Minds that Wander, Moods that Waver: The Influence of Negative Thinking, Cognitive Avoidance, Meta-Awareness and Mood Fluctuations on the Mind-Wandering and Depression Relationship

By

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Summary

Mind-wandering, with and without explicit awareness (i.e., meta-awareness), is associated with depression. But *how* we become meta-aware and *what* cognitive processes (e.g. dissociation, negative thinking patterns) contribute to this mind-wandering and depression relationship remains unclear. Additionally, studies investigating this relationship using laboratory-based mood induction and mind-wandering tasks assume mood remains stable, but this assumption has not been tested. My thesis addresses these gaps by (1) investigating which cognitive processes influence mind-wandering and meta-awareness to maintain depression, and (2) testing the assumption that mood remains stable during a mind-wandering protocol that is used to in examine the effect of mood on mind-wandering.

Existing literature shows both mind-wandering and depression are associated with negative thinking patterns including rumination and meta-cognitive beliefs (e.g., that thoughts are uncontrollable and dangerous). My thesis extends these studies by considering how such patterns—together with maladaptive strategies of dissociation, thought suppression and control—might connect mind-wandering and depression. Studies 1 and 2 showed participants who mind-wandered without meta-awareness and tended to ruminate—specifically brood—were more depressed. Additionally, mind-wandering contributed to depression, partly through maladaptive meta-cognitive beliefs (i.e., uncontrollability of thoughts), and maladaptive strategies (i.e., dissociation, thought suppression and control tendencies). Study 3 tested one of these strategies—dissociation (including amnestic, derealisation and absorption subtypes)—within a five-chain serial mediation model. This model, predicting that mind-wandering increases negative thinking patterns, and activates dissociation tendencies, which in turn reduces meta-awareness and contributes to more depression symptoms, was not supported. However, removing meta-awareness, a four-chain model was supported. Thus, mind-wandering increases negative thinking tendencies,

activating dissociation tendency, contributing to greater depression. My thesis is the first research to show while meta-awareness of mind-wandering is associated with depression, dissociation mediates the relationship between mind-wandering and negative thinking patterns with depression.

My thesis tested the assumption that prior mood remains stable during a commonly used mind-wandering task (Sustained Attention to Response Task; SART), by measuring mood before and after this task. Study 4—including a prior negative, positive, or neutral mood induction—showed negative mood improved, while positive and neutral mood deteriorated. Study 5—without a mood induction—showed an overall mood deterioration during the SART. Study 6 tested whether continuing the mood induction music throughout the SART maintained the induced mood. However, there was no difference in mood deterioration between participants listening to music compared to those without music. My thesis is the first to test and challenge the assumption of mood stability during the SART, showing mood's association with mind-wandering and meta-awareness may be partly spurious due to an interaction of mood with the task.

These studies have clinical and methodological implications. First, people who mind-wander tend to brood and hold maladaptive meta-cognitive beliefs (i.e. negative thinking patterns), and are more depressed, partly because they tend to activate maladaptive strategies (i.e., dissociation, thought suppression and control). Addressing these strategies, particularly dissociation, in treating depression might bring awareness to, and disengagement from, negative thinking patterns to ultimately improve treatment outcomes. Second, future emotion research should account for the unintended effect of task on mood when designing studies to better control for potential confounds.

Declaration

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university
2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and
3. to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text
4. has been completed without the use of generative artificial intelligence tools.

Signed: Diane Nayda.

Date: 01/09/2025

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Publications

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[1] *Note.* This publication does not comprise part of my thesis work but was a publication I worked on during my candidature.
[2] As above.

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Chapter 1: Literature Review

A Brief History of Mind-Wandering in Research

Have you ever found yourself sitting in front of your computer, only to suddenly realise you have mentally taken yourself away to a glorious tropical island with turquoise oceans and sandy beaches to escape the boredom of the computer task? Indeed, you might find yourself drifting away as you read this thesis. This shift of attention occurs because the human mind has the ability to not only represent what we are currently doing, but to also produce thoughts and emotions unrelated to the present moment, or to the task we are currently performing (Pope & Singer, 1978; Smallwood, 2013). To illustrate, as I began writing this chapter I noticed the following thoughts:

> "I need to write two paragraphs…. what journal will I send my manuscript to?…..ooh maybe I could go to a tropical island when I finish?...... I should look up flights …. On no I hate having to make dinner....... I must remember to feed the dog…...come on, focus on writing"

Although my primary task—writing two paragraphs—was clear, my thinking deviated to many topics. Each thought's purpose varied. There were thoughts about writing (i.e., task-related thoughts; "what journal will I send my manuscript to?"), thoughts unrelated to writing (i.e., task-unrelated thoughts; "I can hardly keep awake"), creative thoughts ("maybe I could go to a tropical island when I finish?"), future thoughts ("I must remember to feed the dog"), and emotionally salient thoughts ("I hate always having to make dinner"). Each thought can be classified as a type of *self-generated cognition*—i.e., thoughts, experiences, and/or sensations that emerge freely and independent of the external environment or the primary task being performed (Kucyi, 2018; Marchetti et al., 2014).

Researchers have operationalised self-generated thoughts in various ways (Callard et al., 2013), from emphasising their detachment from the primary task—termed *task-unrelated* *thought*s (TUTs; Mason et al., 2007)—through to relying on internal rather than external sources of information—termed *stimulus-independent* (SIT) and *spontaneous thoughts* (ST; Callard et al., 2013; Christoff et al., 2016). These self-generated thoughts (TUTs, SITs and STs) feature in many cognitive phenomena, including daydreaming, rumination, obsessive thinking, creative thinking and importantly here, *mind-wandering* (Callard et al., 2013). Given the overlap of features, differentiating one phenomenon—specifically mind-wandering—from others has been problematic.

The Controversy of Mind-Wandering

Mind-wandering is a pervasive human experience occupying between 10-60% of our waking hours (Killingworth & Gilbert, 2010; Seli et al., 2018). Yet, mind-wandering has struggled to find its identity within the self-generated cognition category because of difficulties in capturing people's internal thought flow, and the overlapping characteristics between mind-wandering and other self-generated thoughts, like daydreaming. For example, Marchetti et al. (2014) operationalised self-generated thoughts as daydreaming, a "nonworking thought that is either spontaneous or fanciful" (Klinger, 2009, p. 226). This operationalisation included TUTs associated with mind-wandering (i.e., spontaneous but not fanciful, e.g., wondering if you locked the door when reading), suggesting that mind-wandering is a sub-type of daydreaming, rather than a distinct construct. Consequently, researchers have debated whether mind-wandering is a distinct construct (e.g., see Irving & Thompson, 2018). Thus, to lay the foundation for my thesis research, I next consider mind-wandering's evolution, the difficulty with forming a clear definition, and how I have operationalised mind-wandering in my thesis.

Definition Evolution

Early references to mind-wandering can be traced to William James who, in his work on attention, referred to mind-wandering as occurring when a person becomes inattentive to external stimuli, such that the person appears "absent minded, abstracted or distrait" (James, 1890, p. 419). But preliminary investigations into mind-wandering began with Varendonck's (1921) work on daydreaming, described as the illusion where we fulfil our wishes or aspirations, or experience fear, without interference from real-world constraints (e.g., imagining being on a luxurious holiday that in real life is made impossible by financial constraints). Varendonck was interested in the "train of thought" and diarised, then analysed, his thoughts during deliberate daydreaming states. Like James, Varendonck identified many of his thoughts during these states were irrelevant to external influences, like daydreaming of himself as a war hero (i.e., aspirational) who lost his legs in battle (i.e., unrelated to his environment, SIT) despite not being a serving soldier (i.e., fanciful). Concurrently Freud, through his work in psychoanalysis, referred to daydreaming as mental activity that departs from reality to fulfil wishes that cannot be resolved, or imaginings that violate social norms (e.g., revenge fantasy; Person et al., 1995). Taken together, daydreaming was considered an unguided thought process aimed at solving unresolvable goals.

While previous definitions referred to daydreaming as occurring independent of external stimuli (i.e., SIT), but also as fanciful and deliberate (i.e., Vanderonck, 1921), Antrobus and colleagues (1966) defined daydreaming as mental content unrelated to *ongoing activity*. This narrower definition differentiated thoughts unrelated to what a person is currently doing, from thoughts that *are* related to what a person is currently doing. For example, under this definition Varendonck's experience would not be considered mind-wandering because although his daydreaming was stimulus independent (i.e., a SIT), it was also his primary task and therefore task-related (i.e., not a TUT). Klinger (1971) refined this definition to include the spontaneity of these thoughts, describing them as *unintended* mental content that comes to mind effortlessly, which he termed the "mind-wandering form of daydreaming" (Klinger, 1978; 2009). Klinger suggested that this mind-wandering form of daydreaming reflects people's default mental processing of unresolved salient goals or current concerns. Thus, mind-wandering and daydreaming are considered interchangeable constructs that are defined as (1) TUTs and SITs (i.e., self-generated thoughts) and/or (2) goal-directed. But while mind-wandering and daydreaming share similar characteristics, mind-wandering is heterogenous and varies in intentionality (deliberate or spontaneous), temporal focus (past, present, or future focused), purpose (current concern, relief, or boredom), emotional valence (positive, negative, or neutral) and adaptiveness (Mooneyham & Schooler, 2013; see costs and benefits of mind-wandering below). Capturing these characteristics in a single definition has been challenging for researchers.

Definition Dilemma

Despite its early beginnings, mind-wandering research was only recently highlighted in cognitive psychology and neuroscience. The definition of mind-wandering as a distinct construct of self-generated cognition continues to lack consensus (see Irving, 2016 for review). For example, mind-wandering classified as TUTs and SITs has been criticised for two key reasons. Critics argue that this narrow definition (1) is dichotomous (either thinking about the primary task or mind-wandering) and does not consider the dynamic nature of 'wandering'; and (2) does not differentiate mind-wandering from other self-generated thoughts like rumination—repetitive and passive thoughts focusing on the causes and effects of emotional distress (Dias de Silva et al., 2018).

Turning to the first critique, defining mind-wandering dichotomously—that is, as thoughts that are either detached from the primary task *or* on-task—creates a dilemma for classifying thoughts that are goal-directed and stimulus-independent (SIT) but still relate to the primary task. To illustrate, while driving home from work, a person's thoughts and attention shifts away from driving home (primary task) to their workday and not being good at their job. This shift in thinking meets the criteria for mind-wandering: the thought is goal directed, stimulus independent (SIT), and task unrelated (TUT). However, what if the primary task now becomes how to improve work performance (i.e., problem solving) and driving home becomes a secondary task? This shift in attention and thinking towards improving performance would no longer be task-unrelated (TUT) and would not meet the criteria for mind-wandering. Put differently, the thought classification would change from mind-wandering to being on-task. Further, mind-wandering is dynamic—thoughts freely drift from one topic (what to wear) to another (feeding the dog). Consequently, determining which is the primary task and when that task becomes secondary is also difficult. Thus, the dichotomous definition fails to accommodate the flow, and heterogeneous characteristics, of mind-wandering—a dilemma for classifying thoughts as mind-wandering.

The second critique is that this narrow definition does not differentiate mind-wandering from other self-generated thoughts, specifically rumination. Some researchers (e.g., Kane et al., 2007; Killingsworth & Gilbert, 2010) consider rumination a form of mind-wandering—it occurs independently of external stimuli (SIT) and is often task-unrelated (TUT). Using the previous example, worrying about work performance on the commute home is both a SIT and a TUT, and could be classified as both mind-wandering and rumination. Differentiating these two self-generated thought types depends on the focus, content, and emotionality of that thought. If the person experiencing the thought shifts their thinking to a better route home, this thought can be classified as mind-wandering; it is goal directed, a SIT, a TUT, and dynamic. If, however, the person fixates on the thought's negative content (i.e., poor work performance) and the emotional distress associated with that thought (i.e., anxiety and worry), it would be better classified as rumination (Nolen-Hoeksema et al., 2008; Rosenbaum et al., 2017). Where mind-wandering is dynamic and flowing (e.g., "the weekend will be warm", "what will I wear to the party"), rumination is fixed and rigid (e.g., "why do I feel so sad", "when will I stop feeling sad", "this will never end”). Rumination is sometimes classified as mind-wandering with ruminative content (e.g., while reading, your attention shifts to a mistake made at work and you repeatedly worry about the consequences), which further complicates the mind-wandering definition (e.g., Shrimpton et al., 2017). These criticisms show the difficulties in classifying mind-wandering as a distinct construct.

Overcoming the Definition Dilemma: The Dynamic Framework and The Family Resemblance View

A further criticism of narrowly defining mind-wandering is that it does not account for different *types* of spontaneous thoughts occurring *within one train of thought* (e.g., is thinking about “what to make for dinner”, an internally generated problem-solving task; or a goal-directed thought, or both?). To demonstrate, when you think about what to make for dinner, your mind wanders from the primary task (driving home from work) to a TUT (i.e., mind-wandering). As you began thinking about what to make, your thoughts became more akin to creative thinking—a *stimulus-independent, task-related thought*—where the task is now dinner. Once a decision is made, your thoughts become more goal-directed when planning the dinner—a *stimulus-independent, goal-directed thought*. During this train of thought, the thought type shifted according to how deliberate the focus of your attention became, but the transition between each thought type (mind-wandering, creative thought, goal-directed thought) is unclear. Throughout the process, your thoughts flow freely between each stage without fixation, as experienced with rumination.

In response to these criticisms, two frameworks have been proposed—the dynamic framework of spontaneous thoughts (Christoff et al., 2016) and the family resemblance view of mind-wandering (Seli et al., 2018). First, Christoff and colleagues proposed that thoughts evolve over time in a nonlinear, fluid manner influenced by context, mood, memory and goals. Spontaneous thoughts can be classified along two dimensions of constraints: deliberate constraints, reflecting how goal-directed a thought is, and automatic constraints, reflecting the degree of emotional and sensory salience associated with the thought. For example, daydreaming—characterised as fanciful and free flowing—typically arises when deliberate constraints are low; the thoughts are not strongly goal-directed but more flexible. As deliberate constraints increase, thoughts become more goal-directed, shifting from unstructured daydreaming towards mind-wandering and eventually into creative thinking. During each of these spontaneous thought processes, automatic constraints are low to medium, suggesting that the thoughts are moderately salient but not distressing. But when automatic constraints are high, thoughts become more fixed and repetitive and cease to be spontaneous such as rumination or obsessive thinking.

Second, Seli and colleagues (2018) developed the family resemblance view of mind-wandering, which proposes that rather than being a separate construct, mind-wandering is an umbrella construct that encompasses the shared characteristics of thoughts that are both *task-unrelated* and *unintentional;* these characteristics are found in daydreaming, rumination, unguided thought, and spontaneous mind-wandering (Seli et al., 2018). Thus, each of these processes can occur during mind-wandering but they do not always co-occur.

Although both frameworks address the dynamic flow of thoughts, they differ in focus. The dynamic framework of spontaneous thought (Christoff et al., 2016) focuses on how spontaneous thoughts arise and evolve over time, guided by varying levels of deliberate and automatic constraints. In contrast, the family resemblance view of mind-wandering (Seli, et al., 2018) focuses on clarifying what mind-wandering means in different contexts, recognising that mind-wandering can involve diverse content (e.g., rumination, creative and goal directed). The frameworks are complementary: the family resemblance view aids the classification and definition of different types of mind-wandering, while the dynamic framework explains how these thoughts shift over time. Importantly, the family resemblance view supports a flexible approach to identifying mind-wandering episodes based on overlapping features rather than strict criteria (such as measuring task-unrelated and stimulus independent thoughts as a form of mind-wandering). This conceptual flexibility allows researchers to investigate the relationship between mind-wandering and related constructs—such as rumination and perseverative thinking—without assuming a singular definition of mind-wandering.

Operationalisation of Mind-Wandering

For the purposes of my thesis, I have defined and operationalised mind-wandering in line with the family resemblance theory of mind-wandering (Seli et al., 2018) as follows. First, mind-wandering is defined as task-unrelated and stimulus-independent thinking that occurs effortlessly and without intentionality. Although people can engage in *deliberate* and intentional mind-wandering—i.e., consciously shifting thoughts away from a task toward an internal thought, memory, or image—mind-wandering is predominantly unintentional/spontaneous (Seli et al., 2016b). Whereas deliberate mind-wandering is associated with more positive outcomes (e.g., openness, positive and/or constructive daydreaming, and original/divergent thinking; Agnoli et al., 2018; Marcusson-Clavertz & Kjell, 2019; Vannucci & Chiorri, 2018), spontaneous mind-wandering is predominantly associated with negative outcomes, including attention control difficulties and impaired performance (Carriere et al., 2013), dysphoria (Xu et al., 2024), and attention-deficit/hyperactivity disorder (ADHD; e.g., Seli et al., 2015) It is the maladaptive outcomes associated with mind-wandering that is the focus of my thesis; therefore, mind-wandering is operationalised as spontaneous self-generated thoughts, involving internally generated/stimulus independent information, and task-unrelated thoughts that occur unintentionally, unless otherwise stated. Second, being on-task is defined as thoughts, perceptual processes, and attention to external environmental information/stimuli that are unrelated to performing the task. For example, driving in dangerous weather conditions requires focusing on traffic (attention), seeing the cars ahead (perceptual), and problem-solving (thinking) to avoid an accident. Finally, the *train of thought* is defined as several thoughts that flow from one thought to the next within a single topic (Altmann et al., 2014). The train of thought applies to both mind-wandering and being on-task, depending on the direction of a person's attention.

The "How" and "Why" of Mind-Wandering—Four Key Theories of Mind-Wandering

Multiple explanations of why and how mind-wandering occurs have evolved. Here, I first discuss the *current concerns* hypothesis, then how mind-wandering occurs through three key theories: the *decoupling* hypothesis, the *executive failure* hypothesis, and the *process-occurrence* hypotheses. Finally, I introduce the *meta-awareness* theory of mind-wandering to explain why we are not always aware when we mind-wander. These theories are the most established and widely accepted; they also align with the family resemblance view of mind-wandering (e.g., see Smallwood & Schooler, 2015).

The Current Concerns Hypothesis (Klinger et al., 1973)

This hypothesis posits that people's thoughts are influenced by their current motivations and concerns, personally relevant issues, or unresolved goals (Klinger, 1978); and that resolving these current concerns and goals (i.e., by mind-wandering) is people's default state. People's attention is only drawn away from this mind-wandering state when attending to an external task becomes more salient—i.e., has greater motivational value—than the current concern (McVay & Kane, 2010). For example, while walking to the shops, your thoughts might be about planning your purchases (a current concern) until you come to a road junction. Your attention then shifts to the more salient external task–crossing the road (e.g., attending to cars, breaks in traffic)—to judge when to cross the road safely.

Research supporting the current concerns hypothesis is based in neuro- and cognitive psychology. For example, fMRI research identified active brain areas when mind-wandering. In one example study, the Default Mode Network (DMN)—a set of neural structures that are active when people are at rest—was also active when participants mind-wandered with personally-relevant thoughts (Mason et al., 2007). Given the DMN was active both during rest and mind-wandering about current concerns, the authors concluded the brain's default state is to mind-wander with a focus on resolving current concerns.

Another study, from cognitive psychology, compared mind-wandering in participants primed to think about personally relevant concerns (i.e., listing their plans for the week) with a control group (i.e., listing the features of a car) whilst completing a reading task. Participants in the personally relevant concerns group mind-wandered more often than participants in the control group, suggesting people's default state is to mind-wander more when thinking about current concerns (Kopp et al., 2015).

In a similar study, female participants completed a working memory task (the OSPAN) that was framed as: a math task where they were primed to believe that males performed better than females on the task, or as a memory task (i.e., control group). Participants in the math group mind-wandered more about their performance—i.e., a current concern—compared to participants in the control group (Jordano & Touron, 2017), indicating that attending to the task was not as salient as their concerns about their performance. Together, these studies indicate that mind-wandering is the brain's default state and occurs when people's personal concerns are more salient than the external task they are performing.

Executive Failure Hypothesis (McVay & Kane, 2009; 2010; 2012b)

According to this hypothesis, mind-wandering results from failing to control the executive resources responsible for regulating attention, controlling goal-direction, and inhibiting distractions, thus disrupting people's focus on their primary task (McVay & Kane, 2010). For example, when people read, their executive control resources inhibit interference from both internal (i.e., current concerns) and external (e.g., a door closing) distractions to maintain a constant train of thought on what they are reading. Unlike the decoupling hypothesis that considers mind-wandering as an active process, the executive failure hypothesis assumes mind-wandering is a passive process that does not consume cognitive resources but occurs when other cognitive resources fail to minimise distractions.

According to this hypothesis, two factors affect people's tendency to mind-wander: task difficulty and working memory capacity (WMC, i.e., the ability to encode, manipulate, and retrieve information rapidly; Engle, 2002). First, compared to more demanding tasks, mind-wandering is likely to occur during easy or repetitive tasks because the self-regulatory process responsible for directing and controlling executive resources is less active (Randall et al., 2014). Consequently, executive resources fail to inhibit thoughts related to current concerns. Second, when performing a task, people with lower WMC—compared to people with higher WMC—are less able to control and maintain focus on the task and consequently are more susceptible to mind-wandering (Kane & McVay, 2012).

Research supporting the executive failure hypothesis shows that people with lower WMC self-report higher mind-wandering rates, and greater difficulty controlling attention in high demanding tasks, than people with higher WMC (McVay & Kane, 2009; 2012a; 2012b; Randall et al., 2014; Robison & Unsworth, 2018; Unsworth & Robison, 2020). These results suggest that—compared to people with higher WMC—people with lower WMC are less able to inhibit distractions like current concerns—an executive control failure—and consequently, mind-wander more often. Further evidence supporting the executive failure hypothesis comes from mind-wandering and ADHD research. ADHD is a neurodevelopmental disorder associated with inattentiveness, hyperactivity, and impulsivity (American Psychiatric Association [APA], 2022), and marked deficits in WMC (Kofler et al., 2020). Self-reported mind-wandering is positively associated with ADHD symptoms (Franklin et al., 2017; Shaw & Giambra, 1993). Moreover, spontaneous, but not deliberate, mind-wandering is positively associated with ADHD symptom severity (Seli et al., 2015). Thus, people with ADHD mind-wander more frequently, in part, due to an executive control failure related to lower WMC (McVay & Kane, 2010).

The Decoupling Hypothesis (Smallwood & Schooler, 2006)

This hypothesis suggests that the cognitive processes people need to maintain focus on a primary task are also used to maintain mind-wandering, thus competing for the same executive resources (Smallwood & Schooler, 2006). Mind-wandering occurs when a current concern becomes more salient (i.e., has greater motivational value) than performing an external task. This motivational value instigates the attention decoupling (i.e., detaching) from the task that person is performing (Smallwood & Schooler, 2006), to instead coupling with the salient current concern (Smallwood et al., 2011; Smallwood, 2013). Once coupled, the attentional resources remain with the current concern, maintaining mind-wandering.

Neuropsychological research supports the decoupling hypothesis. For instance, studies show that as participants performed a sustained attention task (the primary task), their activity in P300—the electrical potential in neurons associated with executive resource engagement—is reduced when they self-reported mind-wandering, compared to when they are on-task (Kramer & Strayer, 1988; Wickens et al., 1983). Further support for the decoupling hypothesis comes from cognitive psychology. For example, participants reported poorer comprehension for text passages from *The Red-Headed League* during mind-wandering than when they were on-task (Smallwood et al., 2008). This finding suggests that as participants mind-wandered while reading, their mental depiction of the primary task (e.g., reading) was less detailed, suggesting attention was decoupled from encoding the text, leaving information gaps and reduced comprehension.

