC itself. Although WMC is often theoretically linked to maintenance ability and resistance to interference, its association to MW does not always remain robust once other aspects of attention are considered (Baird et al., 2011; Levinson et al., 2012; Rummel & Boywitt,

2014; Zavagnin et al., 2014). Speculation for differences in these findings from this assumption – specifically why WMC was not significantly related or predicted lower rates of mind-wandering – is consistent with findings from Welhaf et al. (2025). In that study, when WMC was added as a covariate into a logistic mixed-effects model it did not significantly predict the occurrence of MW during a sustained attention task. Similarly, gF did not predict overall TUTs either. The correlations between WMC and MW were also not significant and likewise gF and MW had no relation in their sample. One assertion they discuss is that WMC may be negatively related to overall MW in very attentionally demanding situations, but in situations requiring low attentional demands individuals higher in WMC may exhibit more MW (although see Robison & Unsworth, 2017 for the contrary). Nevertheless, in the present study, one could conceptualize the SART administered here as a relatively easy and very low attentionally demanding task. Therefore, the benefit of having higher WMC may not have significantly offset the susceptibility to off-task thought, which provides one possible explanation for the reason why I did not find support for this prediction in this sample.

Methodological differences from prior work may also help to explain why the present findings differed from some earlier studies. In the current design, the probe-caught and self-caught methods were administered at separate instances, rather than being intermixed within the same task. This decision was intentional and was made to reduce reactivity and method variances that might arise when one probing method alters performance or introspective awareness in the other. Although this design choice strengthens interpretability in one sense, it may also have changed the nature of the self-caught measure relative to prior studies in which probe type order and carryover effects could have contributed to the observed effects. Additionally, a review paper

by Chu et al. (2023) alludes to considering that asking participants to catch themselves MW may incur performance costs due to the use of cognitive resources to carry out task switching between the primary task and answering questions about their off-task thought content from the probe. As such, any performance differences between the probe-caught SART and self-caught SART in the present study might have been sensitive to these task switching costs, instead of reflecting direct differences in absolute attentional lapse capture, especially because the task itself was the exact same and the only thing that differed was the method by which MW was reported.

Limitations

Several limitations should be noted. At present, data collection is currently ongoing and the analyses presented here were conducted on a preliminary sample that represents only a part of the intended target sample size. As such, the current findings should be interpreted as preliminary. Additional data may improve the power to detect smaller relations among the cognitive constructs and MW measures. Second, the self-caught MW variable showed a strong floor skewed distribution in which many participants reported very few self-caught episodes of MW which likely limited interpretability. Although a log-transformed variable was used in follow up analyses, the underlying rarity of reported self-caught episodes remains a challenge for drawing strong conclusions about their relation to AC, WMC, and gF. The study broadly relied, in part, on self-report indices of MW, which may carry well known limitations concerning introspective awareness, response bias, and variability in any participants' willingness or ability to report off-task thoughts. Third, although measures of intentionality and emotional valence were collected during the SART, those variables were not analyzed in the present paper. These non-cognitive factors may provide important additional information about not only the frequency

at which an individual experiences MW but also the fundamental content of what those off-task thoughts concern. Finally, the present study was correlational in nature. Although the results provide some support that maintenance and disengagement process contribute differently to probe-caught and self-caught MW, the design does not permit causal conclusions.

Future Directions

Several directions for future research may arise from the present findings. First, additional work is needed to better isolate the distinct processes that contribute to self-caught MW on its own. The results here indicate that self-caught MW may not be captured by a simple linear relation. Future research should work to continue to refine the measurement of self-detected MW as it may be valuable to develop and include direct measures of meta-awareness in order to better isolate how the awareness of attentional lapses contributes to self-caught MW instead of inferring it indirectly from self-caught reports alone. Additionally, other advanced analytic and statistical approaches could be considered to provide a more precise way of modelling such a variable. Second, the present study points to the need for stronger tests of the disengagement account. Future studies should include tasks that more directly index disengagement from no-longer relevant mental content, task sets, or problem-solving strategies rather than relying on gF as a proxy alone. Experimental manipulations that vary the need to disengage from prior rules, internal thoughts, or habitual response tendencies may be especially useful for testing whether individuals higher in gF are better able to notice and recover from MW once it occurs. Finally, future research should continue to systematically explore the methodological relationship between probe-caught and self-caught methods. A central motivation of the present design was the concern that these two procedures might influence one another

when embedded with the same task context. Although the current counterbalanced task order approach reduced that concern, it remains important to determine more precisely how order, probe frequency, and reporting demands shape both objective performance and subjective thought reports. This work will be necessary for clarifying whether probe-caught and self-caught MW are best understood as indexing distinct forms of off-task thought, distinct stages of a similar underlying process, or partially overlapping but non-identical consequences of attentional failures and meta-awareness.

Conclusion

These results suggest that mind-wandering should not be conceptualized solely as a failure of cognition. Although probe-caught mind-wandering seems to map onto more straightforward markers of sustained attention lapses and maintenance, at least some forms of self-detected mind-wandering may instead reveal dynamic monitoring and disengagement mechanisms. In this sense, the present findings still fit somewhat with Burgoyne and Engle's maintenance and disengagement attentional control model. As predicted, probe-caught mind-wandering appears to be more closely aligned with the maintenance side of that framework, insofar as it reflects whether task goals are successfully sustained in the face of distraction. Self-detected mind-wandering, however, could still be tied to disengagement related processes, but there might be other mechanisms also at work. Perhaps noticing and interrupting an ongoing off task thought episode requires separating from currently active internal content and redirecting attention back to the task – which cannot be related to composite scores from basic reasoning tasks. Thus, the present findings suggest that maintenance and disengagement may be expressed differently across methods of assessing mind-wandering.

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