In another study investigating how mind-wandering impacts visual memory, participants pressed a key when presented with a computer-generated scene on-screen (Jalava & Wammes, 2022). They were told to remember the scenes for a later memory test. Participants' mind-wandering was indexed through self-reports during the task, and the reaction time associated with their key press (with increased reaction time indicating mind-wandering; Cheyne et al., 2009; McVay and Kane, 2009; Robertson et al., 1997). After responding to the scenes, participants completed an old-new recognition test comprising previously encoded scenes (old) and some, not previously seen, scenes (new). The more participants reported mind-wandering when encoding the scenes, the less likely they were to correctly recognise these scenes. These two examples suggest that when participants mind-wander, their attention decouples from encoding the primary task information towards mind-wandering, evidenced by reduced comprehension and recognition of their primary task.

Together, the current concerns hypothesis explains *why* mind-wandering occurs, but the executive failure and decoupling hypotheses propose alternative explanations for *how* the mind wanders (McVay & Kane, 2009; 2010; McVay et al., 2009). While the former hypothesis proposes that mind-wandering involves executive control, they differ on how executive control is involved. The executive failures hypothesis suggests mind-wandering is a passive process that occurs when executive control fails to inhibit distracting information. whereas the decoupling hypothesis views mind-wandering as the consequence of executive resources actively shifting from external to internal information. Furthermore, neither hypothesis accounts for how deliberate and spontaneous mind-wandering experiences are differentiated (e.g., Seli et al., 2016a). Understanding the different mind-wandering types is critical for addressing clinical implications, particularly the effect of spontaneous mind-wandering on negative mood and depression; the basis of my thesis. The following section introduces the process-occurrence theory, which accounts for the differences between the decoupling and executive failures hypotheses and explains how and why *deliberate* mind-wandering occurs.

Process-Occurrence Theory of Mind-Wandering (Smallwood, 2013; see Figure 1.1)

The process-occurrence theory posits that the cognitive control processes responsible for performing multiple functions—including attention, problem solving and reasoning; i.e., domain-general processes—influence the occurrence of deliberate and spontaneous mind-wandering (Smallwood, 2013). This theory integrates the current concerns, cognitive failures, and decoupling hypotheses to explain mind-wandering onset and maintenance, in both forms (Smallwood, 2013). *Spontaneous* mind-wandering presumably initiates when: (1) current concerns or unresolved goals have greater importance than the task demands (*current concerns hypothesi*s) and/or (2) cognitive control fails to inhibit distractors (i.e., mind-wandering) not associated with the task (*executive failure hypothesis*; Wong et al, 2023). Once initiated, attentional resources are reallocated internally to sustain the mind-wandering (*decoupling hypothesis*). Consequently, people mind-wander if their current concern (e.g., planning for a trip) has greater motivational value (i.e., more salient) than the task they are performing (e.g., making dinner). People also mind-wander during low demand and well-practiced tasks (e.g., highway driving) that require less cognitive control—and thus are less able to inhibit distractions—than during more demanding tasks that require greater cognitive control (e.g., learning to drive). Once mind-wandering is initiated, decoupling maintains the mind-wandering train of thought by inhibiting unrelated information, ensuring a coherent internal train of thought (Smallwood, 2013). *Deliberate* mind-wandering is presumably initiated not by a control failure but intentionally guided attention away from the task (highway driving) towards the more salient goal (e.g., planning dinner). Put simply, rather than a cognitive control failure to inhibit the salient goals, cognitive control is intentionally redirected to address those goals.

Only one study has directly empirically tested the process-occurrence theory of mind-wandering. Voss and colleagues (2018) estimated participants' task focus and mind-wandering duration from their self-reported mind-wandering, as they meditated. The researchers correlated these time estimates with WMC and found that participants with higher WMC better sustained attention on the task ($r = .27$, $p = .03$)—consistent with the executive failure hypothesis. But WMC was not significantly associated with mind-wandering ($r = .01$, $p = .96$)—suggesting that WMC is unrelated to the ability to detect and maintain mind-wandering. The association between WMC and time-on-task suggests cognitive control is likely to fail when WMC is low, but the absent relationship between WMC and mind-wandering suggests that once executive control fails, a separate process occurs where attention decouples from the task and shifts internally to maintain mind-wandering.

To summarise, the process-occurrence theory can distinguish deliberate from spontaneous mind-wandering based on people's awareness of their mind-wandering experience. This distinction is crucial in understanding the mechanisms underlying mind-wandering. For example, how do we recognise we are mind-wandering if we are unaware our attention has shifted? Additionally, if mind-wandering involves negative content and occurs without awareness, it may negatively impact well-being by reinforcing maladaptive thought patterns, contributing to mood deterioration. These possibilities raise an important question: what are the potential clinical implications for mind-wandering without meta-awareness? To contextualise this important question, I next discuss the purpose and mechanism of meta-awareness (i.e., the explicit awareness) of mind-wandering, grounded in the process-occurrence theory.

Meta-Awareness Theory of Mind-Wandering (Schooler, 2002; see Figure 1.1)

The meta-awareness theory of mind-wandering posits that our thoughts are re-represented into awareness—through intermittent meta-awareness activation—ensuring we are focused on our primary goals (Schooler, 2002). Our basic consciousness involves the continuous processing of perceptions, feelings and automatic/spontaneous thoughts throughout our waking hours (Schooler, 2002). However, basic consciousness is only evaluated and monitored intermittently when meta-awareness is activated.

Intuitively then, meta-awareness—being aware of our thoughts—is crucial to regulating mind-wandering in the process-occurrence theory. When meta-awareness is *inactive,* attention shifts (i.e., from primary task to mind-wandering) occur undetected and therefore we are unaware our attention is no longer focused on the external task (termed *zone-out;* Schooler et al., 2005). When meta-awareness is *active*, consciousness is scanned, the shift is detected, and cognitive processes are engaged to re-direct attention back to the primary task.

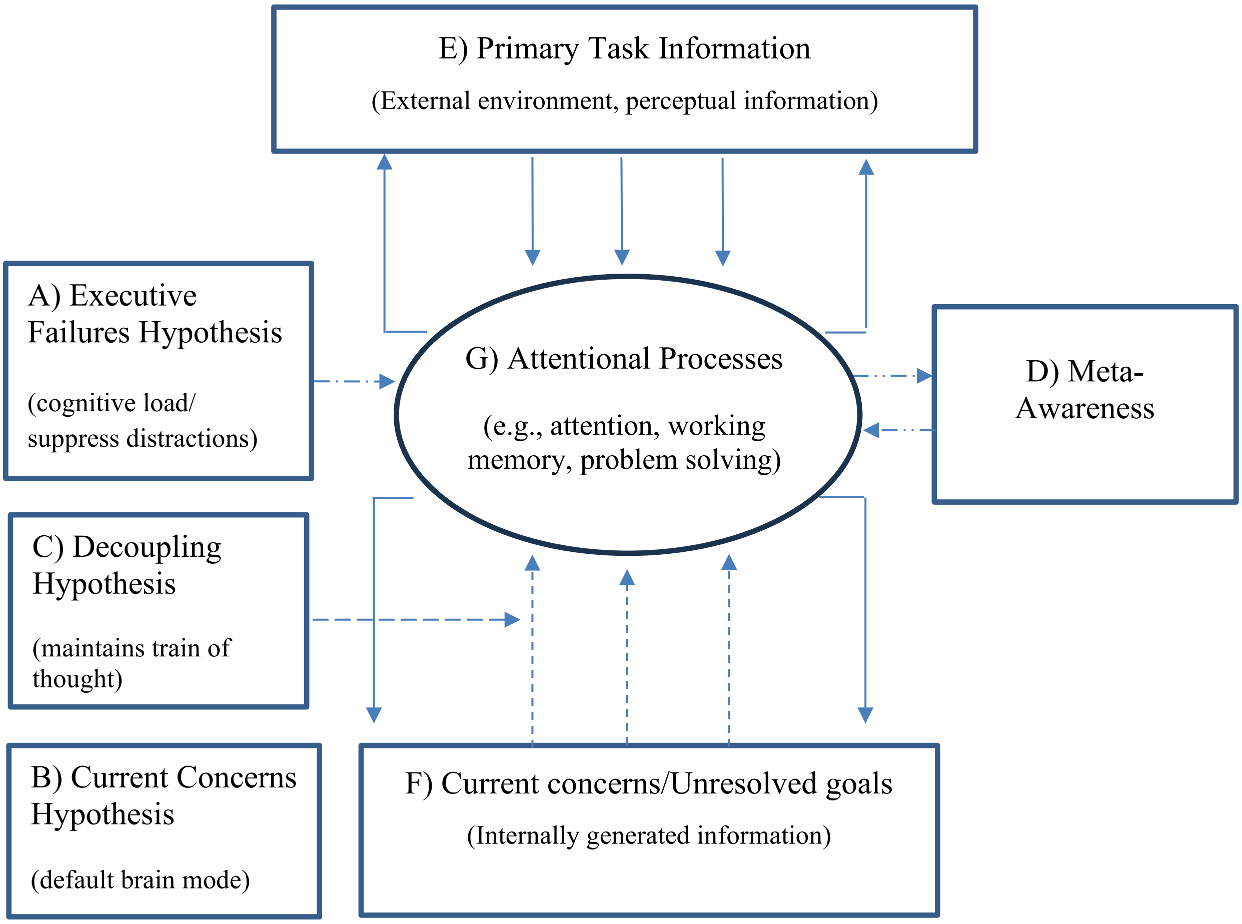
However, if a current concern or goal is more salient than the primary task, then cognitive resources are engaged to consciously continue to mind-wander (i.e., mind-wandering with awareness, also termed *tune-out*). For example, while you are reading this thesis you might suddenly notice (i.e., *meta-awareness activation*) you have been thinking about something unrelated. Until now, *meta-awareness* was *inactive,* and you were zoning-out—unaware of your mind-wandering. After recognising this zone-out, you refocus on the thesis, search for the last sentence you read, and continue reading. Thus, through meta-awareness, the shift in thought away from the primary goal of reading is recognised and corrected, ensuring the goal (here, reading) is achieved.

Empirical evidence supporting the meta-awareness theory of mind-wandering comes from neuro- and cognitive psychology. In one fMRI study, participants completed a task with thought sampling probes assessing attention, focus, and awareness using the following probes: "Where was your attention focused just before the probe?; How aware were you of where your attention was?" (where 1 = completely off task/not aware; 7 = completely on-task/aware). When participants reported being unaware of their thoughts, neural activity occurred in the temporal lobe, whereas awareness was associated with the prefrontal cortex (Christoff et al., 2006). Cognitive research uses experience sampling methods comprising two measurement types—self-caught (participants report when they notice they have mind-wandered) and probe-caught (participants performing a task are interrupted and asked about the focus and awareness of their thoughts; see Schooler et al. 2011 for review). Studies using this approach show that meta-awareness is required for self-caught mind-wandering. However, probe-caught reports indicate when people are not always aware they were mind-wandering until they were probed (see Smallwood & Schooler, 2015 for a review).

Research investigating the distinction between deliberate and spontaneous mind-wandering suggests that people can dynamically shift between these states, depending on their level of meta-awareness at a given moment (Seli et al., 2017). For example, spontaneous mind-wandering begins unintentionally, and typically without awareness (i.e. without meta-awareness) until the person realises their attention has drifted from the task. Once realised, they may choose to continue mind-wandering deliberately, now with meta-awareness (mind-wandering with meta-awareness). Conversely, deliberate mind-wandering begins with an intention to disengage from the task (mind-wandering with awareness) but over time the person may lose track of this intention (mind-wandering without awareness). These patterns suggest that meta-awareness operates independently from mind-wandering intentionality (Seli et al., 2017). Together, these studies suggest that people are not always meta-aware of their thoughts; rather they shift in and out of meta-awareness depending on the intermittent activation of the meta-awareness process.

Figure 1.1

Integrated Mind-Wandering Theories Adapted from Smallwood (2013) p.524 with permission from Psychological Bulletin: Mind-Wandering Theories (A, B, C, D); Information Sources (E, F) and Cognitive/Executive Control (G) doi.org/https://doi.org/10.1037/a0030010



To summarise, as Figure 1.1 shows, mind-wandering occurs because executive resources fail (A), or a current concern is more salient than the primary task (B). Once mind-wandering initiates, attention is decoupled from external information and coupled with current concerns (internally-generated information), maintaining the mind-wandering train of thought until meta-awareness is activated. When meta-awareness activates, resources are directed to the desired goal state (i.e., return to the primary task or continue mind-wandering).

Until now, I have discussed the why and how of mind-wandering. I now turn to the "what" and "when"; that is, the content we mind-wander about, the context(s) mind-wandering usually occurs in, and how mind-wandering can affect our behavioural and emotional functioning. I will outline the costs and benefits of mind-wandering through the *content* and *context* hypotheses (see Smallwood & Schooler, 2015 for review).

The "What" and the "When" of Mind-Wandering: Costs and Benefits Associated with Mind-Wandering

Mind-wandering varies in representation (inner speech or visual imagery), personal relevance, temporal focus (past, present, or future), valence (positive, negative, or neutral), and awareness (Stawarcyzk et al., 2013a). Two key hypotheses explain how mind-wandering is shaped and modulated: the content regulation hypothesis (focusing on *what* we think about) and the context regulation hypotheses (focusing on *when* mind-wandering occurs; Smallwood & Andrews-Hanna, 2013). These hypotheses suggest that mind-wandering is not random but influenced by factors that make certain thoughts or behaviours more likely in different situations. This framework also explains how aspects of mind-wandering are adaptive and, importantly for my thesis research, maladaptive.

Content Regulation Hypothesis

The content regulation hypothesis suggests that mind-wandering thoughts are *goal-related* (e.g., future planning; Baird et al., 2011; Smallwood & Schooler, 2015; Stawarczyk & D'Argembeau, 2015); can promote *emotional and self-reflection;* (e.g., reflecting on an overreaction to criticism); are *motivationally salient* (e.g., imagining a job interview), and can have *cognitive benefits* (e.g., facilitate problem solving). Research supporting the content regulation hypothesis showed that when participants were off-task (operationalised as mind-wandering), they predominantly reported future-focused thoughts that were self-related and goal-directed, thus aimed at goal achievement (Baird et al., 2011). In another study examining how mind-wandering flows between topics, participants verbalised their freely experienced thoughts for 30 minutes (Mildner & Tamir, 2024). The authors then parsed the thoughts into (1) topic-related thoughts referred to as “thought clumps” (e.g., the family coming over, it will be nice to see my sister) and (2) sudden shifts in topics referred to as “thought jumps” (e.g., from: it will be nice to see my sister, to: this room is cold). Any verbalised thoughts related to the Covid-19 pandemic—a global concern occurring during data collection—were classified as participants’ current concerns. The clumps and jumps were analysed for both episodic and concern content. Participants’ current concerns increased during a clump (as measured by Covid-19 related word frequency) until their thoughts jumped to the next current concern or goal-related topic. The authors concluded that mind-wandering prioritised current concerns. Together, these findings suggest mind-wandering supports goal planning and reminding by keeping current concerns accessible.

Mind-wandering can also facilitate creative problem solving, but evidence is mixed. Studies using an “incubation period”—setting aside an unsuccessfully solved problem for a period before returning to it—show mind-wandering can facilitate creative problem solving (e.g., Pachai et al., 2016; Sio & Ormerod, 2009; Yamaoka & Yukawa, 2020). For example, participants completed an unusual uses task that involved producing as many creative uses as possible for a common object (e.g., brick) within a specified time. Participants then completed an incubation period filler task (i.e., either a low-demand, or high-demand cognitive task, or rested), or did not complete an incubation task, and repeated the same unusual uses task. Participants in the low cognitive incubation period—known to induce mind-wandering—produced more creative solutions than participants who completed a high demanding task, rested, or did not have an incubation period. Importantly, although participants in the low demand task reported mind-wandering more often, the contents of their mind-wandering was unrelated to the problem (Baird et al., 2012), suggesting mind-wandering facilitated insight into solving the unusual uses task. However, a conceptual replication failed to support these findings (Murray et al., 2024), and a similar study investigating WMC and mind-wandering's effect on creative thinking showed a weak association between mind-wandering incubation and improved creative problem solving (Smeekens & Kane, 2016). Overall, the evidence is unclear about people's ability to generate solutions during mind-wandering.

Prior research also shows certain mind-wandering content enhances emotional processing and self-reflection (e.g., Smallwood et al., 2011). For example, Ruby and colleagues (2013) found participants whose mind-wandering focused more on personal and emotional content (e.g., an argument with a friend) reported high self-reflection and emotional insight (e.g., "I'm not upset about the argument, I'm angry that I lost my temper"), suggesting that mind-wandering can assist emotion regulation. Further, studies examining self-reflection (i.e., the ability to reflect on behaviours, emotions and thoughts) and mind-wandering show that participants who more frequently self-reflect mind-wander more about future-biased, positive and constructive thoughts (e.g., imagining apologising for losing my temper; Shrimpton et al, 2017; Smallwood et al., 2011).

However, the content regulation hypothesis suggests mind-wandering can be *maladaptive* when the content involves unresolved problems, negative emotions, or ruminative thoughts (Smallwood & Schooler, 2015). Mind-wandering is biased toward future-oriented thoughts overall (e.g., Baird et al., 2011; Ruby et al., 2013), but mind-wandering with past-oriented thoughts is associated with low mood (Ruby et al., 2013; Smallwood & O'Connor, 2011; Smallwood & Schooler, 2015). Furthermore, multiple studies show that participants who mind-wander with negative and past-focused content (e.g., "I am an idiot for what I said in the meeting") mostly report feeling less happy, and more dysphoric and depressed (e.g., Killingsworth & Gilbert, 2010; Poerio et al., 2013; Ruby et al., 2013)

Thus, cognitive content is important to determining whether a mind-wandering episode is adaptive or maladaptive. Similarly, the context influences whether the mind-wandering episode is beneficial or costly. For example, a person studying for an exam may mind-wander less in a quiet environment, but this same environment may facilitate mind-wandering to help a writer overcome writer's block.

Context Regulation Hypothesis: Benefits

The *context regulation hypothesis* posits that mind-wandering is influenced by situational demands, with people more likely to mind-wander in low-demand environments (e.g., relaxing on the couch watching television,) and less likely in settings that require sustained attention or high engagement (e.g., sitting an exam; see Smallwood & Schooler, 2015). This hypothesis is based on three key factors: *task demand*s—mind-wandering is more likely when the task requires minimal cognitive effort (e.g., see Thomson et al., 2014); *adaptive control*—people can regulate attention based on situational demands (see Randall et al., 2014); and *situational cues and triggers*—environmental factors like being in a library and/or taking an exam can signal the need for sustained attention and reduced mind-wandering (see Robison & Unsworth, 2018). All three factors influence the benefits and costs of mind-wandering.

Certain contexts are beneficial in modulating mind-wandering. For example, in educational settings, distributed practice (i.e., widely spacing shorter sessions) enhances learning compared to massed practice (i.e., closely spacing longer sessions; e.g., Mooneyham & Schooler, 2013). This learning enhancement occurs through *dishabituation*—the temporary shifting of attention away from the primary task (i.e., mind-wandering)—to allow attention to refresh before returning to the task (Pachai et al., 2016). Similarly, mind-wandering may provide relief from boredom—the desire, but inability, to leave a primary monotonous activity to engage in an alternative activity (Martarelli & Baillifard, 2024). When performing low demanding, repetitive and well-practiced tasks, mind-wandering offers relief by deliberately or spontaneously shifting attention to more pleasurable self-generated thoughts, allowing the person to continue the task in a more positive mind-set (Martarelli & Baillifard, 2024; Pachai, 2016).

However, depending on the task type and time spent on the task, mind-wandering can have negative consequences. For example, Bonifacci et al. (2023) show that when reading a long and difficult text passage (i.e., task type), mind-wandering increases and comprehension becomes poorer, than when reading a short and easy passage. Additionally, during repetitive, monotonous, and boring tasks (e.g., a response inhibition task) frequent mind-wandering was associated with vigilance decrement—a decline in attention and performance—that worsens as time increases (Zanesco et al., 2024). Similarly, when participants performed a low-demand task requiring sustained attention, they experienced cognitive fatigue over time (i.e., time-on-task), leading to increased fluctuations in mind-wandering and poorer task performance (Thomson et al., 2014).

Together, mind-wandering is a consequence of both context- and content-related information. Although mind-wandering has several benefits, these benefits can be costly (e.g., poor task performance, low mood, depression). Given the complexities of defining and conceptualising mind-wandering, together with its ubiquitous nature, measuring mind-wandering is challenging for cognitive researchers. In the next section I discuss the current research methodologies and conceptual challenges when researching mind-wandering.

Measurements and Conceptual Issues

Mind-wandering research has been hindered by the difficulty in accurately measuring the occurrence, and observing the consequences of, a mind-wandering episode (Smallwood & Schooler, 2015). Typically, cognitive functioning (e.g., attentional bias for eating) is studied in laboratory tasks where different stimuli (e.g., presenting neutral and target words in different colours; the Stroop task) are presented and participants' behavioural, neural, or psychological responses are observed and recorded (e.g., response time to naming the colour of the word; Smallwood & Schooler, 2015). Inferences about underlying processes are drawn through triangulating self-report, physiological and behavioural measures (e.g., the longer the time taken to respond, the larger the attentional bias; e.g., Overduin et al., 1995). However, mind-wandering itself makes scientific understanding more challenging for three reasons. First, mind-wandering's spontaneity makes experimental manipulation difficult (Ostojic-Aitkens et al., 2019). Second, mind-wandering's covert nature complicates measuring the onset and termination of an episode, particularly if it occurs without meta-awareness (Smallwood & Schooler, 2015). Finally, mind-wandering measurement largely relies on participants accurately self-reporting their mind-wandering experience—i.e., their ability to accurately differentiate between thoughts, like determining when solving a problem during mind-wandering becomes a task itself (Smallwood & Schooler, 2006). Despite these challenges, various measurement techniques have been developed to capture mind-wandering, which I discuss in the following sections.

Capturing the Wandering Mind—How Mind-Wandering is Measured

Mind-wandering can be assessed at both the trait and state level. Trait (dispositional) mind-wandering—the general tendency to mind-wander over time—reflects individual differences in the long-term propensity to disengage from a task and is theorised to be associated with personality traits (e.g. neuroticism, conscientiousness; McVay & Kane, 2009). In contrast, state mind-wandering refers to moment-to-moment shifts in attention and is theorised to fluctuate with context, task demands, and affective states (Smallwood & Schooler, 2015). Both trait and state mind-wandering can be measured using overt/subjective self-report methods such as questionnaires (e.g., The Mind-wandering Questionnaire, the Cognitive Failures Questionnaire) or thought probes. However, only state mind-wandering can be measure using covert/objective physiological or behavioural methods including functional magnetic resonance imaging—fMRI; response times and errors when performing a mind-wandering task (Smallwood & Schooler, 2015). One foundational self-report method that captures multiple state mind-wandering episodes is the experience sampling paradigm (Hektner et al., 2007). Experience sampling captures participants' focused experiences—internal and external—in ecological and laboratory research settings. In ecological settings, experience sampling is integrated into a participant's daily life by prompting them to report on their thoughts at random intervals using a handheld device (e.g., phone; Smallwood & Schooler, 2006). The prompts typically ask participants to report what they are doing, and if their thoughts are focused on their current task or mind-wandering (Killingsworth & Gilbert, 2010; McVay et al., 2009; Welhaf et al., 2024b). Prompts can also include questions about thought characteristics, including usefulness and valence (i.e., the level of pleasantness; Kauschke et al., 2019), or a temporal focus on past, present or future (e.g., Franklin, et al., 2017). Data are collected over a specified time (e.g., 7 days) and mind-wandering is measured as the times participants say they were not focused on the task they were doing. While ecological settings enhance generalisability, limited experimental control means extraneous variables are present, and identifying mechanisms underlying mind-wandering is challenging. For example, it is difficult to manipulate mood and measure mind-wandering while controlling for distractions in a natural environment. Thus, we look to laboratory settings for experimental rigour.

A typical experience sampling paradigm in a laboratory setting involves participants performing low cognitively demanding, computer-based tasks (e.g., a reading or vigilance task), where they report their momentary thoughts, and sometimes the meta-awareness of those thoughts, using self-report methods: the self-caught and probe-caught methods (Smallwood & Schooler, 2015). In the *self-caught method,* participants press a key when they notice their thoughts have wandered (e.g., Cunningham et al., 2000). It is assumed that each self-caught report occurred with meta-awareness (i.e., tune-outs). In the *probe-caught method,* participants are randomly prompted to report their attentional state just prior to the probe appearing (e.g., Giambra, 1995; Schooler et al., 2005). For example, while completing a vigilance task, participants might be prompted to report whether they were focused on the task just now (e.g., on-task: "yes", mind-wandering: "no"). In the initial paradigm, probe-caught mind-wandering presumably occurred without meta-awareness (Schooler et al., 2005). However subsequent versions sometimes include a meta-awareness measure, such as a follow-up question about whether participants were aware they were not focused on the task at that moment—"yes" response indicates mind-wandering with meta-awareness (tune-outs); "no" response indicates mind-wandering without meta-awareness (zone-outs). Additionally, researchers have used Likert scales for both mind-wandering types to gauge the degree, rather than the presence, of mind-wandering (e.g., Greve & Was, 2022; Robertson et al., 1997) and meta-awareness (e.g., Vannucci et al., 2019).

Limitations of Experience Sampling Methods

Critics however argue that the accuracy of probe-caught and self-caught methods is limited (e.g., Smallwood and Schooler, 2015). One criticism relates to the heterogeneity of probe question framing and probe response options (dichotomous, categorical or scale) that may introduce bias across studies. Responding to thought probes is a four-step process: participants need to 1) understand the question, 2) recall relevant information 3) decide a single answer and 4) map that answer onto the response options provided (Weinstein, 2018). When questions are framed to suggest a particular response, people are more likely to respond in kind—according to a social desirability bias. For example, when a participant is mind-wandering and presented with the probe question *"Were you on task just now?"* the phrasing may bias them to map 'yes' response rather than accurately reporting 'no'. Similarly, when probe-response options do not accurately map the participant's answer–e.g., an even number response scale that does not provide for a neutral option indicating an ambivalent response—the participant will select the closest response that reflects their accurate answer. These biases may lead to under/overreporting of mind-wandering compared to on-task thinking. However, Weinstein argues this methodological heterogeneity may be a strength given that consistent conclusions can be drawn from studies that measure mind-wandering in various ways, suggesting these conclusions are robust and reliable. For example, studies consistently show that mind-wandering negatively correlates with poor task performance regardless of how the probe questions are framed or probe options presented.

A second criticism involves interactions between the probe format and task demands, potentially influencing mind-wandering estimates (Greves & Was, 2022). For example, compared to receiving fewer probes, participants probed more frequently usually report less mind-wandering during a low-demand task (e.g., watching a video) but more during a high-demand task (e.g., a WMC task; Schubert et al., 2020). However, when completing the same task, variations in probe frequency, or the framing of probe presentation, were not associated with changes in task performance (a behavioural measure of mind-wandering; Schubert et al., 2020; Wiemers & Redick, 2018). Furthermore, the relationship between probe responses and trait mind-wandering measures did not differ regardless of variations in probe presentation

(Schubert et al., 2020). Addressing concerns about probe format inconsistencies, Zanesco et al. (2024) assessed the psychometric properties of probe-caught responses to improve their validity. They found that probes presented earlier in the task are more indicative of trait mind-wandering tendencies. Additionally, probe response options using continuous or multi-categorical scales provided more information about participants' latent mind-wandering tendencies than dichotomous response options.

Generalisability: Laboratory Findings to Everyday Mind-Wandering

While laboratory research is designed to isolate factors involved in mind-wandering through manipulating specific variables, the evidence for how these findings generalise to daily mind-wandering experiences is mixed. For example, mind-wandering rates, reported while participants listened to an audiobook, did not differ whether the participant completed the task in lab or in a natural environment (Varao-Sousa et al., 2018). Additionally, participant attempts to refocus thoughts back to the task after mind-wandering did not differ between the lab and daily life (He et al., 2021). But Linz et al. (2021) found significant correlations between in laboratory and daily mind-wandering when the content was negatively valenced and future focused, but not when mind-wandering was positively valenced and past focused. Additionally, WMC and attention predicted participants' mind-wandering in lab, but only predicted participants' daily life mind-wandering when they attempted to concentrate on the task (Kane et al., 2017). These findings conflict with the prior finding that—compared to lower WMC—people with higher WMC maintained concentration and effort on more challenging daily activities (McVay et al., 2009). Together, these studies suggest that mind-wandering rates remain stable across contexts, but the content and task difficulty of mind-wandering when measured in lab does not necessarily generalise to similar tasks performed in daily life.

Triangulating Measures of Mind-Wandering and Experimental Manipulation

To validate self-report data, researchers can pair experience sampling methods with other covert mind-wandering measures (i.e., the behavioural, neuroimaging and physiological), while the participant performs a laboratory task that replicates everyday mind-wandering activities. Think about when you tend to mind-wander in daily life. Typically, it is when performing well-rehearsed, repetitive, and either low- or high- cognitive load activities, that can lead to boredom and/or decreased motivation (e.g., reading; Franklin et al., 2011; Giambra, 1995). The three most common tasks that meet these characteristics include: *reading tasks* (i.e., participants read passages from book extracts presented on-screen; e.g., Smallwood et al., 2008); *working memory tasks* like the *n-Back* (i.e., participants indicate whether the current stimuli match the one presented "n" of steps earlier in the series; Barrington & Miller, 2023), and *vigilance tasks* like the go/no-go sustained attention to response task (SART; i.e., participants respond to frequently presented non-target stimuli but withhold responses to the target stimulus). Mind-wandering during these tasks is measured using self-report probe responses alongside behavioural measures, including task performance and errors rates (e.g., poor comprehension, incorrectly responding to a target stimulus), and reaction time (e.g., time taken to respond to the stimulus, read a passage). Increased response time and higher error rates indicate attention lapses that show off-task thinking (e.g., Kane et al., 2007; Mrazek et al., 2011; Welhaf & Kane, 2024). Interestingly, response variability is also a behavioural indicator of mind-wandering valence; specifically, there is increased variability before and after negatively compared to neutrally valenced TUTs (Banks & Welhaf, 2022).

Additionally, neuroimaging techniques and physiological measures are paired with experience sampling methods during tasks to examine neural and physiological correlates of mind-wandering. Specifically, during the SART, participants' self-reported mind-wandering in response to a probe was associated with increased DMN activity immediately preceding that probe (Christoff et al., 2004; 2006; 2009). Apparatus like pupillometry to detect pupil dilation (e.g. Pelgatti et al., 2018; Vannucci et al., 2020)—associated with off-task thinking—and ambulatory heart rate monitors to detect autonomic changes like heart rate variability are used to detect worry and perseverative thinking during mind-wandering (Ottaviani et al., 2015). Self-report measures, like the Mind-Wandering Questionnaire (MWQ; Mrazek et al., 2013) and the Dundee Stress State Questionnaire (DSSQ; Matthews et al., 1999), assess trait and state tendencies for mind-wandering, and are often used alongside behavioural and neuroimaging data to validate findings.

While the full duration of mind-wandering episodes cannot be easily induced, researchers can influence mind-wandering's occurrence by manipulating task characteristics, including task difficulty and time on-task, in line with context and content hypotheses. Increasing cognitive load can increase the likelihood of mind-wandering. For example, in the n-Back task, requiring participants to recall stimuli further back in the sequence (e.g., 2-back instead of 1-back) increases working memory and attentional demands (Barrington & Miller, 2023). As cognitive load increases, participants' ability to self-regulate attention diminishes, leading to greater mind-wandering, more errors and task disengagement (Barrington & Miller, 2023).

Prolonged engagement in low demand or high demand tasks—time on-task effect—often results in vigilance decrements, characterised by decreased focus and performance. In tasks like the SART, error rates increase as participants' motivation wanes, and they become fatigued and frustrated (Randall et al., 2014; Robertson et al., 1997). This decline in cognitive control leads to reduced attention and more mind-wandering, reflected in increased task errors.

In summary, triangulating multiple methods—experience sampling, behavioural data, neuroimaging, and physiological measures—is used to enhance the reliability of mind-wandering research. This multi-method approach, together with task manipulation, strengthens the understanding of mind-wandering's occurrence, cognitive mechanisms, and physiological correlates. Such methodological rigour is particularly important when examining mind-wandering in psychopathological contexts, such as depression. In the following section I outline theories explaining vulnerability to depression, evidence linking mind-wandering with depression, and the role of meta-awareness in this relationship.

Mind-Wandering and Depression

What is Depression?

Depression refers to depressive disorders including disruptive mood dysregulation disorder, major depressive disorder, major depressive episode, and dysthymia (APA, 2013). Depression affects approximately 5% of the global adult population over their lifetime (World Health Organisation, 2023), and a further 34% of adolescents (aged 10-19) are at risk of experiencing depression (Shorey et al., 2021). The incidence of depression increased by 49.86% globally between 1990 and 2017, and in Australia, a mental health survey showed 10.4% of Australians reported experiencing depression or feeling depressed (Australian Bureau of Statistics, 2017-2018). Importantly, the lifetime suicide risk among people with untreated depression is 20% (Gotlib & Hammen, 2002).

Major depressive disorder (MDD) is characterised by depressed mood—including marked feelings of sadness, excessive/inappropriate guilt, irritability and/or emptiness—with diminished interest or pleasure in activities (APA, 2022). The symptoms are accompanied by behavioural (e.g., social withdrawal), physical (e.g., reduced energy, appetite, sleep), and cognitive functioning (thoughts of helplessness and hopelessness; difficulty concentrating) changes. These changes persist for most of each day, for two or more weeks, and cause significant distress and impairment in daily functioning (APA, 2022). Depending on symptom severity, functional impact, and suicidality, MDD is classified as mild, moderate, or severe. While mild MDD may resolve spontaneously, treatment is recommended for moderate-to-severe depression to resolve the negative impact on functioning and risk (Otte et al., 2016).

Operationalisation of Depression

In my thesis, depression vulnerability and depression are operationalised as depressive symptoms, negative mood, negative affect, and dysphoria. This operationalisation is based on three key research findings. First, high negative affect and low positive affect are positively associated with depression symptom severity (e.g., Iqbar & Dar, 2015) and dysphoria (e.g., Novovic et al., 2008). Second, negative mood is associated with depression vulnerability by activating depressive cognitions (e.g., Hoffman et al., 2016; Janowsky, 2003; Ottaviani et al., 2015). Third, dysphoria is a risk factor for experiencing a major depressive episode, and for developing and perpetuating MDD (e.g., Guesdon et al., 2020; Janowski, 2003). Consequently, when discussing the relationship between mind-wandering and depression, these terms represent the dimension of negative emotions ranging from negative mood to major depressive episode and MDD.

Depression Theories: Why Do Some People Become Depressed?

The cognitive vulnerability-stress theories of psychopathology are widely researched and are the prevailing explanation for depression aetiology and development. These theories converge on the premise that individual differences in attending to, interpreting, and remembering negative events create vulnerabilities to developing depression when negative life events occur (Gibb et al., 2005). Three cognitive vulnerability theories are discussed here:

schema activation (see Beck, 1967; Clark et al., 1999), *response styles* (see Nolen-Hoeksema, 1991; 2003), and *meta-cognitive* (Wells & Matthews, 1994; 1996) theories.

Schema Activation Theory. Beck and colleagues' (1979) cognitive theory of depression posits that people process information through schemas—assumptions, beliefs, attitudes, or rules that form cognitive frameworks and shape people's self, world, and future perceptions (Beck, 1967). These schemas develop through childhood experiences and unconsciously influence how new experiences are interpreted. When events align with existing schema, the schema are activated and influence perceptions, reinforcing specific thought patterns. Maladaptive schema, like beliefs about being unlovable and helpless, increase depression vulnerability (see Gibb & Coles, 2005). For example, a child with a critical or emotionally unavailable caregiver may internalise the belief "I am unworthy of love". This belief may shape their ability to form friendships, making them prone to interpreting interpersonal conflicts as confirmation of their "unworthiness schema", distorting their self-perception. Once activated, these maladaptive schemas create negative biases, directing attention towards self-referential depressive stimuli (e.g., failure and helplessness), while ignoring contradictory evidence (Kendall & Ingram, 1989).

Substantial research has investigated schema theory in depression using cross-sectional, retrospective and remitted depression designs (e.g., Abramson et al., 2002; Clark et al., 1999; Gotlib & Neubauer, 2000; Haaga et al., 1991; Ingram et al., 1998; Joiner & Wagner, 1995; Peterson & Seligman, 1984 for reviews). For example, in a cross-sectional study involving patients with moderate-to-severe anxiety and depression symptoms, all five schema domains (broad categories of the 18 identified maladaptive schema which develop in childhood) positively correlated with self-reported depression symptoms (*r*s: .47-.74; McGinn et al., 2005). In a longitudinal study, adolescents' dysfunctional attitudes (beliefs about self-worth and lovableness) and negative attribution style were assessed at baseline and at one-year follow-up (Lewinsohn et al., 2001). For participants who experienced a negative life event, the likelihood of being diagnosed with depression was higher among those with strong dysfunctional self-beliefs. But negative attribution style was not associated with depression, suggesting *maladaptive schema* is related to depression. However, in Abela and Hankin (2011), participants awaiting college acceptance completed depression and dysfunctional attitudes measures at time-1: (1-8 weeks prior to a negative outcome), and depression measures again at time-2 (shortly after negative outcome), and at a 4-week follow-up. Consistent with schema theory, participants with future-based dysfunctional attitudes were more likely to be depressed after not being accepted to college. These findings suggest that maladaptive schema contribute to depression risk, but their influence varies depending on the specific schema domain, individual cognitive vulnerabilities and the presence of life stressors.

Response Style Theory. Nolen-Hoeksema (1987; 1991; 2003) proposed that depression vulnerability is influenced by rumination (i.e., a specific attentional bias), described as perseverative self-focused attention. The theory suggests that when people experience dysphoric mood (characterised by feeling intensely depressed, discontented, or indifferent; APA, DSM-5-TR), they engage in perseverative thinking, repetitively focusing on negative emotions and their consequences. This persistent rumination intensifies the dysphoric mood, increasing the likelihood of more severe depression (Nolen-Hoeksema et al., 2008). Conversely, people with dysphoria who use distraction to cope seemingly recover quicker because they shift focus from their dysphoria to more neutral or pleasant thoughts, or to activities like exercise or socialising, to regulate their mood. For example, after a breakup, someone may ruminate over the details of the relationship, dwell on why it ended, and blame themselves for its failure—perseverative negative thinking. This pattern compounds feelings of sadness, and hopelessness, exacerbating the person’s distress and increasing their vulnerability to depression vulnerability. However, if the person can distract themselves from their perseverative thinking and rumination (e.g., by socialising with friends, exercising), shifting their focus away from their dysphoria, they reduce their depression vulnerability.

Multiple studies provide support for the response theory of depression vulnerability (e.g., Just & Alloy, 1997; Nolen-Hoeksema, 2000; Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema et al., 1993). In one example longitudinal study, nondepressed adults were assessed for ruminative response style and depression risk factors (e.g., negative cognitions, self-criticism, past depression; Spasojevic & Alloy, 2001). Participants with preexisting risk factors predicted future depressive episodes at 2.5-year follow-up, through their tendency to ruminate, supporting the ruminative response style theory of depression vulnerability. In a cross-sectional study example, participants with MDD completed questionnaires measuring ruminative response style, neuroticism, and information processing. Participants who ruminated more about their symptoms typically had more severe depression, while participants who distracted themselves reported less severe depression (Lam et al., 2003). Contrastingly, Lara et al. (2000) found rumination did not strongly predict depression over 6-months in participants with recent-onset MDD (i.e., met current MDD criteria for less than 6-months, with no other depressive conditions or drug dependence) at baseline. One explanation for Lara et al.'s discrepant finding is that, of their 84 participants, 68% recovered by 6-month follow-up, and 12 recovered and relapsed during the follow-up period, thus variability in recovery rate may have influenced their results. Overall, these studies suggest ruminating and engaging in negative thinking leads to increased depression symptoms over time, but not necessarily to the maintenance of short-term depression symptoms.

Meta-Cognitive Theory of Depression (Wells & Matthews, 1994; 1996). Meta-cognition is the process of 'thinking about thinking', i.e., knowledge about our cognitive processes, and our ability to regulate those processes to oversee and control thinking.

According to this theory, meta-cognitive beliefs (i.e., beliefs about thinking) that develop into a maladaptive thinking pattern, termed the cognitive-attentional syndrome (CAS; Wells et al., 2009), influence depression vulnerability. CAS is characterised by self-referential processing including worry, rumination, threat monitoring driven by positive beliefs (e.g., “rumination is helpful to overcome my sadness”), and negative beliefs; for instance, about depressive symptom uncontrollability (e.g., “I can’t control these depressive thoughts”; Capobianco et al., 2020). These maladaptive beliefs about thoughts create a sense of threat and loss of control, which activates unhelpful coping strategies like thought suppression and avoidance, consequently preventing the person from challenging the validity of their faulty beliefs. The avoidant behaviours ultimately maintain the negative meta-cognitive beliefs and worsen depression symptoms.

Empirical evidence, using semi-structured interviews, showed people with recurring MDD hold positive beliefs (i.e., coping) and negative beliefs (i.e., uncontrollability and harm; interpersonal and social consequences) about rumination (Papageorgiou & Wells, 2001a). Further, a longitudinal study of 172 students showed negative meta-cognitive beliefs about the uncontrollability of danger and worry predicted changes in depression over time (Yilmaz et al., 2011). This finding was supported by a systematic review examining meta-cognitive beliefs in children and adolescents with anxiety and depression, which showed that negative meta-cognitive beliefs were reliably and significantly associated with depression symptoms (Thingbak et al., 2015). Overall, people’s depression vulnerability is dependent on their thinking patterns: maladaptive schema activation, self-focused rumination about dysphoria, inferred negative consequences, and self-characteristics in response to negative events and maladaptive meta-cognitive beliefs. The theories presented converge on the idea that negative thinking patterns are central to depression vulnerability; put simply, negative thinking causes negative mood.

Mind-Wandering and Depression: What the Research Tells Us

Substantial evidence suggests that mind-wandering, particularly with negative content, is associated with negative mood, dysphoria and depression, (e.g., Banks et al., 2016; Hoffman et al., 2016; Poerio et al., 2013; Ottaviani et al., 2015; Vannucci et al., 2020). But the direction of these relationships is unclear (e.g., Chaieb et al., 2022 for review; Welz et al., 2018), with research showing three possible outcomes: mind-wandering precedes negative mood (e.g., Marchetti et al., 2012; Mrazek et al., 2013), depression or dysphoria is a precursor to mind-wandering (e.g., Poerio et al., 2013; Smallwood et al., 2009; Stawarczyk et al., 2013), or there is a bidirectional relationship where prior mood predicts mind-wandering with negative content, which subsequently predicts mood deterioration (Poerio et al., 2013). Different research methods may explain these mixed findings.

In Daily Life

Ecological studies typically use experience sampling to measure mood prior to mind-wandering and activity questions (e.g., Killingsworth & Gilbert, 2010), and conclusions are cautiously drawn. In one experience sampling study example, participants were prompted to report on their current happiness, activity and mind-wandering in daily life (Killingsworth & Gilbert, 2010). Based on time-lagged analysis, mind-wandering predicted less happiness even if participants mind-wandered to pleasant topics, suggesting mind-wandering precedes mood deterioration. Conversely, a study examining prospective mind-wandering effects on mood showed that while participants' mood deteriorated when mind-wandered with more negative content—supporting Killingsworth and Gilbert—mind-wandering with pleasant content repaired their negative mood (Welz et al., 2018) suggesting mind-wandering content influences subsequent mood. Interestingly, some research indicates a bidirectional relationship between mind-wandering and depression. In Poerio et al. (2013) participants reported their current focus (i.e., mind-wandering or on-task), affective content, temporal orientation (past, present, future), and current concerns when prompted 6 times daily for 7 days (Poerio et al., 2013). Here, prior sadness predicted greater mind-wandering and only mind-wandering with negative content predicted mood deterioration. In Welhaf et al. (2024), MDD participants reported greater mind-wandering, especially with negative content, compared to healthy controls. This mind-wandering was associated with lower subsequent positive affect but no increased negative affect, suggesting that negative mind-wandering may reduce positive affect, contributing to the maintenance of depression. Taken together., these ecological studies suggest that mind-wandering content predicts mood, but when mood worsens, mind-wandering with negative content increases. However, ecological mood and mind-wandering studies are limited due to difficulties manipulating mood and instead relying on natural mood variations in daily settings, making causal conclusions difficult.

In the Laboratory

Laboratory studies investigating depression and mind-wandering also show inconsistent findings. For example, in one study, participants with dysphoria—compared to healthy controls—committed more task errors in a low-demand, than high-demand task, suggesting dysphoria is associated with increased mind-wandering (Guesdon et al., 2020; Murphy et al., 2013). Further studies show negative mood is associated with mind-wandering (operationalised as task disengagement and task errors) due to increased negative self-focused thinking that biases attention away from the task towards negative information (e.g., Ainsworth & Garner, 2013; Yaroslavsky et al., 2019). While Stawarczyk et al. (2012) found participants who mind-wandered more reported greater negative affect, this relationship depended on participants' tendency to focus on the present-moment, suggesting that mind-wandering influences negative mood but only when participants are not present-moment focused. Additionally, mind-wandering often reflects self-referential (e.g., "I am a bad person") or distressing (e.g., "something bad is about to happen"; Ottaviani et al., 2015) thoughts, that may intensify the negative mood, creating a bi-directional relationship that perpetually maintains depression symptoms (e.g., Poerio et al., 2013).

With Mood Induction

One method used to clarify issues with direction is combining a mood induction protocol with a mind-wandering protocol to isolate mood effects on mind-wandering. Typically, participants are induced into a particular mood state (negative, neutral or positive) by having them read negatively valenced self-referential statements (Velten statements), or listen to sad music, then they complete a task like a SART with experience sampling probes. Mood induction studies consistently show participants induced in a negative mood, compared to a neutral or positive mood, mind-wander more often with predominantly retrospective thoughts (e.g., Jonkman et al., 2017; Smallwood et al., 2009; Smallwood & O'Connor, 2011; Stawarczyk et al., 2012).

But some research indicates induction duration and effectiveness weakens over time (e.g., Stawarczyk et al., 2013). For example, Jonkman et al. (2017) found that after a mood induction, participants' affect subsided (i.e., their negatively induced mood improved while positively induced mood deteriorated) when they completed a SART. Interestingly, in part two of the study, participants repeated the mood induction, then completed a reading task with random probes, and showed diverging results (i.e., participants' negative affect significantly reduced while their positive affect remained stable). Either the mood induction weakened, or the task participants performed after the induction changed their affect. These patterns raise an important methodological issue for understanding the relationship between mood and mind-wandering. If mood unintentionally alters when participants perform a subsequent task, then mind-wandering rates might be affected, which confounds our understanding of the mood and mind-wandering relationship and makes directionality difficult to determine.

Mind-Wandering and Depression with Rumination and Maladaptive Meta-Cognitive Beliefs: What We Know

To understand the relationship between mind-wandering and depression we can look to the associated factors they share. For example, mind-wandering—the shift in attention from the primary task—and depression are both associated with rumination repetitive negative thinking. Indeed, in one study spontaneous mind-wandering predicted increased rumination, but the relationship was not bi-directional suggesting that the more people reported being off task, the more they ruminated but rumination did not lead to off task thoughts (Xu et al., 2024). Additionally, spontaneous, compared with deliberate, mind-wandering is more strongly associated with trait self-rumination and depressive symptoms (Vannucci & Chiorri, 2018; Vannucci et al., 2020). Importantly both mind-wandering and rumination are associated with increased negative affect (Poerio et al., 2013; Robison et al., 2020). However, Ottaviani et al. (2013; 2015)—who operationalised mind-wandering separately from perseverative thinking (i.e., rigid inflexible repetitive cognitions)—showed that participants reported greater mood deterioration when engaging in perseverative thinking than when mind-wandering; a pattern that was stronger in participants with MDD compared to healthy controls. Furthermore, Rosenbaum et al. (2017) found that patients with MDD mind-wandered less and ruminated more at rest than healthy controls. Together these findings suggest that increased mind-wandering is associated with increased depression both directly, and with rumination and perseverative thinking, the relationship varying based on how mind-wandering is operationalised. For the purpose of this thesis, rumination and perseverative thinking are conceptualised within the family resemblance framework, which defines them as forms of mind-wandering (Seli et al., 2018). Although mind-wandering includes various types of off-task thoughts, such as goal setting, planning and prospective thinking, it also occurs in the form of negative thinking patterns including rumination and perseverative thinking.

Mind-wandering and depression are also both associated with maladaptive cognitive beliefs. For example, Carciofo et al. (2017) showed that participants' mind-wandering activated maladaptive meta-cognitive beliefs and subsequently increased negative affect. Additionally, Takarangi et al. (2017) found people with strong beliefs about needing to control thoughts mind-wandered more (both with and without meta-awareness). However, Carciofo et al. did not investigate specific maladaptive beliefs with depression symptomology and Takarangi et al. limited their investigation to control beliefs. Thus, it is unclear what other maladaptive meta-cognitive beliefs (e.g., negative beliefs about cognitive confidence, positive beliefs about worry) are associated with mind-wandering that might explain the relationship with depression.

Overall, these studies emphasise the complex relationship between negative mood and mind-wandering, confounded by mood manipulation difficulties in both ecological and laboratory settings. These studies suggest the relationship between mind-wandering and depression is influenced by negative thinking patterns that arise from a negative mood, increasing people's tendency to mind-wander and/or people mind-wandering with negative content that results in mood deterioration.

Mind-Wandering, Meta-Awareness and Cognitive Strategies: What is the Link?

Detecting when our mind has wandered is linked to metacognitive abilities and meta-awareness. Meta-cognitive processes detect mind-wandering by assessing current thoughts (unresolved current goal or failure to maintain attention), then engage higher processes to either redirect attention back to the task, or plan to resolve the current concern. Intuitively, making a meta-cognitive judgment about mind-wandering would require meta-awareness activation—the intermittent re-representation of thoughts into awareness (Schooler, 2002). If meta-awareness is deactivated, mind-wandering is not detected and negative thinking patterns can continue freely without redirection from meta-cognitive processes, which may lead to mood deterioration. Indeed, research shows that people's depression symptom severity increases alongside increases in mind-wandering without meta-awareness (i.e., zone-out; Deng et al., 2014). This raises the question: what activates meta-awareness? One possible explanation is that meta-awareness is associated with people's tendency to activate cognitive strategies—both maladaptive (e.g. avoidant strategies of dissociation, thought suppression and thought control) and adaptive (mindful present-moment awareness). These cognitive strategies are intended to manage negative thinking patterns and regulate negative emotions.

Thought Suppression

People with maladaptive meta-cognitive beliefs (e.g. about uncontrollable thoughts) may perceive mind-wandering as bad due to its spontaneous, unintended nature. These beliefs may facilitate an increase in negative thinking patterns (e.g., "If I don't stop my mind from wandering, I'll go crazy"), which cause distress. To manage this distress, people may attempt to suppress their thoughts (Purdon & Clark, 2001; Ragen et al., 2016). However, suppressing these thoughts may make the thoughts a salient current concern, potentially increasing mind-wandering frequency. Further, suppression often leads to a rebound effect (Wegner et al., 1987), where suppressed thoughts return with greater frequency and intensity, increasing distress and potentially heightening mind-wandering meta-awareness.

Extent research findings suggest that thought suppression is associated with both mind-wandering and depression. For example, self-reported thought suppression is associated with clinically significant depression symptoms (Beevers et al., 1999; Petkus et al., 2012; Purdon, 1999). Research from the mind-wandering literature suggests that suppressed thoughts occur more frequently without awareness (probe-caught) in high demand tasks, whereas suppressed thoughts with meta-awareness (self-caught) remain unchanged across task demands (Baird et al., 2013). This indicates that, in high demand tasks, suppressed mind-wandering without awareness is associated with stronger attentional decoupling, highlighting the role of cognitive resources in monitoring awareness. Another study found students in a more negative mood were less able to intentionally suppress mind-wandering during a lecture, suggesting mood mediated the relationship between intentional suppression and mind-wandering (Hattori & Ikeda, 2016). Interestingly, not all suppression efforts lead to a rebound effect and worsening symptoms. In one study, patients with depression who were trained to suppress fear-related intrusive thoughts (i.e., COVID-19 fears) after exposure to fear-inducing cues (e.g. COVID-related information), did not experience an increase in those thoughts afterwards (Mamat & Anderson, 2023). However, this suppression training was part of an exposure-based intervention therapy specifically targeting fear, which may have reduced the rebound effect.

Thought Control

Thought control processes are engaged to manage unwanted spontaneous and intrusive thoughts through negative processes such as worry and punishment (e.g. self-critical thinking "I'm so useless because I can't control my mind from wandering"). These processes might affect how we experience mind-wandering. People with maladaptive beliefs about mind-wandering might use self-punishment to regulate emotions. In doing so, they might try to avoid mind-wandering to reduce associated distress which paradoxically, like suppression, might heighten awareness through a rebound effect (Wegner et al., 1987). People who believe that worry helps manage uncontrollable thoughts might think "What if I can't focus on my job because I can't stop mind-wandering". This worry may become repetitive and rigid, consuming attentional resources likely increasing the frequency, but not necessarily meta-awareness, of mind-wandering (Eysenck & Deraksan, 2011).

The thought control strategies people use to manage their distress associated with mind-wandering might shape the frequency and awareness of that mind-wandering.
For example, previously depressed participants endorsed worry and punishment more than previously depressed or never-depressed participants (Halvorsen et al., 2015). Additionally, a perceived inability to control unwanted and unpleasant intrusive thoughts has been linked to an increased likelihood of developing emotional disorders like depression and anxiety (Feliu-Soler et al., 2019; He et al., 2019; Luciano & Algarabel, 2006). A study examining perceived abilities to control thoughts with mind-wandering—using fMRI and mind-wandering data—showed people with high levels of mind-wandering reported lower perceived control over their thoughts and higher negative affect compared to those with low levels of mind-wandering (He et al., 2019).

Dissociation

Finally, of the maladaptive cognitive strategies, dissociation involves the disruption in consciousness, memory, identity, emotion, perception, behaviour, or self-concept; Soffer-Dudek, 2014). Dissociation can range from brief and transitory episodes occurring in daily life (e.g., forgetting why you went to the kitchen) to extremely distressing experiences (e.g., re-experiencing trauma) associated with psychiatric disorders like posttraumatic stress (PTSD) and MDD (Pedone et al., 2025). For the purpose of this thesis, dissociation is conceptualised as a set of symptoms rather than a clinical dissociative disorder such as dissociative identity disorder.

Dissociation is multifaceted with three main subcategories: amnestic (e.g., arriving without knowing how); depersonalisation/derealisation (e.g., not recognising yourself in the mirror); and absorption/imaginative involvement (e.g., being so absorbed in the fictional story that you become unsure whether it actually happened; Carlson & Putnam, 1993). These dissociation subcategories conceptually overlap with mind-wandering episodes *without* meta-awareness. For example, people mind-wandering while driving can: arrive without being fully aware of the route they took (amnestic dissociation); or be on a familiar route where the surroundings seem unrecognisable (derealisation dissociation); or become so engrossed in imagining the story they are reading that they become unaware of their surroundings, time, or others interacting with them (absorption dissociation). Indeed, the concept of dissociation is akin to the decoupling hypothesis of mind-wandering (Soffer-Dudek, 2019).

Despite the overlap, few studies have investigated the relationship between dissociation and mind-wandering. One case study suggests that dissociation predicts repetitive and negatively-valenced daydreaming in people with poor sleep (Poerio et al., 2016). Importantly, mind-wandering is positively associated with absorption-type dissociation (Vannikov-Lugassi & Soffer-Dudek, 2018). Further, people who ruminate more typically experience greater derealisation dissociation over time, and the relationship between derealisation dissociation and sleeplessness is moderated by depression (Vannikov-Lugassi & Soffer-Dudek, 2018; Vannikov-Lugassi et al., 2021), suggesting dissociation types contribute to depression and mind-wandering. Additionally, in the trauma literature, dissociation is posited as a coping mechanism that reduces conscious awareness of overwhelming emotions during, and immediately after, exposure to a traumatic event (Horowitz, 1993). Perhaps then, when people mind-wander with ruminative or perseverative content, they may become overwhelmed by negative emotions. In response, dissociation might act to reduce mind-wandering meta-awareness to avoid the distressing thoughts. However, the diminished meta-awareness may also impair the person's ability to recognise and correct the maladaptive or distorted thinking, potentially leading to increased depressive symptoms. Put simply, a potential mechanism linking mind-wandering and depression is a tendency towards negative thinking patterns that may increase a tendency to dissociate (a coping mechanism), decreasing meta-awareness that without the ability to address the negative thinking, results in increased depression.

Mindfulness

Mindfulness—the anchoring of attention to the here and now (Mrazek et al., 2012)—has been increasingly recognised as an effective cognitive process for reducing mind-wandering and managing maladaptive cognitive strategies commonly linked to negative emotions and thinking patterns (Guendelman et al., 2017). Unlike, for example, thought suppression, control and dissociation, mindfulness encourages people to observe negative thoughts without judgement, reducing cognitive reactivity to distressing experiences (Keng et al., 2011). While the psychological processes underpinning mindfulness are unclear, meta-cognitive and cognitive models posit that mindfulness might act through changing attention and attitudes (Shapiro et al., 2006), and by enhancing self-awareness (e.g. meta-awareness) and self-regulation (e.g. observing emotions without judgement or reaction). Mindfulness and mind-wandering theoretically differ across attention, awareness and intentionality (Smallwood & Schooler, 2015). Where mindfulness involves sustained attention to the present moment with intention and awareness, mind-wandering involves a shift in attention that can occur without intention and awareness. Consequently, mindfulness is considered an opposing construct to mind-wandering with studies showing negative correlations between mindfulness and both self-reported trait mind-wandering and behavioural indicators during the SART (Mrazek et al., 2012; Somaraju et al., 2023). Neuroimaging studies further support that mindfulness improves prefrontal regulation of limbic activity, enhancing emotional control and reducing excessive mind-wandering (Brewer & Garrison, 2014; Zeidan et al., 2010). By engaging in present moment awareness and acceptance, mindfulness can reduce the tendency to suppress or attempt to control negative thoughts, ultimately increasing meta-awareness of distressing thoughts.

Research shows mindfulness is negatively correlated with depression (Brown & Ryan, 2003; Cash & Whittingham, 2010), dissociation (Vancappel et al., 2021), and rumination (Raes & Williams, 2010). Additionally, Frewen et al. (2008) found that mindfulness in undergraduate students was associated with less frequent negative automatic thoughts and an improved ability to disengage from those thoughts. Two studies have shown that mindfulness linked to better performance on-tasks measuring sustained attention (Schmertz et al., 2009).

Taken together, these processes suggest a potential mechanism linking mind-wandering and depression. A tendency towards negative thinking patterns that may increase the use of avoidant-cognitive strategies—dissociation, thought suppression and thought control—aimed at reducing meta-awareness of negative thinking patterns. However, by avoiding engaging with and regulating these thoughts, people may be unable to address them, resulting in increased depression. In contrast, when engaging in mindfulness, the link between mind-wandering and depression is likely weakened through recognition and disengagement of these negative thoughts, reducing the possibility of a rebound effect and dissociation.

Clinical Implications

Although the relationship between mind-wandering and depression has several clinical implications, one critical implication is our understanding of meta-awareness of our negative cognitions and how that affects depression symptom severity. Treatments for depression and dysphoria, like cognitive behaviour therapy (see: McEachrane, 2009) and meta-cognitive therapy (see: Hussain, 2015) rely on people's ability to access and reflect on their thoughts. These therapies aim to identify and challenge negative thinking patterns and maladaptive beliefs to help people develop more adaptive and less distressing cognitive patterns (e.g. Persons et al., 2001; Hussain, 2015). However, if we dissociate from these negative cognitive patterns to protect from becoming more dysphoric and depressed, it raises important questions about treatment efficacy. If meta-awareness is diminished, we have limited access to the dysfunctional thoughts and beliefs that may reduce treatment efficacy. Importantly, if these negative thoughts are inaccessible due to reduced meta-awareness, and therefore proceed untreated, this lack of meta-awareness through dissociation may contribute to depression onset and maintenance. Understanding how negative thoughts and maladaptive beliefs interact with dissociation and meta-awareness in the relationship between mind-wandering and depression is crucial for refining treatment approaches and improving treatment outcomes.

Summary

Mind-wandering is a pervasive human experience that is difficult to define due to complexities in capturing the internal flow of thoughts and the overlapping characteristics of self-generated thoughts. Adaptive mind-wandering can support creative problem-solving and goal planning. But when mind-wandering is maladaptive, it can lead to poorer task performance and importantly, is associated with negative mood, dysphoria and depression. Additionally, mind-wandering can be deliberate, and used to relieve boredom and fatigue, but is more frequently experienced as spontaneous, which is associated with more negative consequences.

Several theories explain the how and why of mind-wandering, based on a priority to resolve current concerns or goals (current concern hypothesis), attentional/executive resource control (decoupling hypothesis), the failure to maintain attention on a task (executive failure hypothesis), and the ability to regulate mind-wandering through meta-awareness activation (meta-awareness hypothesis). Collectively these theories explain the onset and maintenance of both task focus and mind-wandering (process-occurrence hypothesis).

We know mind-wandering is associated with depression, a common psychological disorder. Both depression and mind-wandering are associated with negative thinking patterns including rumination and perseverative thinking, and maladaptive beliefs and maladaptive and adaptive cognitive strategies. Additionally, we know that people who mind-wander with greater depressive symptoms typically mind-wander without awareness (zone-out) more often. This finding suggests that mind-wandering without meta-awareness may be critical in depression onset, and potentially maintenance. Specifically, if people mind-wander with negative content and have an increased tendency to dissociate to cope, they might be less meta-aware of their negative thinking patterns and unable to address them, consequently experiencing greater depression symptoms. Yet, how these factors collectively contribute to the mind-wandering and depression relationship has not been investigated. Gap 1: Understanding how negative thinking patterns, cognitive strategies (particularly dissociation), and meta-awareness are linked to the mind-wandering and depression relationship.

Understanding the mood and mind-wandering relationship also relies on accurately manipulating and measuring both mood and mind-wandering. Measuring mind-wandering is inherently challenging given it is covert and spontaneous. Various methods have been developed to capture mind-wandering; these methods rely on subjective self-report methods in laboratory and naturalistic settings. Self-reports are validated through triangulation with behavioural, physiological and neuropsychological measures. However, manipulating mind-wandering experimentally is challenging. Tasks performed when assessing mind-wandering are assumed not to confound mind-wandering frequency and content. But recent evidence suggests that people's mood deteriorates as they perform such tasks. This altered mood effect may influence mind-wandering and to date, neither the assumption that people's mood alters when performing a task assessing mind-wandering, nor whether any changes in mind-wandering occurring alongside unintended mood changes, have been formally tested. Gap 2:

Understanding how performing a task used to assess mind-wandering—specifically the SART—affects an induced mood.

Aims

My thesis aimed to address two key gaps in the literature: one conceptual and one methodological (see Chapter 2 for study overview). For the conceptual issue, I aimed to examine the various associations between factors common to both mind-wandering and depression; specifically the correlations between negative thinking patterns, maladaptive cognitive beliefs and dissociation, and cognitive behaviours. Then I propose a mechanism that mind-wandering and depression are associated through increased negative thinking patterns (rumination and perseverative thinking), which increase the tendency to dissociate to cope with the negative thoughts, decreasing meta-awareness and leading to a worsening, or maintaining, of depressive symptoms. I conducted three studies to address this aim.

For the methodological issue I aimed to test the assumption that an induced mood is maintained during a low-demand attention task, here the SART, when assessing mind-wandering frequency. In addition, I aimed to test an adapted protocol that involved extending the mood induction through the task. I conducted three studies to address this aim.

I note that, due to this thesis format where central chapters are formed by articles designed to stand alone, there is some repetition of concepts and ideas.

Chapter 2: Overview of Thesis Studies

My thesis had two overarching aims: a *conceptual* and a *methodological* aim.

Conceptual Aim: Do Negative Thinking Patterns, Maladaptive Cognitive Beliefs and Avoidant Cognitive Strategies Influence the Mind-Wandering and Depression Relationship?

My first aim was to investigate mechanisms by which general mind-wandering becomes maladaptive and linked to depression, focusing on how maladaptive cognitive processes—negative thinking patterns and avoidant cognitive strategies—*and* meta-awareness (i.e., explicit awareness of our thoughts)—contribute to this relationship. Although mind-wandering can be adaptive (e.g., assist in problem solving), it can also be maladaptive, particularly when its content is negative, such as rumination. We know that *negative thinking patterns* are associated with depression, and these patterns are often present when people mind-wander with negative content (i.e., negative mind-wandering; Killingsworth & Gilbert, 2010). When people lack meta-awareness of mind-wandering, they are unable to recognise and consequently address such negative thinking patterns, potentially worsening depression symptoms. However, little research has examined how these factors—avoidant-cognitive processes such as thought suppression, thought control and dissociation, and negative thinking patterns—collectively contribute to mind-wandering and depression, or how meta-awareness is activated in this context (e.g. Halvorsen et al., 2015; Vannikov-Lugussi & Soffer-Dudek, 2018; Vannikov-Lugussi et al., 2021). This gap in the research raised three research questions:

1. To what extent are negative thinking patterns (i.e. rumination and maladaptive meta-cognitive beliefs) and avoidant cognitive strategies (dissociation, thought suppression and thought control) associated with both mind-wandering and depression *and* how do these factors influence the relationship between mind-wandering and depression?

2. How does meta-awareness of mind-wandering influence the relationship between depression and mind-wandering?
3. What mechanisms may activate meta-awareness when people have an increased tendency towards negative thinking patterns and greater depression symptoms?

To address these questions, I first examined how negative thinking patterns (e.g. rumination and maladaptive meta-cognitive beliefs) and maladaptive cognitive strategies (e.g. thought suppression, thought control and dissociation) relate to mind-wandering and depression (question 1). Establishing these associations formed a foundation for understanding potential mechanisms that explain how, mind-wandering contributes to depression, and depression contributes to mind-wandering (questions 2 and 3). For example, one potential mechanism is that *maladaptive cognitive strategies* help people avoid negative thinking patterns and emotional experiences (Purdon & Clark, 2001; Pektus et al., 2014), which may reduce meta-awareness, ultimately worsening depression. Building on these relationships, I proposed and tested a serial mediation that I conducted across Studies 1, 2, and 3 to achieve my conceptual aim.

The relationship between mind-wandering and depression can be bidirectional (e.g., Welhaf et al., 2024)—whereby people who mind-wander with negative content report mood deterioration (Mrazek et al., 2013), and people with depression mind-wander more frequently (Poerio et al., 2013). Therefore, I examined factors that may influence both directions of this relationship—i.e., mind-wandering predicting depression (Studies 1 and 3), and depression predicting mind-wandering (Study 2).

Study 1

My first study examined relationships between mind-wandering and depression, and negative thinking patterns (meta-cognitive beliefs and rumination) and meta-cognitive strategies (dissociation, thought suppression and control). Because depression is co-morbid with PTSD and associated with dissociation, I also explored whether traumatic intrusions (i.e., spontaneous, intrusive re-experiencing trauma images) might contribute to the connection between mind-wandering and depression. Although it is possible that people with depression might mind-wander more in part due to these factors, here I investigated these factors in the direction of mind-wandering predicting depression.

In this correlational study, participants rated their tendencies towards using negative thinking patterns (meta-cognitive beliefs, rumination) and cognitive strategies (dissociation, thought suppression and thought control); they also self-reported trauma intrusion frequency (i.e., related to their recalled trauma history), their tendency to mind-wander (i.e., trait mind-wandering), and depression symptoms. Using mediation, I found that participants' self-reported mind-wandering predicted depression symptoms through maladaptive meta-cognitive belief tendencies—specifically poor confidence in thought accuracy, and the uncontrollability and danger of their thinking—and through trauma intrusions. Further, mind-wandering predicted depression symptoms through all tested maladaptive cognitive strategies (i.e., dissociation, thought suppression and thought control). I concluded that people prone to mind-wandering and who hold more maladaptive meta-cognitive beliefs may experience greater depression, partly due to a tendency to engage in maladaptive cognitive strategies, and partly due to trauma intrusion experiences. Therefore, Study 1 formed the foundation for the mechanisms I proposed to underpin the mind-wandering and depression relationship; see Studies 2 and 3. However, Study 1 was limited by measuring negative thinking patterns generally through the Global Rumination Scale. Although this measure captures the negative aspects of rumination, it does not distinguish between different rumination sub-types like brooding, depression and self-reflection. Further, the measure's internal consistency in my sample was poor (α = .49). I addressed this limitation by using the Ruminative Responses Scale in Study 2.

Study 2

Study 1 identified meta-cognitive beliefs and cognitive strategies as key factors in the relationship between mind-wandering and depression, but we know mind-wandering can occur without meta-awareness—an explicit awareness of our mind-wandering (Schooler, 2002). Poor meta-awareness of mind-wandering behaviour may exacerbate people's depression symptoms by reducing the ability to recognise, and address, any negative thinking patterns. Therefore, in Study 2 I examined how meta-awareness of mind-wandering is associated with depression symptoms. One previous study examined this issue (Deng et al., 2014); all participants completed depression and trait mindfulness measures, then completed the SART. Deng et al. found that the more severe the participants' depression symptom severity, the less meta-aware they were of their mind-wandering (termed *zone-outs*). However, this study had two key limitations: (1) the study was underpowered ($N = 23$), and (2) participants reported on depression symptoms before the mind-wandering task, which may have primed participants to activate a depression mindset, potentially initiating more mind-wandering.

In Study 2, I replicated Deng et al. and extended the method to: (1) address the limitations, and (2) include factors identified in Study 1—rumination tendencies and trauma symptoms—that were associated with both mind-wandering and depression. I increased the sample size ($N = 200$), and counterbalanced the depression measure presentation, with half of participants completing the depression measure before the SART, the other half after the SART. Unlike Study 1, which examined factors mediating the relationship from mind-wandering to depression, in Study 2 I investigated the reverse pathway—whether depression predicts mind-wandering through reduced mindfulness. If people with greater depression symptoms report greater mind-wandering through a tendency to be less aware of the present moment, this would support a bi-directional relationship between depression and mind-wandering.

Overall, Study 2 showed that increases in participants' self-reported mind-wandering frequency, both with and without meta-awareness, were associated with increases in depression symptoms—regardless of whether participants completed the depression measure before or after the SART. Additionally, increases in participants' tendencies to mind-wander and brood (i.e., self-focused rumination) were associated with increased depression symptoms. My mediation analyses showed that a tendency to brood likely increases depression through reduced mindfulness. Furthermore, participants with greater depression were likely to mind-wander with, but not without, meta-awareness because of their tendency to be less mindful, suggesting a bi-directional relationship. However, we could not determine what regulates *meta-awareness* of mind-wandering to influence depression.

Study 3

In Study 1 I identified that people more prone to mind-wandering and engaging in both negative thinking patterns (i.e., brooding and maladaptive meta-cognitive beliefs) and cognitive strategies (dissociation, thought suppression and thought control) experience greater depression. Study 2 showed people with greater depression mind-wandered more with awareness, partly due to a tendency to be less present moment focused, and when people lack meta-awareness of their mind-wandering, they tend to be more depressed. Taken together, these findings suggest a bidirectional relationship: mind-wandering can influence depression, and depression can influence mind-wandering, with meta-awareness playing an important role in this relationship. But how do these factors—negative thinking patterns, avoidant cognitive strategies and meta-awareness—work collectively to explain the mind-wandering depression relationship? Specifically, in Study 3, I wondered whether dissociation—an avoidant cognitive strategy——underpins a mechanism linking mind-wandering, negative thinking and depression by influencing meta-awareness activation. I hypothesised a five-chain serial mediation proposing that people who mind-wander with negative content—e.g., brooding and/or worrying—attempt to detach from that negative thought content through dissociation, which might lead to decreased meta-awareness and consequently increased depression. In this study, participants completed questionnaires that measured trait characteristics of mind-wandering, negative thinking (i.e., brooding and perseverative thinking), dissociative experiences, trait meta-awareness tendencies, and depression symptoms. I found that while perseverative thinking, brooding, dissociation, and meta-awareness independently mediated the relationship between mind-wandering and depression, my proposed five-chain serial mediation model was unsubstantiated. Instead, I found support for a four-chain serial mediation that predicted mind-wandering with increased negative cognitions influenced dissociation (i.e., amnestic dissociation, depersonalisation/derealisation dissociation and absorption dissociation), which then influenced greater depression symptomology. Together, these findings suggest that while negative thinking patterns, avoidant-cognitive strategies and reduced meta-awareness each influence the relationship to mind-wandering and depression, dissociation rather than meta-awareness, appears to be a key influencing factor in predicting depression in people prone to mind-wandering and negative thinking.

Methodological Aim: Does an Induced Mood Change During the SART?

My second aim was to examine whether an induced mood remains stable during a task commonly used to assess mind-wandering—the SART. The ability to accurately manipulate mood and mind-wandering is essential for understanding the mood and mind-wandering relationship. Laboratory mood induction procedures are designed to induce participants into a specific mood state with the assumption that the induced mood remains stable through subsequent tasks. But this assumption is untested, and recent research suggests that participants' mood shifts when completing the SART (e.g., He et al., 2021; Smallwood et al., 2009; Stawarczyk et al., 2013). If the assumption of mood stability is violated, and mood incidentally shifts while participants perform the SART (e.g. Besten et al., 2023; Jonkman et al., 2017; Stawarcyzk et al., 2013b; Smallwood et al., 2009), mind-wandering frequency may be affected (e.g., with increased negative mood, mind-wandering tends to increase; with increased positive mood, mind-wandering tends to decrease), confounding our understanding of the mood and mind-wandering relationship. Here, I tested the assumption that mood remains stable during the SART and propose an adaptation that might sustain the mood while mind-wandering and meta-awareness is assessed. I conducted Studies 4, 5, and 6 to address this methodological aim.

Studies 4 and 5

In Study 4 I investigated whether an induced mood changes when performing the SART. Mood induction occurs by activating schema associated with thought patterns aligning with the intended mood (e.g., Martin, 1990). For example, to induce a negative mood, participants read schema-related statements (e.g., "I'm ashamed that I've caused my parents needless worry"), which can activate associated concepts (e.g., "I fail at everything, I never get anything right"), leading to feelings of sadness and loneliness. In Study 4, participants were induced into a negative, positive, or neutral (control) mood state by reading valenced self-referential statements (i.e., Velten mood induction statements; Velten, 1968) while listening to mood-congruent music (Seibert & Ellis, 1991). Following the mood induction, participants completed a mind-wandering procedure containing two 5-minute SART blocks with random thought probes to assess mind-wandering and meta-awareness. Mood was operationalised as positive and negative affect, and measured at 4-timepoints: pre-induction, post-induction, and at the end of each SART block. When I compared mood before and after each SART block, I found that participants in the negative mood condition felt less negative overall, while those in the positive condition experienced a significant reduction in positive affect in each SART block. Interestingly, participants in the neutral condition reported feeling less positive after the SART, suggesting that the SART itself may negatively influence mood. Therefore, while performing the SART, participants' induced mood weakened—negatively induced mood became less negative, positively induced mood less positive—and their mood overall was less positive.

To ensure the mood weakening effect related to performing the SART itself—and was not an unintended consequence of the mood induction or mood naturally returning to baseline—Study 5 replicated Study 4 without a mood induction. Participants' mood significantly deteriorated during the SART, indicating that performing the SART negatively affected mood. These findings have implications for mood and mind-wandering research because when participants' positive affect decreases during the SART, increased mind-wandering cannot be solely attributed to a negative mood—it may instead be a result of the SART.

Study 6

To address the methodological issue found in Studies 4 and 5, I designed a procedure aimed at sustaining the induced mood by continuing the mood induction protocol through the SART. I hypothesised that if participants' mood changed due to schema activation, then listening to the mood induction music during the SART would sustain that activation and maintain the induced mood. I therefore replicated and extended Study 4 by additionally allocating participants in each of the negative and positive mood inductions to one of two conditions. Half the participants completed the SART whilst listening to the valenced music from the mood induction, while for the other participants, no music played during the SART. I compared the difference in mood between participants who listened to the valenced music and those who did not. However, listening to valenced music through the SART did not prevent the induced mood from weakening, indicating the adapted protocol was unsuccessful.

Summary and Implications

Overall, my thesis has several key findings. First, people prone to mind-wandering experience greater depression severity partly due to their tendencies towards negative thinking patterns (i.e. brooding, beliefs about the uncontrollability and danger of thoughts, and trauma intrusions) and avoidant cognitive strategies (dissociation, thought suppression and thought control processes [worry and punishment]). Second, people who tend to brood and mind-wander, both with and without meta-awareness, also experience greater depression. Third, mind-wandering tendencies are associated with greater depression severity, with negative thinking patterns influencing dissociation tendencies, which in turn contributes to increased depression. Third, in the context of negative thinking patterns, the link between mind-wandering and depression is more strongly associated with a tendency to dissociate, rather than reduced meta-awareness. Finally, I confirmed that when people are induced into a positive or negative mood state, this induced mood weakens when they perform the SART. However, adapting the SART protocol to sustain the induced mood did not successfully maintain mood (i.e., the induced mood weakened despite participants listening to valenced music during the task). Potentially, extending the music component of the mood induction was not sufficient to maintain the spread of activated schema to sustain the mood induction.

These six studies have clinical and methodological implications. First, since dissociation underpins the relationship between mind-wandering with negative cognitions and depression, addressing dissociation when treating depression might help people focus on their thoughts and improve treatment efficacy. Methodologically, designing a task that sustains an induced mood while measuring mind-wandering may provide a more accurate representation of mind-wandering direction and frequency, and how it is associated with greater depression symptoms.

Chapter 3: The Role of Negative thinking and Cognitive Strategies in Supporting the Relationship Between Mind-Wandering and Depression

Author contributions: I developed the study design with the guidance of MKTT. I collected the data, cleaned the data for analysis and performed the data analysis and interpretation. I drafted the manuscript and MKTT provided critical revisions.

Abstract

Mind-wandering is related to negative mood and depression symptoms, but the role of negative thinking patterns and avoidant cognitive strategies (i.e. dissociation, suppression, thought control) in this relationship is unclear. Therefore, we examined (1) the associations between negative thinking patterns (i.e., rumination and metacognitive beliefs), and cognitive strategies (dissociation, thought suppression and control) with both mind-wandering and depression; and (2) how these factors influence the mind-wandering and depression relationship. Additionally, because trauma intrusions are associated with dissociation and PTSD—which often co-occurs with depression—we explored whether trauma intrusions also contributed to this relationship. Participants completed trait mind-wandering, rumination, thought control processes, meta-cognitive beliefs, thought suppression, dissociation tendencies, trauma intrusions and depression symptom severity self-report measures. We used correlations and mediation models to examine the relationships between cognitive strategies and negative thinking patterns (e.g. meta-cognitive beliefs) with mind-wandering and depression. We found mind-wandering and depression were weakly-to-moderately correlated, and both correlated with negative thinking (rumination, meta-cognitive beliefs), trauma intrusions and cognitive strategies (i.e., dissociation, thought suppression and thought control). Meta-cognitive beliefs (thought uncontrollability and danger, cognitive confidence), dissociation (i.e. depersonalisation), thought suppression and thought control (worry and punishment), and trauma intrusion tendencies partly explained the mind-wandering and

depression relationship. Overall, mind-wandering tendency contributed to participant's depression symptomology, partly through beliefs that thoughts are uncontrollable and dangerous, certain avoidant-cognitive strategies, a lack of cognitive confidence, and trauma intrusions. Therefore, avoidant-cognitive strategies may impair awareness and regulation of negative thinking patterns, maintaining depression severity.

Introduction

"The best times in life are usually random, unplanned and completely spontaneous" (Anonymous). But does this notion apply to our thoughts? Not always, it seems. Spontaneous mind-wandering—an unintentional shift in attention away from the present task to internally generated information (Smallwood & Schooler, 2006)—is often linked with low mood and depression (Chaieb et al., 2022). This connection may occur from a tendency towards negative thinking patterns like rumination and meta-cognitive beliefs (i.e., beliefs about our thoughts; Chen et al., 2021), common in people vulnerable to depression. Indeed, research shows that mind-wandering with negative content is associated with greater depression symptoms (Poerio et al., 2013). Furthermore, people prone to depression engage in negative thinking patterns and rely on avoidant-cognitive strategies (e.g. dissociation, thought suppression and control) to regulate their negative emotions (Beck, 1987; Wells & Matthews, 1994; 1996). But less is known about *how* negative thinking patterns and avoidant-cognitive strategies influence the relationship between mind-wandering and depression. Thus, we investigated: (1) the associations between negative thinking patterns (i.e., rumination and metacognitive beliefs), and cognitive strategies (dissociation, thought suppression and control) with both mind-wandering and depression, and (2) how these factors influence the mind-wandering depression relationship. Additionally, we explored whether trauma intrusions—unwanted distressing memories, nightmares, or trauma flashbacks—are associated with mind-wandering. Evidence suggests that people who experience trauma intrusions often dissociate to manage their PTSD symptoms, which frequently co-occur with depression (Fung et al., 2025). Examining these interactions is critical to understanding the cognitive mechanisms underlying depression.

Mind-wandering is a shift in attention away from a primary task (e.g., reading), and occurs because we have unresolved concerns or goals (e.g., planning what to cook for dinner) that become more salient than the task being performed (e.g., reading); the *current concerns hypothesis* (Klinger et al., 1973). Attention is then either directed away from the task—the *decoupling hypothesis* (Smallwood & Schooler, 2006; Teasdale et al., 1995)—towards the concern, or our ability to inhibit these concerns to maintain task focus fails—–the *executive failure hypothesis* (McVay & Kane, 2010; 2012). When and how we mind-wander also depends on task content (e.g., significance, emotionality, and temporal focus: past, present or future), and context (e.g., complexity, cognitive demand; see Smallwood & Andrews-Hanna, 2013). For example, mind-wandering about unresolved goals and concerns (e.g., goal planning; Smallwood & Andrews-Hanna, 2013) is more likely during less cognitively demanding and engaging tasks (e.g., driving).

Mind-wandering can be both adaptive and maladaptive. Adaptive mind-wandering can support goal planning (e.g., remembering to purchase milk while driving home; e.g., Baird et al., 2011), and creative problem solving (e.g., resolving how to fix a math problem while out walking; Pachai et al., 2016). Alternatively, maladaptive mind-wandering can impair task performance, for example, by diminishing reading comprehension (Smallwood et al., 2008,) and driving performance (e.g., Yanko et al., 2013). Critically, mind-wandering is associated with more negative mood (e.g., Marchetti et al., 2012), and people who mind-wander with negative content report more depressive symptoms (see Chaieb, 2022 for review). Mind-wandering without meta-awareness (i.e., noticing our mind has wandered; Schooler, 2002) is also associated with depression (Deng et al., 2014).

Depression, a mood disorder, can occur when certain meta-cognitive beliefs generate and reinforce negative thinking patterns like rumination (i.e., fixed, rigid and negatively-valenced thought patterns) and worry (see Wells & Matthews, 1994; 1996). People can hold meta-cognitive beliefs that negative thinking patterns can be helpful (e.g. "worry helps me prepare for challenges"), but also unhelpful (e.g., "if I can't stop thinking about this, I'll go mad"). These beliefs influence our cognitive and emotional responses (Chen et al., 2021; Papageorgiou & Wells, 2003; Wells et al., 2009). For example, people with negative meta-cognitive beliefs about mind-wandering uncontrollability might generate worrying thoughts ("I must not be normal"). These thoughts may create feelings of low self-worth that negatively affect people's mood. People may then engage cognitive strategies to suppress and/or avoid these negative thoughts and mood. But this avoidance may increase depression symptoms (Wegner, 1987).

Because depression is positively associated with mind-wandering about negative content (e.g. Murphy et al., 2013; Poerio et al., 2013), people in a negative mood might mind-wander through rumination and maladaptive meta-cognitive beliefs. Indeed, extant research shows mind-wandering is associated with dispositional (i.e., trait) self-focused rumination and depressive symptoms (e.g. Vannucci et al., 2020). In a cross-sectional study investigating mind-wandering, rumination tendencies and depression vulnerability, people with a history of depression who frequently mind-wandered ruminated more often (Xu et al., 2024). However, greater rumination did not lead to increased mind-wandering, even after controlling for participants' initial depression levels. This pattern suggests that mind-wandering influences rumination in its association with greater depression severity. But to our knowledge, only two studies have investigated the relationship between mind-wandering and maladaptive meta-cognitive beliefs. These studies show that meta-cognitive beliefs (i.e., cognitive confidence, greater uncontrollability and danger, and need to control thoughts) are associated with mind-wandering and negative affect (Carciofo et al., 2017), and that beliefs about controlling thoughts are positively associated with mind-wandering without meta-awareness (Takarangi et al., 2017). Yet *how* negative thinking patterns influence depression severity remains unclear.

Perhaps people use cognitive strategies, like thought suppression, control and/or dissociation, to regulate distress associated with negative thoughts. However, these strategies may be counterproductive, reinforcing negative thoughts and associated distress, and ultimately contributing to depression. For example, some people use thought suppression to avoid negative thoughts (Ragen et al., 2016), but suppression can increase thought frequency and intensity (*the rebound effect*; Wegner, 1987). Consequently, people who attempt to suppress their negative mind-wandering may mind-wander *more,* with any resulting increase in negative mind-wandering likely increasing depression symptoms.

Thought control—the perceived inability to control unwanted and unpleasant intrusive thoughts—can increase people's likelihood of developing emotional disorders (e.g., anxiety, depression; Feliu-Soler et al., 2019; He et al., 2019; Luciano & Algarabel, 2006). Possibly, people who mind-wander and engage in negative thinking patterns perceive a lack of control over their mind-wandering. Consequently, when mind-wandering involves negative content, they may experience distress because they believe they cannot disengage from their mind-wandering, ultimately contributing to greater depression severity.

Finally, dissociation—the disruption in cognitive processes like memory, emotion and perception (Soffer-Dudek, 2014)—is associated with depression, particularly in people with trauma histories (e.g. Feeny et al., 2000; Hagenaars et al., 2010; Hodgson & Webster, 2011). Dissociative episodes range from everyday lapses (e.g. forgetfulness) to severely distressing experiences associated with major depression and PTSD (e.g., re-experiencing trauma: Fung et al., 2022; Waller & Ross, 1997). Everyday dissociation can involve detached attention from the external environment (Soffer-Dudek, 2019), resembling mind-wandering. For example, we can read without recalling the content (i.e., amnestic dissociation), be so engrossed in mind-wandering that surroundings seem unfamiliar (i.e., absorption dissociation), and/or so lost in thought while walking that our surroundings feel dreamlike (i.e. derealisation dissociation). Thus, when people who are depressed mind-wander, they may dissociate from depressive thoughts to avoid the associated distress.

These three cognitive strategies—thought suppression, thought control and dissociation—may partially regulate how people respond to mind-wandering and negative thinking patterns, and thus influence depression symptomology. Indeed, research has found that women who suppressed mind-wandering thoughts performed worse on a math task than those who did not (Schuster et al., 2015). Since mind-wandering is associated with poorer task performance, the findings suggest that attempts to suppress thoughts may influence performance by increasing mind-wandering (Thomson et al., 2014). Additionally, students in a more negative mood had difficulty intentionally suppressing mind-wandering during a lecture, suggesting mood mediated the relationship between intentional suppression and mind-wandering (Hattori & Ikeda, 2016). Similarly, people who frequently mind-wandered had lower perceived ability to control their thoughts, and higher negative affect, than people who mind-wandered less frequently (He et al., 2019). However, few studies have investigated the relationship between mind-wandering and dissociation, and how this relationship may contribute to depression. Poerio et al. (2016) found that dissociation was associated with increased repetitive and negatively valenced daydreaming—a form of mind-wandering—in participants with poor sleep. Other research shows that increased rumination predicts greater derealisation dissociation over time, but people who are more depressed experience greater sleep difficulties due to increased derealisation dissociation (Vannikov-Lugassi & Soffer-Dudek, 2018; Vannikov-Lugassi et al., 2021). Together, these studies point to possible mechanisms that connect cognitive strategies and negative thinking patterns, mind-wandering and depression.

The relationship between dissociation, PTSD and depression, as well as the co-morbidity between depression and PTSD, raises the possibility that trauma intrusions—a hallmark PTSD symptom—are also related to mind-wandering and depression. Supporting research shows intrusive imagery in patients with depression likely plays a significant role in maintaining depressed mood, and spontaneous mind-wandering is positively associated with trauma intrusion frequency (Brosowsky et al., 2022; Patel et al., 2007). In Takarangi et al. (2017), participants experienced traumatic intrusions both with and without meta-awareness following an analogue trauma. In another study, the more frequently participants were caught thinking about a prior analogue trauma, the worse they performed on a reading task, indicating their attention had shifted from reading to the thoughts about the trauma (i.e. they had *mind-wandered*; Takarangi et al., 2014). Additionally, in a study examining the association between mind-wandering, PTSD symptomology and self-control, spontaneous mind-wandering was positively associated with trauma intrusions (Brosowsky et al., 2022). Together these studies suggest that intrusive thoughts (e.g. trauma intrusions), dissociation and mind-wandering might interact to exacerbate depressive symptoms through mechanisms like repetitive negative thinking.

To summarise, the evidence suggests that mind-wandering and depression are linked through rumination, meta-cognitive beliefs and cognitive strategies, and the tendency to mind-wander with negative content. But what remains unclear is whether (1) people engage cognitive strategies to dissociate from, suppress, and/or control negative thoughts (e.g. rumination) and mind-wandering, to regulate their distress, and (2) whether using such strategies exacerbates and/or maintains depression.

Therefore, our primary aim here was to examine (1) the associations between negative thinking patterns (i.e., rumination, meta-cognitive beliefs)[3] and cognitive strategies (dissociation, thought suppression, thought control processes) with mind-wandering and depression, and (2) how these factors influence the mind-wandering and depression relationship. We expected that mind-wandering would predict depression severity through increased tendency to ruminate and holding stronger maladaptive meta-cognitive beliefs. We also expected that mind-wandering would predict depression severity through an increased tendency to engage maladaptive cognitive strategies of dissociation (amnestic, absorption and derealisation subtypes), thought suppression and/or maladaptive thought control processes (worry and punishment). Our exploratory aim was to examine the associations between trauma intrusions, mind-wandering, and depression, and how trauma intrusions influence the mind-wandering and depression relationship.

Method

Design and Participants

We recruited 640 US participants using Amazon's Mechanical Turk. We excluded data from 58 participants who failed the English Proficiency Test (EPT) and 11 participants who failed all three embedded attention checks. Our final sample comprised 571 participants (55% female, aged 18-73 years: M = 35.88, SD = 12.05) who identified as Caucasian (including White, 58.4%), Asian (11.1%), American (6.7%), of Mixed ethnicity (5.3%), Black (3.5%); Hispanic (3.3%), African American, (3.2%); European (3.0%) American Indian, (1.1%) or other (4.6%: Religious 1.9%, Indian 1.7%, Latino, 0.6% Guamanian, 0.2%; Middle Eastern, 0.2%).

[3] Because maladaptive meta-cognitive beliefs develop into negative thinking patterns termed cognitive-attentional syndrome (Wells et al., 2009), we operationalised them under the umbrella term of negative thinking patterns.

Procedure

We told participants we were investigating different thinking processes—experiences of shifts in attention and ways of dealing with unpleasant thoughts—as well as people's exposure to different types of traumas, and their feelings and beliefs about those experiences. After providing informed consent, all participants completed the EPT and had to pass at least three out of the five questions to proceed. They then completed the battery of questionnaires presented in randomised order[4]. Participants were debriefed and remunerated (AUD$2.50). This research was approved by the Social and Behavioural Research Ethics Committee at Flinders University.

Measures

Mind-Wandering

Cognitive Failures Questionnaire (CFQ; Broadbent et al., 1982; see Appendix A). Participants rated 25 items measuring how often they experience everyday cognitive errors (e.g., *"Do you find you forget what you came to the shops to buy?";* 0 = *Never,* 4 = *Very often*). Higher scores indicate greater attention lapses. The CFQ has good internal consistency ranging from ά = .89-.93 (Bridger et al., 2013; Broadbent et al., 1982; present study: ά =.93).

Depression

Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995; see Appendix B). Participants rated the degree to which 21 statements (e.g. *"I couldn't seem to experience any positive feelings at all"*) applied to them over the previous week (0 = *Did not apply to me at all,* 3 = *Applied to me very much, or most of the time*). Here, we only analysed scores for the depression subscale. Higher scores indicate more severe depressive symptoms. The DASS-21 has acceptable concurrent validity with established measures, good

[4] The battery included questionnaires collected as part of a larger study and not reported or analysed here: A Trauma History, Frequency of Involuntary Thoughts Scale, Biographical Inventory of Creative Behaviours, the Daydreaming Frequency Scale, the Mind-wandering Awareness and Attention Scale, the Interpretation of Intrusions Inventory – control subscale.

internal consistency (ά = 0.92- 0.97; Antony et al., 1998; present study ά = 0.88 – 0.94), and test-retest reliability (Kakemam et al., 2022).

Negative Thinking Patterns

Meta-Cognitions Questionnaire (MCQ-30; Wells & Cartwright-Hatton, 2004; see Appendix C). Participants rated 30 statements concerning their a) positive beliefs about worry and rumination (e.g., *"worrying helps me cope"*), b) negative beliefs about the uncontrollability (e.g., "*not being able to control my thoughts is a sign of weakness*") and danger of their thoughts (e.g., "*when I start worrying I cannot stop*"), and c) negative beliefs about the consequences of their thoughts (e.g., cognitive confidence: "*my memory can mislead me at times"* and self-consciousness: "*I pay close attention to the way my mind works";* 1 = *Do not agree,* 4 = *Agree very much*). Higher scores indicate higher levels of maladaptive metacognitions. The MCQ has good internal consistency (Cronbach's ά = 0.88- .092; Wolters et al., 2012; present study ά = 0.93).

Global Rumination Scale (GRS; McIntosh & Martin, 1992; see Appendix D). Participants rated 10 items about their tendency to engage in repetitive thinking, including themes of controllability and frequency (e.g. "*When I have a problem, I tend to think of it a lot of the time"*), temporal focus (e.g. *"I seldom think about things that happened in the past''* [reverse-scored]), and distractibility (e.g. *"I often get distracted from what I am doing with thoughts about something else"*; 1 = *Does not describe me well,* 7 = *Describes me well;* present study: ά = .49 [standardized items]). Higher scores indicate greater rumination.

Cognitive Strategies

White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994; see Appendix E). Participants rated 15 statements concerning their tendency to suppress unwanted thoughts (e.g., "*There are things I prefer not to think about*", "*I often have thoughts I try to avoid*"; 1 = *Strongly disagree,* 5 = *Strongly agree*). The WBSI has good internal consistency (ά = 0.88; present study: ά = 0.94) and satisfactory test–retest reliability (*r* = 0.78; Hoping & de Jong Meyer, 2003). Higher scores indicate greater suppression.

Dissociative Experiences Scale (DES; Bernstein & Putman, 1986; see Appendix F). Participants rated the frequency of 28 dissociative experiences, ranging from everyday (e.g. *loss of awareness during driving*) to more pathological (e.g. *looking in a mirror and not recognising themselves*) experiences, in relation to one another (0 = *Much less than others,* 5 = *About the same as others,*10 = *Much more than others*). Higher scores indicate more severe dissociative symptoms. The DES has good internal consistency (ά = .95; present study ά =.95) and test-retest reliability (*r*s =.84 to .96; Dubester et al., 1995).

Thought Control Questionnaire (TCQ; Wells & Davies, 1994; see Appendix G). Participants answered 30 items assessing how often they used five different thought control strategies to manage unpleasant/unwanted thoughts (1 = *Never* to 4 = *Almost always*). Strategies included distraction (e.g. *"I think about something else"*), social control (e.g. "*I talk to a friend about the thought"*), worry (e.g. *"I dwell on other worries"*), punishment (e.g. "*I get angry at myself for having the thought"*), and reappraisal (e.g. *"I try to reinterpret the thought"*). Higher scores indicate stronger endorsement of thought control strategies (present study: ά = .89).

Trauma Intrusions

Posttraumatic Checklist 5 (PCL-5; Weathers et al., 2013; see Appendix H). Participants described their worst traumatic experience and then rated how bothered they were by 20 DSM-5 PTSD symptoms over the past three days in relation to this experience (e.g., *"Repeated, disturbing memories thoughts or images of a stressful from the past?",* 0 = *Not at all,* 4 = *Extremely*). We only analysed scores for the re-experiencing subscale. Higher scores indicating more severe intrusion symptoms. The PCL-5 also has strong test-retest reliability (*r* = .82, Blevins et al., 2015) and internal consistency (present study: *ά* = .97).

Results and Discussion

Recall our main aim was to examine the relationship between mind-wandering and depression through (1) negative thinking patterns—rumination and meta-cognitive beliefs—and (2) a tendency to use cognitive strategies of dissociation, thought suppression and control.

Statistical Analyses

We correlated negative thinking patterns (rumination: GRS; meta-cognitive beliefs: MCQ-30), trauma intrusions (PCL-5), cognitive strategies (dissociation: DES-II; thought suppression: WBSI; and thought control processes: TCQ), mind-wandering (CFQ) and depression (DASS-21). Where relationships existed, we compared correlation coefficients (Steiger, 1980) to determine the difference in strength of those relationships for both mind-wandering and depression, separately. We ran mediation analyses using the PROCESS macro in SPSS 27 with bias-corrected bootstrapping (5000 samples), where mind-wandering scores (CFQ)[5] were entered as the predictor variable, depression (DASS-D) scores as the outcome variable, with various mediators. See Table 3.1 for descriptive statistics.

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[5] At the time of study design and data collection phases, the CFQ and the Daydream Frequency Scale (DDFS) were typically used to operationalise mind-wandering, and the Mindfulness Awareness and Attention Scale (MAAS) operationalised mindfulness. We collected data for all three measures, ran correlational analyses between these measures, and found the CFQ showed significant medium positive correlations with the DDFS and negative correlation with the MAAS ($r = .47, -.67$ $p < .001$ respectively) indicating consistency across measures. We also ran correlational and mediation analyses using the DDFS, and MAAS separately with the same variables as CFQ and found a similar patterns of associations across all three measures although the MAAS consistently showed an opposite pattern of results, reflecting the inverse relationship with mind-wandering. (See supplementary materials). We report the primary analyses using the CFQ because it aligns more closely with the Executive Failure theory of mind-wandering, whereas the DDFS assesses more fanciful thinking and the MAAS measures mindfulness.

Table 3.1

Descriptive Statistics

	N	Minimum	Maximum	*Mean (SD)*
Mind-wandering (CFQ)	570	0	89	38.37 (15.33)
Rumination (GRS)	570	16	70	44.53 (6.92)
Meta-cognitive Beliefs (MCQ)	565			
Cognitive confidence		6	24	11.60 (3.86)
Positive beliefs about worry	565	6	24	11.77 (4.01)
Negative beliefs-Uncontrollability and danger	565	6	24	13.23 (3.45)
Need to control thoughts	565	6	24	11.89 (4.51)
Cognitive self-consciousness	565	6	24	12.32 (4.00)
Dissociation (DES-II)	569	0	226	91.05 (47.71)
Derealisation/depersonalisation		0	52	13.70 (13.02)
Absorption		0	84	37.12 (17.13)
Amnestic		0	64	19.95 (15.04)
Thought Suppression (WBSI)	570	15	75	49.03 (13.88)
Thought Control (TCQ)	570			
Punishment		6	24	9.87 (3.95)
Worry		6	24	10.28 (3.90)
Distraction		5	20	12.97 (3.14)
Reappraisal		6	23	13.31 (3.80)
Social Control		6	23	11.63 (4.10)
Trauma Intrusions (PCL-5)	570	0	25	10.65 (5.41)
Depression (DASS-21)	570	0	21	6.46 (5.92)

Correlational Analyses

First, we correlated mind-wandering with depression. Then we correlated negative thinking patterns (rumination, types of meta-cognitive beliefs), cognitive strategies (dissociation, thought suppression, thought control), and trauma intrusions with both mind-wandering and depression, to replicate prior research and establish a foundation for our mediation analyses (see Table 3.2).

Table 3.2

Correlations Between Cognitive Process and Negative Thinking Patterns with Mind-Wandering and Depression

Cognitive processes and negative thinking patterns		Mind-wandering	Depression	Correlation differences
		r	*r*	*t*
Mind-wandering		-	$.53^{***}$	-
Rumination		$.40^{***}$	$.30^{***}$	1.87
Meta-cognitive beliefs				
Negative	Uncontrollability/danger	$.49^{***}$	$.63^{***}$	-3.26^{**}
	Control	$.39^{***}$	$.57^{***}$	-3.78^{***}
	Self-consciousness	$.44^{***}$	$.57^{***}$	-2.80^{**}
	Cognitive confidence	$.52^{***}$	$.60^{***}$	-1.86
Positive	Worry	$.34^{***}$	$.43^{***}$	-1.72
Dissociation		$.55^{***}$	$.48^{***}$	1.52
	Depersonalisation	$.39^{***}$	$.45^{***}$	-1.18
	Absorption	$.57^{***}$	$.49^{***}$	1.78
	Amnestic	$.44^{***}$	$.37^{***}$	1.36
Suppression		$.52^{***}$	$.55^{***}$	-0.67
Thought Control				
Negative	Punishment	$.44^{***}$	$.55^{**}$	-2.34^{**}
	Worry	$.42^{***}$	$.52^{***}$	-2.06^{*}

Positive	Distraction	.06	-.08	-0.34
	Reappraisal	.18**	.24***	-1.05
	Social Control	-.08	-.13**	-0.90
Trauma intrusions		.41***	.54***	-2.70**

(***) p < .001, (**) p < .01, (*) p < .05

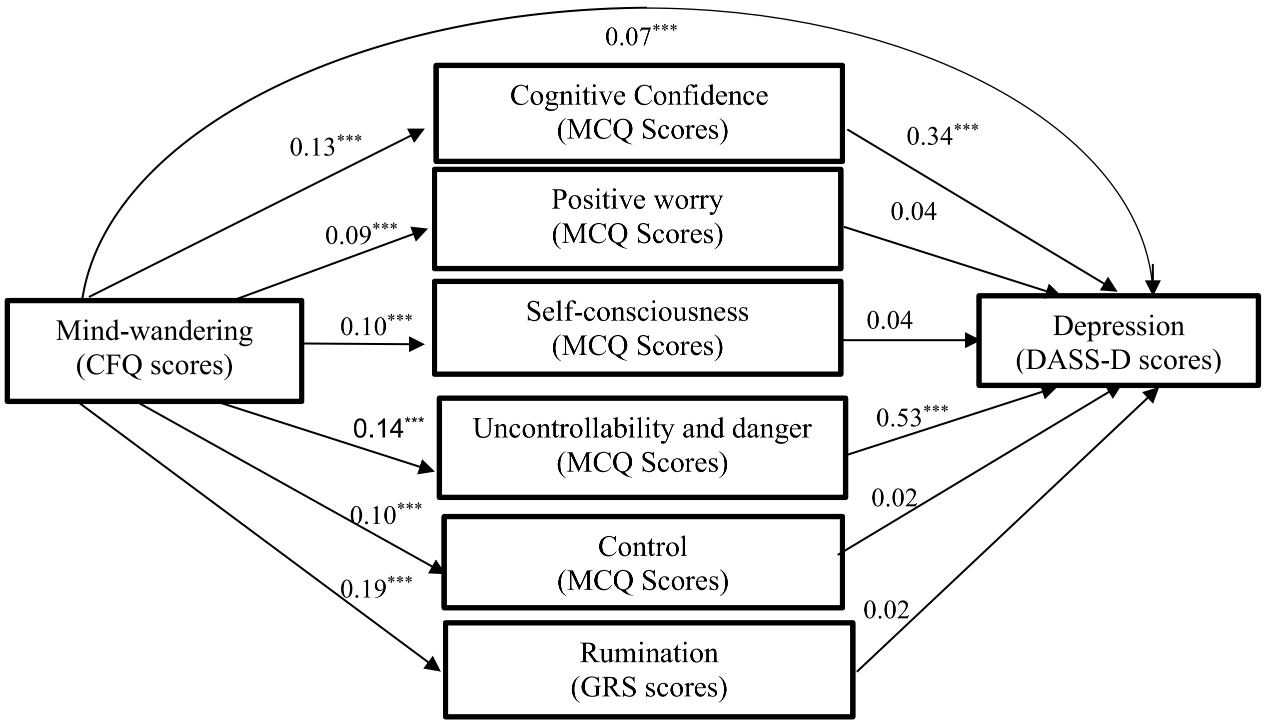
We found a medium correlation between mind-wandering and depression as expected. We also found small-to-medium correlations between negative thinking patterns (rumination, meta-cognitive beliefs), cognitive strategies (dissociation, dissociation subtypes, suppression, thought control processes: worry, punishment, reappraisal and social control), and trauma intrusions, and both mind-wandering and depression. However, distraction was not significantly related to either mind-wandering or depression.

We compared the strength of the relationships between negative thinking patterns, cognitive strategies and mind-wandering to their relationships with depression. We found the correlations between trauma intrusions, meta-cognitive beliefs (cognitive control, uncontrollability and danger, and self-consciousness), and maladaptive thought control strategies of worry and punishment, were significantly stronger with depression than with mind-wandering. We found no difference for rumination, dissociation, suppression and positive thought control strategies.

Together, these correlations suggest that as people's mind-wandering increases, their tendency to engage in more rumination, to activate meta-cognitive beliefs, to engage in cognitive strategies, and to experience depression symptoms also increases (e.g. see Carciofo et al., 2017; Chaieb et al., 2022; Fredrick et al., 2020; He et al., 2019; Poerio et al., 2016; Schuster et al., 2015; Seli et al., 2019; Takarangi et al., 2017; Vannucci et al., 2020). More importantly, here we demonstrated that these negative thinking patterns (rumination, meta-cognitive beliefs) and cognitive strategies (dissociation, thought suppression and thought control) are connected to both mind-wandering and depression, which formed the foundation of our predicted and exploratory mediations. Notably, distraction—a thought control process—was not associated with either mind-wandering or depression, suggesting that as people's mind-wandering or depression increases, they are no more likely to use distraction as a cognitive strategy.

Figure 3.1

Mediating the Relationship Between Mind-wandering on Depression (A) Negative Thinking Patterns: Meta-Cognitive Beliefs and Rumination



Mediation Effects of Negative Thinking Patterns on Mind-Wandering and Depression

We next examined our first main aim relating to the mediating effects of negative thinking patterns (meta-cognitive beliefs and rumination) in the relationship between mind-wandering and depression. We expected that mind-wandering would predict depression severity through increased rumination tendency, and maladaptive meta-cognitive beliefs. We ran one mediation model with meta-cognitive beliefs and rumination scores entered as mediators (Figure 3.1).

For meta-cognitive beliefs, the direct effect of mind-wandering on depression (95% CI: 0.420 - 0.098), and the indirect effect of mind-wandering on depression through cognitive confidence (95% CI: 0.024 - 0.065), and uncontrollability and danger (95% CI: 0.053 - 0.102) were significant. Consistent with our prediction, cognitive confidence and uncontrollability explained 21.70% and 37.54% of the total variance of this relationship (see Figure 3.1). These data suggest that lower confidence in cognitive ability, and a belief that thoughts are uncontrollable and dangerous, mediated the relationship between mind-wandering and depression. The indirect effects of positive beliefs about worry, cognitive self-consciousness, and need to control thoughts were not significant. For rumination, while the direct effect of mind-wandering on depression was significant, the indirect effect of mind-wandering on depression through rumination (95% CI: -0.008 – 0.014) was not significant, contrary to our prediction.

Our findings converge with some previous findings, but diverge with others, suggesting a complex relationship between mind-wandering, depression and maladaptive meta-cognitive beliefs and rumination. For example, Caricofo et al. (2017) also found that meta-cognitive beliefs about the uncontrollability and danger of thoughts mediated the relationship between mind-wandering and negative affect. However, they did not find evidence for cognitive confidence as a mediator for mind-wandering and negative affect.

One explanation for these mixed findings is the operationalisation of negative mood. Carciofo et al. used negative affect (e.g., anger, contempt, nervousness), whereas our study focused on depressive symptoms like sadness and low energy. While these findings diverge, they also suggest different mechanisms might link mind-wandering to negative mood and depression. Specifically, people prone to mind-wandering may believe their thoughts are uncontrollable, which could intensify nervousness and anger (i.e. increased negative affect). If they lack cognitive confidence (i.e., doubt the accuracy of their thoughts), they might feel hopeless in managing these uncontrollable thoughts, shifting negative affect towards depressive symptoms.

We found that people's rumination tendency was positively correlated with mind-wandering and depression—indicating that participants prone to mind-wandering also ruminated and experienced depressive symptoms. Yet, we did not find evidence that people who mind-wander had greater depression symptom severity *due* to rumination tendencies. That is, rumination did not *mediate* the relationship between mind-wandering and depression. This result contradicts our prediction and prior research showing that mind-wandering predicted rumination, and that mind-wandering with perseverative thinking (a type of negative rumination) predicted mood deterioration (Ottaviani et al., 2013; 2015; Xu et al., 2024). Perhaps these results diverge because of how we measured rumination. For example, Xu et al. (2024) assessed reflection using three items focused on self-reflection and self-focused rumination, and Ottaviani et al. (2013) included reactive (ruminating following a negative event), depressive rumination (self-focus thoughts about depressive symptoms) and worry measures. By contrast, we operationalised rumination using a global measure of repetitive and uncontrollable thoughts that included items measuring people's tendencies to engage in mental rehearsal of future and past events, and distractibility (McIntosh & Martin, 1992). This broader operationalisation may have been less sensitive to specific ruminative type thinking patterns. Indeed, our rumination measure showed poor internal consistency (r = .49), indicating constructs other than rumination were captured. Additionally, our findings suggest that participants' meta-cognitive beliefs about, and the uncontrollability of their thoughts and their need to control their thoughts, might be stronger mediators of the mind-wandering and depression relationship, than rumination. Potentially, individual differences in factors like emotion regulation and meta-awareness—which were not included in the mediation model—moderate the relationship between mind-wandering, rumination, and depression.

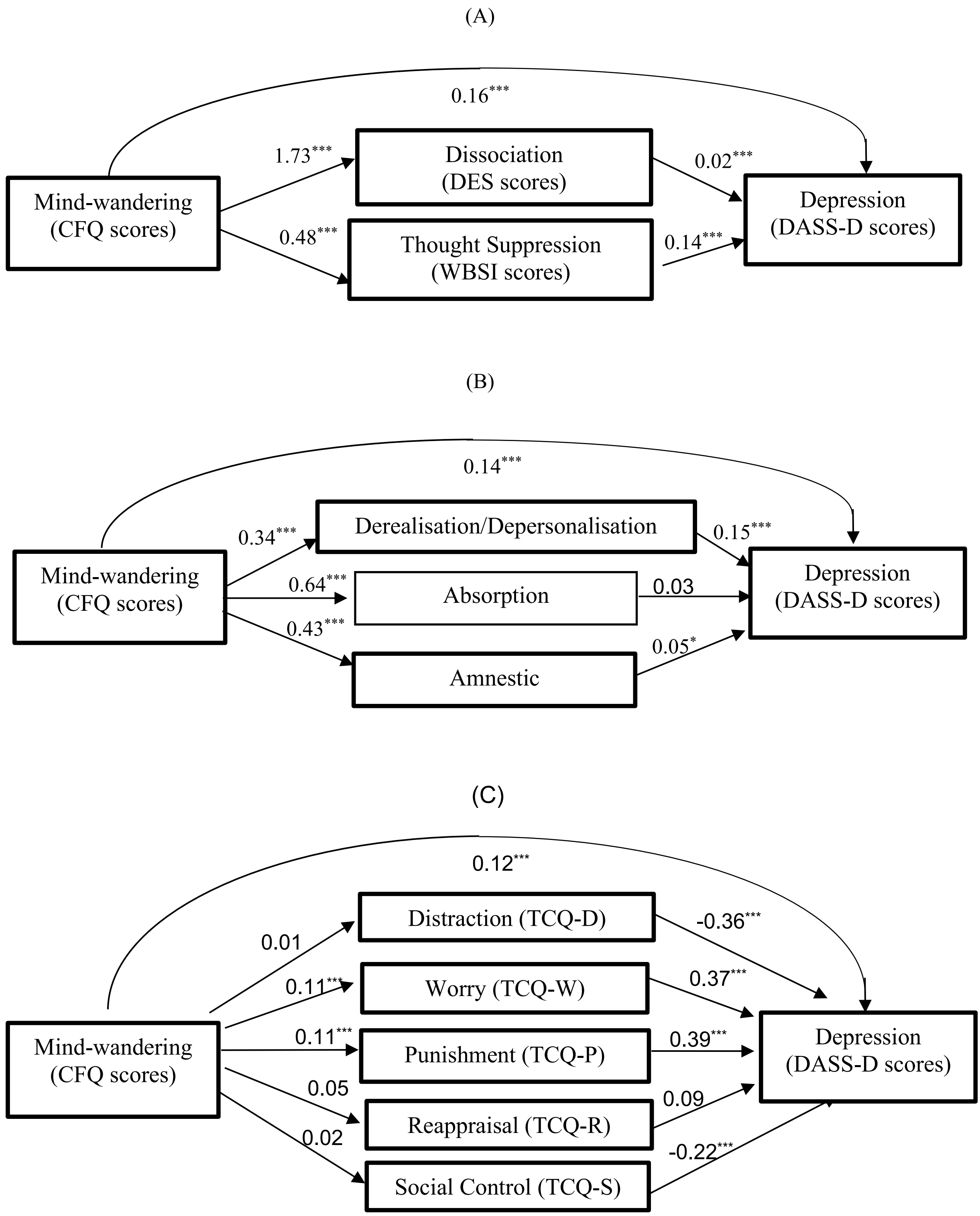
Overall, people prone to negative thinking patterns, specifically the uncontrollability and danger of thoughts (e.g., "if I start thinking about this, I won't be able to stop and I'll go mad"), and/or a lack of confidence in their ability to think through problems, are more likely to experience depression. These beliefs may have a stronger relationship with mind-wandering and depression, than rumination.

Mediation Effects of Cognitive Strategies on Mind-Wandering and Depression

Recall our second main aim was to investigate the influence of maladaptive cognitive strategies on the relationship between mind-wandering and depression. We ran two mediation models with dissociation and thought suppression scores entered as mediators in one model (Figure 3.2A), and thought control processes of distraction, reappraisal, social control (adaptive processes), and worry and punishment (maladaptive processes) scores entered as mediators in the models (Figure 3.2B). We expected that mind-wandering would predict depression severity through increased dissociation tendency, and use of thought suppression and maladaptive thought control processes (worry and punishment). Conversely, mind-wandering would predict decreased depression through adaptive thought control strategies (distraction, social control, and reappraisal; see Figure 3.2)

Figure 3.2

Mediating the Relationship Between Mind-Wandering on Depression (A) Cognitive Strategies: Dissociation and Thought Suppression, (B) Dissociation Subtypes and (C) Thought Control Processes



For dissociation and suppression, the direct effect of mind-wandering on depression (95% CI: 0.064 – 0.128), and the indirect effects of dissociation (95% CI: 0.022 – 0.059), and thought suppression (95% CI: 0.049 – 0.089) were significant, with dissociation and thought suppression explaining 19.80% and 33.33% of the total variance, respectively (see Figure 3.2A).

For dissociation subtypes, the direct effect of mind-wandering on depression (95% CI: 0.124 – 0.188), and the indirect effects of derealisation dissociation (95% CI: 0.028 - 0.074) were significant, with derealisation accounting for 24.22% of the total variance respectively (Figure 3.2B). However, the mediations through amnestic (95% CI: -0.041 – 0.017) and absorption (95% CI: -0.004 – 0.041) dissociation were not significant. For thought control, the direct effect of mind-wandering on depression (95% CI: 0.090 – 0.144), and the indirect effects of worry (95% CI: 0.022 – 0.058) and punishment (95% CI: 0.028 – 0.064) were significant, with worry and punishment explaining 19.06% and 21.94% of the total variance respectively (see Figure 3.2C). The mediations through adaptive thought control processes—distraction (95% CI: -0.011 – 0.002), reappraisal (95% CI: - 0.0009 – 0.010) and social control (95% CI: 0.0001 – 0.011)—were not significant.

Consistent with our predictions, our findings suggest that people who mind-wander experience greater depression symptoms partly because they tend to engage in cognitive strategies—specifically derealisation dissociation, thought suppression and thought control processes (i.e., punishment and worry). Our results converge with, and extend on, prior research in several ways. First, our finding that mind-wandering is associated with thought suppression aligns with studies showing that suppressing mind-wandering is associated with impaired task performance (Schuster et al., 2015), and that the relationship between thought suppression and mind-wandering is mediated by negative mood (Hattori & Kenji, 2016). However, our study extends these findings by demonstrating that thought suppression partly influences the relationship between mind-wandering and depression symptomology. Second, our finding that dissociation and thought control partly mediate the relationship between mind-wandering and depression is consistent with prior research examining how these factors mediate mind-wandering and other outcomes (i.e., negative affect and physical health). For example, studies show that dissociation mediates the relationship between depression and sleep difficulties (Vannikov-Lugassi & Soffer-Dudek, 2018), and that a perceived inability to control thoughts is associated with greater mind-wandering and negative affect (He et al., 2019). Our findings build on this research by showing that the relationship between dissociation, especially depersonalisation/derealisation and depression, is affected by people's tendency to mind-wander. Whereas previous research examined people's perceived abilities to control thoughts, we demonstrate that worry and self-critical punishment influence the relationship between mind-wandering and depression.

Our findings highlight the roles that meta-cognitive beliefs and maladaptive cognitive strategies play in the mind-wandering and depression relationship. When people mind-wander, their activated meta-cognitive beliefs about their thoughts cause distress. For example, people with beliefs about the uncontrollability of thoughts may think "If I don't stop my mind from wandering, I will lose control of my thoughts and won't be able to focus on anything". Similarly, for a lack of cognitive confidence, people might think "My thoughts keep drifting, and I can't think clearly to make a decision" (Wells & Matthews, 1994; 1996). In response, people with tendencies to avoid negative thoughts and emotions might attempt to suppress, control or depersonalise from the distress. However, these strategies can increase the frequency of mind-wandering and negative thought patterns, consequently perpetuating distress (the rebound effect; Wegner, 1987). Thus, mind-wandering may contribute to depression through ineffective attempts to manage distressing thoughts and emotions.

Exploratory Mediation: Mediation Effect of Trauma Intrusions on the Mind-wandering and Depression Relationship

Recall our exploratory aim to determine if trauma intrusions mediated the relationship between mind-wandering and depression. We entered trauma intrusion scores as a mediator, with mind-wandering scores as the predictor and depression scores as the outcome variable. The direct effect of mind-wandering on depression ($\beta = 0.14$, 95% CI: 0.115 – 0.169), and the indirect effect of mind-wandering on depression through trauma intrusions ($\beta = 0.06$, 95% CI: 0.046 – 0.080) were significant, with trauma intrusions explaining 30.35% of the variance. As predicted, these data suggest that experiencing intrusive traumatic images partially mediates the relationship between mind-wandering and depression.

Our finding converges with studies showing that mind-wandering is associated with trauma intrusions (Brosowsky et al., 2022) and that depressive symptoms are likely maintained with intrusive imagery in people with depression (Patel et al., 2007). Our results extend this research by showing that people who mind-wander more frequently experience greater depression symptoms, partly because of their trauma intrusions.

These findings have clinical implications. For example, interventions that promote acceptance of mind-wandering (e.g. acceptance and commitment therapy), while addressing maladaptive meta-cognitive beliefs (e.g., meta-cognitive therapy), may help people reduce avoidance of the negative thoughts associated with mind-wandering in depression. Specifically, meta-cognitive behaviour therapies that challenge beliefs about thoughts being uncontrollable may help people recognise and accept that mind-wandering is a normal cognitive process rather than a threat. This perspective shift could reduce avoidance of negative thoughts that coincide with maladaptive beliefs (e.g. fixating on inability to control mind-wandering thoughts), facilitating disengagement and potentially lowering the risk of worsening depression symptoms. Moreover, depression treatments that target avoidant strategies (dissociation, thought suppression and thought control) may help people develop cognitive flexibility, typically impaired in people with depression, enabling them to recognise and disengage from negative thinking patterns arising during mind-wandering (e.g., Zheng et al., 2024). This ability to shift away from distressing thoughts could reduce ruminative cycles, ultimately decreasing depression persistence.

Our study has limitations. First, our rumination measure showed poor internal consistency (r = .49), suggesting it was an unreliable rumination measure. This internal consistency might explain why, contrary to previous research and our predictions, we did not find evidence that rumination influenced the relationship between mind-wandering and depression. Second, we captured people's tendencies to mind-wander and engage in negative thinking patterns, not their mind-wandering *content*. Consequently, while we linked mind-wandering to depression through negative thinking patterns, we cannot conclude that participants mind-wandered with negative content, causing greater depression. Future research that captures mind-wandering content might help determine if it is avoidance of negative content or the belief that mind-wandering is uncontrollable that most contributes to people's depression symptomology, which would enable more targeted interventions. Third, we did not measure meta-awareness to determine if the avoidant-cognitive strategies were related to people's self-reported meta-awareness of their mind-wandering. Future research might include a mind-wandering protocol that uses thought probes during a low-demand task to assess self-report mind-wandering and meta-awareness. Comparing people's cognitive strategies and meta-cognitive beliefs with their mind-wandering content could clarify the causal link between these processes, mind-wandering and depression. Additionally, exploring the different avoidant-cognitive strategy types, and their relationship with depression severity and mind-wandering over time, would clarify the mechanisms underpinning the relationship between mind-wandering and depression. Finally, we used a single measure of trait mind-wandering—the Cognitive Failures Questionnaire—which captures the frequency of cognitive lapses, one indicator of mind-wandering, over time. Future research could strengthen reliability of results by using a composite of trait mind-wandering measures (e.g. cognitive failures questionnaire, the daydream frequency scale, the mindfulness awareness and attention scale) to capture a broader range of trait mind-wandering indicators such as task unrelated thoughts and mind-wandering tendencies.

Conclusion

We examined the mediating effects of negative thinking patterns (meta-cognitive beliefs and rumination) and cognitive strategies (dissociation, thought suppression and thought control) in the relationship between mind-wandering and depression. Participants' mind-wandering tendency increased depression symptomology partly through (1) beliefs that their thinking was uncontrollable and dangerous, and their lack of confidence in their cognitive ability, and (2) avoidant-cognitive strategies (dissociation—depersonalisation/derealisation; thought suppression; thought control—worry and punishment). These avoidant-cognitive strategies may reduce people's awareness of, and impair access to, negative thinking patterns generated by maladaptive beliefs, thus maintaining depression symptom severity. We found no evidence supporting the role of rumination in the relationship between mind-wandering and depression. Future research comparing self-reported probe-caught mind-wandering and meta-awareness with avoidant-cognitive strategies and meta-cognitive beliefs might help clarify the relationship between mind-wandering and depression.

Chapter 4: The Cost of Being Absent: Is Meta-Awareness of Mind-Wandering Related to Depression Symptom Severity, Rumination Tendencies and Trauma Intrusions?[6]

Author contributions: I developed the study design with the guidance of MKTT. I collected the data with some assistance, cleaned the data for analysis and performed the data analysis and interpretation. I drafted the manuscript and MKTT provided critical revisions.

Abstract

Background: Deng et al. (2014) reported that depression symptom severity is negatively associated with dispositional mindfulness and importantly, positively associated with zone-outs (mind-wandering without meta-awareness). We replicated and extended their study by exploring possible explanations for these relationships, and by also investigating whether mind-wandering is related to (1) trait rumination subtype—brooding, depressive or reflective, and (2) trauma intrusions—a hallmark PTSD symptom, since both rumination and trauma intrusions strongly correlate with depression. We also explored if dispositional mindfulness—the opposing construct of mind-wandering—mediated these relationships. Method: Two hundred participants completed dispositional mindfulness and depression severity measures, counterbalanced with the SART indexing behavioural mind-wandering (target-error frequency), subjective mind-wandering and meta-awareness (thought probe responses), then rumination style and trauma intrusion frequency measures. Results: Depression scores positively correlated with mind-wandering with and without awareness and with SART target-error rates, and negatively correlated with dispositional mindfulness. Further, the trait brooding positively correlated with mind-wandering without meta-awareness. Dispositional mindfulness mediated the relationships between brooding and depression, *and* depression and mind-wandering, and also negatively correlated with trauma

[6] Nayda, D. M., & Takarangi, M. K. (2021). The cost of being absent: Is meta-awareness of mind-wandering related to depression symptom severity, rumination tendencies and trauma intrusions? *Journal of Affective Disorders*, *292*, 131–138.

intrusion frequency. Limitations: Limitations include measurement and mind-wandering definitions and inability to make causal claims. Conclusions: People experiencing greater depression symptomology mind-wandered more often. People with a greater trait tendency towards brooding and more frequent trauma intrusions also mind-wandered more often. These results point to potential harmful effects of mind-wandering through people's reduced propensity to be mindful, facilitating a negative self-referenced cognitive loop that may maintain or increase depression.

Introduction

Have you ever reached the end of a page you've been reading and wondered: "What have I just read?" only to realize you were thinking about something entirely unrelated? This attention shift away from performing a task towards a thought, image or memory is an example of mind-wandering (Smallwood & Schooler, 2006). Mind-wandering—an opposing construct of mindfulness which is being present moment focus—can occur spontaneously and with or without our notice—termed "meta-awareness." Being "meta-aware" of mind-wandering appears intuitively helpful; noticing when our mind has shifted enables us to re-focus our attention back to the primary task (e.g., reading). Conversely, lacking meta-awareness could be harmful to psychological well-being if, for example, our mind wanders to negative content (e.g., an unresolved argument), because we cannot deliberately refocus.

We know that mind-wandering is positively associated with negative mood and dysphoria—a persistent negative mood (see Murphy et al., 2013; Hoffmann et al., 2016). Indeed, Deng et al. (2014) reported that mind-wandering without meta-awareness is associated with depression symptom severity. Perhaps people mind-wander more about their potential depression, which draws their attention to their depressive symptoms, a concern that becomes more pertinent than focusing on the task. Another possibility is that rumination is a critical part of the depression and mind-wandering relationship; for example, people who have greater depression symptoms and have a tendency to ruminate, mind-wander more often. (Nolen-Hoeksema, 2000; Nolen-Hoeksema & Morrow, 1993; Nolen-Hoeksema et al., 1993). The potential harm of mind-wandering without meta-awareness becomes particularly important if attention spontaneously shifts to a trauma intrusion—a hallmark symptom of Post-Traumatic Stress Disorder (PTSD), which is highly co-morbid with depression (Barnes, 2017). In the present study we sought to examine these potential explanations for the relationship between mind-wandering, meta-awareness and depression, by replicating and extending Deng et al.'s study.

According to the current concerns hypothesis, people mind-wander when a salient internal goal or desire—such as planning to collect the children on time—outweighs the importance of the task they are currently performing, particularly when that task is well practiced (e.g., driving; Klinger et al., 1973). Put simply, people's attention shifts away from the external task towards resolving the more salient internal goal or desire. Extensive experimental research supports this hypothesis: mind-wandering enhances creative problem solving, planning and anticipating uncompleted personal goals, such as deciding when and how to ask for a pay rise, or visualizing a future holiday (see Klinger, 2009).

However, sometimes people's salient concerns can be negative, such as financial distress. In these situations, mind-wandering can be adaptive when it involves generating potential solutions—a type of productive worry (MacLeod, 2019) or reflective rumination (Verhaeghen et al., 2014)—but maladaptive when it leads to mood deterioration (Poerio et al., 2013). Indeed, dysphoria is characterized by elevated levels of negative current concerns (Ruehlman, 1985; Salmela-Aro & Nurmi, 1996), and people with depression have increased access to self-referenced cognitions about their future or past—rumination, which could act as unresolved current concerns.

People's meta-awareness of their thoughts and feelings during mind-wandering may be critical to understanding when and how mind-wandering becomes harmful. More specifically, when meta-awareness is present we know that our focus has shifted to a salient concern. We can then plausibly decide to either re-focus our thoughts back on-task or persist with the current concerns. But when meta-awareness is absent, our negative thoughts and salient concerns go unchecked, preventing the ability to challenge or distract ourselves from these thoughts. It is therefore possible that if we are ruminating on negative content without meta-awareness, the negative thoughts persist and our mood continues to deteriorate, contributing to overall greater depression symptom severity. Put simply, lacking meta-awareness could be harmful to psychological well-being, for example by encouraging ruminative thought about negative content.

To our knowledge, only one study has investigated the relationship between meta-awareness of mind-wandering and depression. In Deng et al. (2014), 23 healthy students completed the Beck Depression Inventory (BDI) and a trait mindfulness scale (Mindful Attention and Awareness Scale; MAAS), then completed a 16-block SART. At the end of each block a thought probe appeared ("did you focus on the task just now" yes/no – if no, then "were you aware that you did not pay attention to your task just now? yes/no). Responses were coded as either: a) on-task, b) tune-out (mind-wandering with meta-awareness) or c) zone-out (mind-wandering without meta-awareness). Deng et al. found that both zone-out and tune-out rates were positively and moderately correlated with BDI scores, though only the correlation with zone-outs was statistically significant. They concluded that the more severe the participant's depressive symptoms, the less meta-aware participants were of their mind-wandering; perhaps mind-wandering without meta-awareness initiates a process that results in negative mood. But an alternative possibility is that reporting on depression symptoms before the mind-wandering task primed participants to activate a depression mindset and/or prompted a more negative mood, rendering this negative mood a more salient current concern than the SART. We know that activating a specific mindset directs subsequent thoughts to be congruent with that mindset (see: Gollwitzer et al., 1990; Gollwitzer & Kinney, 1989; Oyserman, 2009). Thus, whilst performing the SART, participants' attention may have shifted towards resolving any depressive symptoms they reported, ultimately leading to greater mind-wandering.

To explore our hypothesized explanations for the relationship between mind-wandering, meta-awareness and depression, we adapted Deng et al.'s (2014) method to address limitations: we recruited a larger sample and counterbalanced presentation of the BDI and the SART. We also measured participants' confidence in their self-reported responses, to explore whether confidence differed depending on whether participants were on-task or mind-wandering. We expected that depression symptom severity would be positively correlated with mind-wandering; specifically, both with and without meta-awareness. We also had subsidiary hypotheses relating to our proposed explanation for this relationship. First, if negative mind-wandering initiates a process that results in negative mood (Poerio et al., 2013), and rumination is associated with depression, it is possible that trait rumination may also be associated with increased mind-wandering. This positive relationship could point toward a mechanism that results in greater depression severity. Since trait rumination is comprised of three related thinking styles: depression related rumination; brooding—passive and judgemental pondering of one's mood, and reflective rumination—contemplative, intentional pondering of one's mood with a focus on problem solving (Nolen-Hoeksema, 2000), we investigated whether one style is more strongly related to mind-wandering and depression. Second, we know that trauma intrusions are positively related to mind-wandering (e.g. Berntsen et al., 2015) and sometimes experienced without meta-awareness (Takarangi et al., 2014). Further, PTSD is often comorbid with depression (see Elhai et al., 2008). We therefore expected that a participant's trauma intrusion experience would be positively correlated with mind-wandering, both with and without meta-awareness.

Method

Participants

We used Schönbrodt and Perugini's (2013) calculations to determine that a sample size of 152 participants is the point of stability for a correlation effect size of $r = .38$ (r-to-z =.40), to remain within a .15 half-width Corridor of Stability range (here, rs = .245-.501), with 95% confidence (for preregistration see: https://osf.io/y6geq). We initially recruited 158 participants from the Flinders University student pool and the wider community, for credit or a nominal payment of $15. We excluded four participants for failing to follow instructions, leaving a usable sample of 154. However, we did not originally power for comparing correlations across conditions, so we collected an additional 46 participants to increase our sample to 200 and registered this amendment on the Open Science Framework https://osf.io/dmq3s)[1]. The participants were predominantly female (72.5%), mean age 24.81 years (SD = 9.00), who identified as Caucasian or White (30.5%) and Australian (26.0%); the remainder as Chinese/Asian (20.0%), English/European (13.5%), Indian, (5.0%) African (3.0%), and "other" (2.0%).

Measures

The *Beck Depression Inventory-II* (BDI-II; Beck et al., 1996; see Appendix I) is a self-report, 21-item measure of participants' depression symptom severity experienced over the previous two weeks. Items are rated on a 4-point scale, for example, people rate sadness by selecting one of the following scores: 0 (*I do not feel sad*) to 3 (*I am so sad or unhappy that I can't stand it*). Cut-off score guidelines are used to evaluate depression severity; minimal (0–13), mild (14-19), moderate (20-28), and severe (29-63). The BDI-II has high internal consistency (in our sample, $\alpha = .93$), and test-retest reliability ($r = .60$; Beck et al., 1996).

The *Mindful Attention and Awareness Scale* (MAAS; Brown & Ryan, 2003; see Appendix J) is a 15-item self-report measure of participants' dispositional mindfulness—the propensity to stay focused in the present moment—using a 6-point rating scale. Lower scores reflect greater attention lapses—an indicator of mind-wandering. Participants rate items such as "I find myself doing things without paying attention" from 1 (*Almost always*) to 6 (*Almost never*). The MAAS negatively correlates with mind-wandering scales such as the Daydream Frequency Scale ($r = -.37$, $p < .01$; Stawarczyk et al., 2012) and SART errors ($r = -.23$, $p < .05$; Mrazek et al., 2012), demonstrating that mind-wandering is an opposing construct to mindfulness, further supporting lower scores as a valid indicator of mind-wandering. The MAAS has high internal consistency (our sample, $\alpha = .85$).

The *Ruminative Responses Scale* (RRS; Nolan-Hoeksema et al., 1999; see Appendix K) is a 22-item measure of participants' tendency to ruminate across three related rumination styles— depression (12 items), brooding (5 items) and self-reflection (5 items)—using a 4-point rating scale. For example, participants rate how frequently they "Think about how hard it is to concentrate" (depression item); "What am I doing to deserve this" (brooding item); and "Go someplace alone to think about your feelings" (reflection item)—from 1 (*Almost never*) to 4 (*Almost always*). Larger scores indicate greater rumination tendencies. The RRS has high internal consistency (our sample, $\alpha = .93$) and test-retest reliability ($r = .67$; Treynor et al., 2003).

The *Posttraumatic Checklist 5* (PCL-5; Weathers et al., 2013; see Appendix H) is a 20-item self-report measure of PTSD symptoms experienced over the previous month. Participants describe their worst traumatic experience, and with this experience in mind, rate how much they are bothered by symptoms of re-experiencing *trauma intrusions* (e.g., "Repeated, disturbing *memories thoughts or images* of a stressful from the past?")[7], avoidance (e.g., avoiding memories, thoughts, or feelings related to the stressful experience), cognition and mood change (e.g., trouble remembering important parts of the stressful experience), and arousal (e.g., being "superalert" or watchful or on guard), from 0 (*Not at all*) to 4 (*Extremely*). Higher scores indicate greater symptom severity. We found excellent internal consistency ($\alpha = .94$). The PCL-5 also has strong test-retest reliability ($r = .82$; Blevins et al., 2015).

The *Sustained Attention to Response Task* (SART; see Deng et al., 2014) is a behavioural measure of mind-wandering. Consistent with Deng et al., we presented digits ranging from 0 to 9 on a computer screen. Participants responded with a key press to 427 non-target stimuli (0-2, 4-9) but withheld their response to the 53 target stimuli (3)[8]. The stimuli appeared in 16 blocks of varying lengths (15-45 trials), with target presentation distributed on a minimum of 1 and maximum of 5 occasions per block. Each stimulus appeared for 750 ms in font sizes between 48 and 120, with an inter-stimulus interval of 1250 ms. The blocks appeared in a random order with a thought probe at the end of each block to measure participants' subjective mind-wandering. Each probe asked the participant: "Was your attention focused on the task just now?". Participants responded yes or no and then rated their level of confidence in their response on a 5-point scale ranging from 0 (*Not at all confident*) to 4 (*Extremely confident*). If the participant had responded "no" to the first question, they were then asked: "Were you aware that your attention was not focused on the task just now?". The participant responded either: "Yes, I was aware BEFORE you asked me" or "No, I was NOT aware UNTIL you asked me". We used responses to this question to classify participants' mind-wandering experience as either a *tune-out* (mind-wandering with

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[7] Since intrusions were our variable of interest, we do not report data on the other subscales.
[8] Due to a coding error, our participants saw 53 targets (11.04% of trials) rather than the intended 52 targets (10.8%) of trials presented in the original Deng et al. procedure.

awareness) or *zone-out* (mind-wandering without awareness; Christoff et al., 2009; Deng et al., 2014; Smallwood et al., 2008a).

Procedure

We told participants we were investigating how certain cognitive process, such as thinking and attention, influence people's reactions to emotional events. After providing consent, participants commenced the study on 20" Apple Mac computers. In Phase 1, consistent with Deng et al. (2014), participants completed the BDI-II, MAAS and SART. However, we randomly assigned participants to one of two conditions: BDI-Before and BDI-After, depending on whether the depression measure (BDI) and MAAS was given before or after the mind-wandering measure (SART). Next participants completed Phase 2, an extension to the Deng et al. (2014) procedure, by completing the PCL-5 to measure PTSD symptoms in relation to their described traumatic event, then the RRS to measure rumination tendency and subtypes. At the conclusion of Phase 2, we fully debriefed participants.

Results

Following Deng et al. (2014), we measured behavioural mind-wandering as participants' average SART target-error rate, subjective mind-wandering as participants' self-reported tune-out and zone-out response rates, and dispositional mindfulness as total MAAS score, where lower scores indicated greater attention lapses associated with mind-wandering (see Mrazek et al., 2012). Descriptive statistics for our key measures appear in Table 4.1.

Table 4.1

Means and Standard Deviations for Mind-Wandering, Depression, Rumination and Trauma Intrusions (n = 200)

	Range	*Mean*	*SD*
Target-error	0-34	14.28	8.17
On-task reports	0-16	13.04	2.87
Confidence on-task	1-5	3.71	0.76
Off-task reports	0-16	2.96	2.86
Confidence off-task	1-5	2.70	1.04
Tune-out	0-16	2.52	2.56
Zone-out	0-8	0.48	0.98
MAAS	21-81	53.71	10.64
BDI	0-49	16.40	11,37
RRS	24-85	48.58	13.24
PCL-5B trauma intrusions	0-20	6.99	4.76

We first examined the relationship between our behavioural and subjective mind-wandering measures, as well as participants' confidence in their subjective mind-wandering reports (see Table 4.2). We found significant, small correlations between behavioural and self-report mind-wandering measures. Specifically, participants who committed more SART target-errors also reported tuning and zoning out more and being on-task less. In addition, the lower the participants' dispositional mindfulness (MAAS scores), the more they reported tuning-out and zoning-out and the less being on-task. These results indicate congruence between self-reported, and behavioural mind-wandering measures, with mind-wandering as an opposing construct to mindfulness—consistent with Mrazek et al. (2012).

We expected target-error rate to negatively correlate with on-task confidence and positively correlate with off-task confidence if participants were confidently monitoring their cognitions. But we found that participants' on-task *and* off-task confidence scores negatively correlated with target-error rate, suggesting that as participants' confidence increased their target-error rate decreased, regardless of their confidence at being on or off-task. Also, as participants' on-task confidence increased, their off-task confidence also increased ($r = .59$, $p < .001$) suggesting some participants were more confident in their judgements overall. Interestingly, participants were significantly more confident when judging themselves as being on-task than off-task ($t(134.92) = 7.91$, $p < .001$, $d = 0.99$). Since participants rated confidence before they were asked about their meta-awareness, perhaps they were not as confident that their mind had wandered until they were asked about their awareness. For example, if the participant had zoned-out they might know they were not *on-task* but not feel confident about being *off-task* until we drew their attention towards awareness.

Table 4.2

Correlations [95% CI] Between Different Mind-Wandering Measures and Depression (n = 200)

	On-task rate	*Tune-out rate*	*Zone-out rate*	*MAAS*	*BDI*	*Confidence Off-task*	*Confidence On-task*
Target-error Rate	-.29*** [-.41, -16]	.22** [.08, .35]	.26*** [.13, .38]	-.23** [-.36, -.09]	.20** [.06, .33]	-.21* [-.34, -.07]	-.50*** [-.60, -.39]
On-task rate		-.93** [-.95, -.91]	-.46*** [-.56, -.34]	.31*** [.18, .43]	-.25*** [-.38, -.11]	-.23** [-.36, -.09]	.18* [.04, .31]
Tune-out rate			.12 [-.02, .25]	-.27*** [-.39, -.14]	.19** [32, .05]	.23** [.09, .36]	-.15* [-.28, -.01]
Zone-out rate				-.21** [-.34, -.07]	.21** [.07, .34]	.05 [-.09, .02]	-.11 [-.25, .03]
MAAS					-.50*** [-.60, -.39]	.07 [-.07, .21]	.24** [.11, .37]

* Correlation is significant at $p < .05$, ** Correlation is significant at $p < .01$, *** Correlation is significant at $p < .001$

Recall our main aim was to investigate the relationship between meta-awareness of mind-wandering and depression. Like Deng et al. (2014), we found a significant, yet small, positive correlation between BDI scores—depression—and zone-out rate and a significant moderate, negative correlation between BDI and MAAS—mindfulness tendency (Table 4.2). We also found a significant small positive correlation between BDI scores and tune-out rate and target-error rate.

We wondered whether the positive relationship between depression and mind-wandering occurred due to a priming effect: presenting the BDI before the SART, as in Deng et al. (2014), increased the participants' mind-wandering by drawing attention towards symptoms. To test this possibility, we split the data according to the two conditions—BDI-Before and BDI-After—then compared tune-out, on-task and zone-out rates across conditions using independent samples t-tests (see Table 4.3). We found participants' tune-out rate was significantly higher, and on-task rate significantly lower, in the BDI-Before compared to BDI-After condition, suggesting that the BDI may prime participants to reflect on their depression and consequently mind-wander with awareness more often. Target-error and zone-out rates did not significantly differ, suggesting BDI presentation did not affect behavioural mind-wandering or zone-outs.

Table 4.3

Comparisons of Means (Standard Deviations) of On-Task and Mind-Wandering Rates Between Conditions

	BDI -Before		BDI-After					
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*	*d*
Tune-outs	100	3.07 (2.68)	100	1.96 (2.38)	3.10	198	.00	0.44
Zone-outs	100	0.43 (0.79)	100	0.53 (1.13)	-0.72	198	.47	-0.10
On-task rate	100	12.54 (2.89)	100	13.54 (2.77)	-2.50	198	.01	-0.35
Target-error rate	100	13.81 (8.71)	100	14.74 (7.60)	-0.81	198	.42	-0.11

We then reran our original correlations with the data split (Table 4.4). We found that BDI scores were significantly positively correlated with mind-wandering (zone-outs, tune-outs and target-error rates) and negatively correlated with being on-task *only* in the BDI-Before condition. In the BDI-After condition the relationships between BDI scores with zone-out and target-error rates were smaller and no longer significant. However, when we statistically compared the size of the correlation coefficients, the difference between conditions was not significant (see Jonason et al., 2020). This result suggests presentation order did not affect mind-wandering, either with or without meta-awareness, and thus does not support our priming explanation.

Table 4.4

Correlations [95% CI] Between BDI Scores and Mind-Wandering Rates for BDI Presented Before and After the SART

	BDI-Before		*BDI-After*			
	n	*r*	*n*	*r*	*z*	*p*
Target-error	100	.25* [.05, .42]	100	.16 [-.04, .34]	0.66	.51
On-task	100	-.26** [-.43, -.07]	100	-.22* [-.40, -.03]	0.30	.77
Tune-out	100	.19* [-.00, .38]	100	.18 [-.02, .36]	0.07	.94
Zone-out	100	.28** [.08, .45]	100	.17 [-.03, .36]	0.81	.42

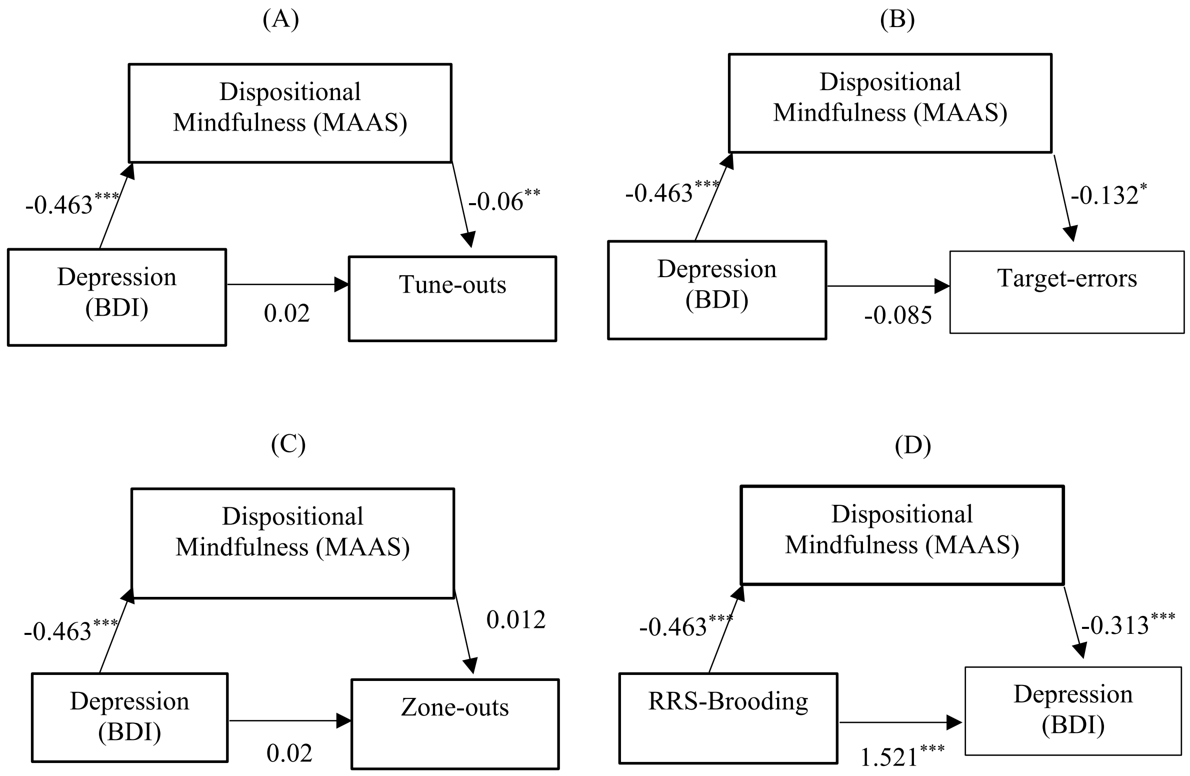
* Correlation is significant at $p < .05$, ** Correlation is significant at $p < .0$, *** Correlation is significant at $p < .001$

Overall, these data suggest that as participants' depression increases, their tendency to focus on the present moment decreases, and mind-wandering—both with and without meta-awareness—increases, regardless of BDI presentation. We wondered then if depression decreases dispositional mindfulness, and hence participants become less current-moment focused resulting, at least partially, in greater mind-wandering. Put simply, does dispositional mindfulness mediate the relationship between depression and mind-wandering?

To investigate, we ran mediations using the PROCESS macro in SPSS 27 with bias-corrected bootstrapping (5000 samples) We entered BDI as the predictor variable, MAAS scores as the mediator, and tune-outs, zone-outs and target-errors respectively as outcome variables.

Figure 4.1.

Dispositional Mindfulness Mediated the Effect of Depression on Tune-Out (A), Target-Error Frequency (B), and Brooding on Depression (D), but not the Effect of Depression on Zone-Outs (C)



*Correlation is significant at p < .05, **Correlation is significant at p < .01, ***Correlation is significant at p < .001

First, the mediation analyses showed MAAS scores fully mediated the relationship between BDI and tune-outs (see Figure 4.1A). The direct effect between BDI and tune-outs was not significant (95% CI: -0.02 - 0.05, p = .33). However, the indirect effect through MAAS scores was significant (95% CI: 0.01 – 0.05). BDI significantly predicted MAAS scores and MAAS scores significantly predicted tune-outs, suggesting as depression increases dispositional mindfulness, people become less current-moment focused, which results in more self-reported tune-outs. Similarly, MAAS scores fully mediated the relationship between BDI and target-errors (Figure 4.1B). The direct effect between BDI and target-errors was not significant (95% CI: -0.03 – 0.20) while the indirect effect was significant (95% CI: 0.002 – 0.131). BDI significantly predicted MAAS scores and MASS scores significantly predicted target-errors, suggesting that as depression decreases mindfulness, people become less focused and commit more target-errors. Together, the results suggest that participants with greater depression may mind-wander with meta-awareness because they tend to be less mindful. There was no significant direct effect of BDI and zone-outs (95% CI: -0.001 - 0.026) nor an indirect effect through MAAS (95% CI: -0.002 - 0.013), BDI significantly predicted MAAS scores but MAAS scores did not significantly predict zone-outs (Figure 4.1C)

Recall our additional interest in whether mind-wandering is related to trait rumination and specifically, rumination subtypes. We ran correlations between participants' dispositional mindfulness (MAAS) and overall rumination (RRS) with their subjective reports of zone-outs, tune-outs, and target-error rates (Table 4.5). Consistent with expectations, we found a significant small negative correlation between mean MAAS scores and all mean RRS scores—total and subscales: depression, brooding and reflection— suggesting participants' dispositional mindfulness is negatively related to their tendency to ruminate. When we examined the relationship between rumination and our subjective and behavioural measures of mind-wandering, we found that all three subtypes—brooding, depression and reflection—positively correlated with tune-out rate and being off-task, and negatively correlated with on-task rate, indicating all rumination styles are related to subjective mind-wandering (Table 4.5). Importantly, only *brooding* significantly positively correlated with target-error and zone-out rates.

Table 4.5

Correlations [95% CI] Between Mind-Wandering, Depression, Rumination and Trauma Intrusion (n = 200)

	Target-error rate	*On-task rate*	*Off-task*	*Tune-out rate*	*Zone-out rate*	*MAAS*	*BDI*	*RRS*	*PCL Total*
BDI-Total	.20**	-.25**	.24**	.19**	.21**	-.50***			
	[.06, .33]	[-37, -.12]	[.09, .38]	[.05, .32]	[.07, .33]	[-.60, -.39]			
RRS-Total	.14*	-.19**	.19**	.18*	.09	-.47***	.66***		
	[.01, .27]	[-.32, -.05]	[.05, .32]	[.04, .31]	[-.05, .23]	[-.57, -.35]	[.57, .73]		
RRS-Depression	.11	-.16*	.16*	.16*	.07	-.49**	.69***		
	[-.03, .25]	[-.29, -.02]	[.02, .29]	[.02, .29]	[-.07, .21]	[-.59, .38]	[.61, .76]		
RRS-Brooding	.18**	-.20**	.20**	.17*	.14*	-.43***	.60***		
	[04, .31]	[-.33, -.06]	[.06, .33]	[.03, .30]	[.00, .27]	[-.54, -.31]	[.61, .76]		
RRS-Reflection	.11	-.15*	.14*	.15*	.03	-.23**	.32**		
	[-.03, .25]	[-.29, -.01]	[.01, .27]	[.01, .28]	[-.11, .17]	[-.36, -.09]	[.19, .44]		
PCL-5B Trauma Intrusions	.09	-.14*	.14*	.11	.12	-.28***	.47**	.52***	.86***
	[-.05, .23]	[.27 ,.01]	[.01, .27]	[.03, .24]	[-.02, .26]	[-.4, -.15]	[.35, .57]	[.41,.61]	[.82, .89]

* Correlation is significant at $p < .05$, ** Correlation is significant at $p < .01$, *** Correlation is significant at $p < .001$

Since negative thoughts lead to dysphoria and depression (see Gotlib & Joormann, 2010), it follows that a person with greater tendency to ruminate during mind-wandering, particularly if they have a lower propensity to focus on the current moment—lower dispositional mindfulness, will also report greater depression. Of novel interest is that people with a greater tendency to brood (e.g. “why are others happy and I’m not) who judge those thoughts negatively (e.g. “Thinking this way is bad”) are doing so without meta-awareness, potentially maintaining their depression symptomology. It is possible then that participants’ dispositional mindfulness may mediate the relationship between brooding and depression.

To test this possibility, we reran regression mediations using Process with RRS-Brooding scores entered as the predictor variable, BDI scores as the outcome variable and MAAS scores as the mediator (Figure 4.1D). The analysis showed MAAS scores partially mediated the relationship between RRS-Brooding and BDI. The direct effect of RRS-Brooding on BDI was significant (95% CI: 1.137 – 1.905). Similarly, the indirect effect through MAAS was significant (95% CI: 0.210 – 0.650). RRS-Brooding significantly predicted MAAS scores and MAAS scores significantly predicted BDI. Thus, as brooding decreases dispositional mindfulness, people may become less current-moment focused, which then results in greater depression.

We were also interested in the relationship between people’s mind-wandering behaviour and trauma intrusions (Table 4.5). We found small, yet significant negative correlations between participants’ MAAS and re-experiencing symptoms scores. This pattern indicates the lower the participants’ dispositional mindfulness, the greater their reported trauma intrusions. We also found trauma intrusions negatively correlated with on-task rate and positively correlated off-task rate. Thus, as dispositional mindfulness decreased, reported trauma intrusion and subjective off-task rate increased while subjective on-task rate decreased. We found no empirical support for relationships between trauma intrusions with either subjective or objective mind-wandering measures.

These exploratory results suggest that people who experience more trauma intrusions were less focused on the task, but not likely to report mind-wandering either with or without awareness. One explanation is the relationship between off-task reports and trauma intrusions is confounded by participants' depression symptoms, since PTSD and depression are comorbid. We tested this explanation by controlling for depression in a partial correlation and found the relationship between trauma intrusions and being off-task was no longer significant (*r*s between .01 and .04).

Discussion

We investigated whether people's depression symptom severity is related to their dispositional mindfulness, and their mind-wandering—using self-report and behavioural measures—during a SART task. We found a significant positive correlation between depression symptom severity with self-reported zone-outs, and tunes-outs. These data indicate that people with greater depression symptomology mind-wander more frequently both with and without meta-awareness. Further, people with greater depression report mind-wander with awareness more often, through a decreased propensity to be in the current moment—mindfulness tendency. However, we did not find empirical evidence for the idea that participants' attention was drawn to their depression symptoms, priming them to mind-wander about their depression during the latter mind-wandering task. In support of our first subsidiary hypothesis, we found that all three subtypes of rumination are related to mind-wandering and depression; but only participants' trait tendency to *brood* is positively correlated with both behavioural and subjective mind-wandering. Finally, in line with our second subsidiary hypothesis, trauma intrusions significantly negatively correlated with dispositional mindfulness, but not behavioural or subjective mind-wandering. In addition, we found that participants were more off-task if they had a lower tendency to focus on current moment and also experienced more trauma intrusions. Taken together, our findings suggest that as a person’s self-reported mind-wandering frequency increases, both with and without meta-awareness, their depression symptomology increases, and they have a greater trait tendency to brood. In addition, a person’s dispositional mindfulness decreases as their trauma intrusion frequency increases.

Our results are consistent with previous research demonstrating that negative mood, and depression in particular, is related to mind-wandering, but they extend our understanding to include the relationship with mind-wandering without meta-awareness (zone-outs). Specifically, our results suggest that mind-wandering without meta-awareness is potentially harmful due to its relationship with greater depression severity. When we mind-wander without awareness, our ability to deliberately challenge and redirect our negative thoughts is compromised. For people with a greater trait tendency to brood, mind-wandering without awareness may encourage rumination about negative content leading to mood deterioration—as evidenced by elevated depression symptoms.

There are two potential explanations for our lack of evidence supporting our priming idea. On the one hand, perhaps drawing attention to depression symptoms was not a means to trigger a more salient current concern than completing the SART. On the other hand, there may be an effect but we were unable to detect it for the following reasons. First, perhaps the BDI was not a sufficient prime to activate a depression mind-set or increase a negative mood. Second, the presentation of the MAAS was paired with, and followed, the BDI. Completing the MAAS between the depression measure and the SART might have shifted participants’ attention from why they are depressed to why they mind-wander, attenuating the activation of the depression mind-set and/or negative mood. Future research using a mood induction procedure to induce the desired mood could clarify this methodological query.

Our findings support previous research showing that mind-wandering is associated with less effortful state depressive rumination (Hamilton et al., 2011), but uniquely demonstrate that reflection and brooding are also associated with dispositional mindfulness and self-reported state mind-wandering. Importantly, our results point to a cognitive loop of self-referenced negative cognitions, maintaining if not worsening, depressive symptoms. If people's tendency to brood reduces their propensity to focus on the current moment, their depression may worsen. The greater depression may further reduce people's current-moment focus, resulting in greater mind-wandering. If this mind-wandering includes brooding content, the cycle could act to maintain depression particularly if occurring when mind-wandering without awareness.

In addition, our finding that trauma intrusions are positively related to lower dispositional mindfulness, but not to self-reported mind-wandering, suggests that people who experience frequent intrusions may be more familiar with more frequent attention lapses—focus shifts away from tasks, and consequently may have difficulty differentiating a trauma intrusion from mind-wandering. In line with this explanation, clinical evidence demonstrates that war veterans with PTSD perform worse than controls on sustained attention and working memory tasks (Vasterling et al., 2002), indicating a relationship between mind-wandering and PTSD. Importantly, Takarangi et al. (2017) found that following an analogue trauma, participants experienced intrusions both with and without meta-awareness during a reading task, indicating they were mind-wandering—their attention had shifted away from reading. Future research that differentiates trauma intrusions from mind-wandering may could tease out this discrepancy.

Our findings have potential clinical relevance. Common treatments for depression using thought restructuring such as Cognitive Behaviour Therapy (e.g. Nyer et al., 1995) require meta-awareness of thoughts. Our findings suggest that treatment effectiveness for people with greater symptom severity may be attenuated by zoning-out. If people with greater depression symptomology are not able to identify their thought patterns during these more frequent zone-out episodes, then access to these thoughts during therapy may also be restricted. If these patterns contain negative content, as experienced in brooding, it is possible that the depression is exacerbated during zone-outs. Without access to these maladaptive thoughts, treatment effectiveness may be limited to people with milder symptom severity who experience fewer zone-out episodes. Research determining whether thoughts during zone-outs are helpful or harmful will clarify if zone-outs while depressed exacerbate depression symptom severity. Further, identifying methods of accessing zone-out content during therapy may improve treatment effectiveness.

Our research has limitations. First, we used a measure of dispositional mindfulness to indirectly measure participants' trait tendency to mind-wander based on previous research demonstrating mind-wandering and mindfulness are opposing constructs. Future research using scales such as the mind-wandering questionnaire (MWQ; Mrazek et al., 2013) directly measuring trait mind-wandering would clarify if reduced mindfulness, or indeed mind-wandering, mediates the relationship between depression and state mind-wandering. Our research addressed trait but not state rumination. Whilst people may have a greater tendency to brood, we cannot conclude that they have greater access to negative cognitions. By sampling participants' thoughts during their mind-wandering episodes we could determine if state brooding is contributing to the relationship between mind-wandering and depression, specifically the self-referenced negative cognition loop. Thought sampling may also clarify if the shift in attention was due to activating a depressive mindset or a current concern, to give a better understanding of the mind-wandering activation process.

Some researchers contend that mind-wandering and meta-awareness are dynamic processes that can occur on a continuum (e.g., Anderson & Farb, 2020). For example, people can shift focus across multiple tasks, meaning they could be “somewhat” mind-wandering or meta-aware. While we measured mind-wandering both behaviourally and subjectively, and these measures showed a similar pattern, our self-report measures assumed that participants were either completely on-task or off-task and either aware or unaware of their thoughts. Future research that measures mind-wandering and meta-awareness using a Likert scale—from completely aware/on-task to completely unaware/off-task—could address this. In addition, we defined mind-wandering as a spontaneous cognition, but we know people can also intentionally mind-wander (e.g., taking ourselves to our ‘happy place’ when feeling sad; e.g., Seli et al., 2016b). Differentiating between intentional and unintentional mind-wandering may highlight which type of mind-wandering is more unhelpful. Finally, we did not differentiate between Task Unrelated Thoughts (TUTs) and Task-Related Interference (TRI; i.e., thoughts that are task related but not necessarily task focused such as assessing task performance; Stawarczyk et al., 2011). Robison et al. (2019, Study 2) found that when TRIs are not distinguished from TUTs, participants will group TRIs as being ‘on-task’ thus underreporting mind-wandering episodes.

Conclusion

The present study provides insight into the relationship between depression symptom severity and mind-wandering by identifying that people with greater symptom severity mind-wander more, both with and without awareness. In addition, trait brooding has been highlighted as the rumination subtype associated with the relationship. Our results point to a cognitive loop of self-referenced negative cognitions, maintaining if not worsening depressive symptoms, through people’s reduced propensity to focus on the current-moment suggesting a potential harmful effect of mind-wandering. Future research designed to access cognitions during mind-wandering episodes is needed to investigate the role of state rumination style in the mind-wandering, depression relationship. In addition, using a mood induction procedure to manipulate mood state could illuminate direction of the relationship.

Supplementary Materials

Table S1

Means and Standard Deviations for Mind-Wandering, Depression, Rumination and Trauma Intrusions (n =154)

	n	*Range*	*Mean*	*SD*
Target-error	154	0-34	14.10	8.20
On-task rate	154	0-16	13.00	2.80
Confidence On-task	153	1-5	3.72	0.77
Off-task rate	154	0-16	2.99	2.80
Confidence Off-task	114	1-5	2.73	1.04
Tune-out	154	0-16	2.56	2.57
Zone-out	154	0-4	0.46	0.84
MAAS	154	21-81	53.75	10.58
BDI	153	0-49	15.03	10.31
RRS	154	24-85	47.21	12.47
PCL-5B Trauma intrusions	154	0-20	6.40	4.60

Table S2

Correlations [95% CI] Between Different Mind-Wandering Measures and Depression Symptom Severity

	n	*On-task rate*	*Tune-out rate*	*Zone-out rate*	*MAAS*	*BDI*	*Confidence Off-task*	*Confidence On-task*
Target-Error Rate	154	-.24** [-.38,-.08]	.19* [.04, .34]	.18* [.02, .33]	-.28*** [-.24, -.13]	.21** [.05, .36]	-.22* [-.38, -.03]	-.49*** [-.60, -.36]
On-task rate	154		-.95*** [-.97, -.93]	-40*** [-.53, -.26]	.36*** [.21, .49]	-30*** [-.44, -.15]	-.19* [-36, -.003]	.16* [.003, .31]
Tune-out rate	154			.11 [-.05, .26]	-.30*** [-.44, .15]	.24** [.08, .38]	.16 [-.02, .34]	-.14 [-.27, .05]
Zone-out rate	154				-.24** [-.38, -.08]	.24** [.08, .38]	.10 [-.09, .28]	-.11 [-.27, .05]
MAAS	154					-.54*** [-.62, -.38]	.15 [-.01, .30]	.25** [.10, .39]

* Correlation is significant at $p < .05$, ** Correlation is significant at $p < .01$, *** Correlation is significant at $p < .001$

Table S3

Comparisons of Means (Standard Deviations) of On-Task and Mind-Wandering Rates Between Conditions

	BDI-Before		BDI-After					
	n	*M (SD)*	n	*M (SD)*	*t*	*df*	*p*	*d*
Tune-outs	77	3.04 (2.65)	76[9]	2.09 (2.42)	2.31	151	.02	0.35
Zone-outs	77	0.48 (0.84)	76	0.44 (0.85)	0.29	151	.78	0.05
On-task rate	77	12.52 (2.90)	76	13.49 (2.62)	-2.19	151	.03	0.35
Target-error rate	77	13.48 (8.81)	76	14.66 (7.56)	-0.90	151	.37	0.14

Our initial data set (n = 154) showed participants' tune-out rate was significantly higher, and on-task rate significantly lower, in the BDI-Before compared to BDI-After condition, suggesting that the BDI may prime participants to reflect on their depression and consequently mind-wander with awareness more often. Error and zone-out rates did not significantly differ, suggesting BDI presentation did not affect behavioural mind-wandering or zone-outs.

We then reran our original correlations with the data split (Table S4). We found that BDI scores were significantly positively correlated with mind-wandering (zone-outs, tune-outs and target-error rates) and negatively correlated with being on-task *only* in the BDI-Before condition. In the BDI-After condition the relationships between BDI scores with zone-out and target-error rates were smaller and no longer significant. However, when we statistically compared the size of the correlation coefficients, the difference between conditions was not significant (see Jonason et al., 2020).

[9] One participant failed to complete the BDI measure.

Table S4

Correlations [95% CI] Between BDI Scores and Mind-Wandering Rates for BDI Presented Before and After the SART

	BDI-Before	*BDI-After*				
	n	*r*	*n*	*r*	*z*	*p*
Target-Error	77	.25* [.02, .44]	76	.17 [-.06, .38]	0.51	.61
On-task	77	-.34** [.11,.52]	76	-.23* [-.43, .00]	0.73	.51
Tune-out	77	.25* [.02, .44]	76	.22 [-.01, .42]	0.19	.46
Zone-out	77	.38** [.17, .56]	76	.09 [-.14, .31]	1.89	.77

* Correlation is significant at $p < .05$, ** Correlation is significant at $p < .01$, *** Correlation is significant at $p < .001$

Table S5

Correlations [95% CI] Between Mind-Wandering, Depression, Rumination and Trauma Intrusion

	n	*Target-error rate*	*On-task rate*	*Off-task*	*Tune-out rate*	*Zone-out rate*	*MAAS*	*BDI*	*RRS*	*PCL Total*
BDI-Total	153	.21** [.05, .36]	-.30*** [-.44, -.14]	.30*** [.14, .44]	.24** [.09, .39]	.24** [.09, .39]	-.54*** [-.63, -.39]			
RRS- Total	154	.17 [.01, .32]	-.18* [-.33, -.02]	.18* [.02, .33]	.16* [00, .31]	.09 [-.07, .25]	-.45*** [-.57, -.31]	.71** [.62, .78]		
RRS-Depression	154	.13 [-.03, .29]	-.14 [-.30,.02]	.14 [-.02, .29]	.13 [-.03,.28]	.09 [-.07,.24]	-.46*** [.58,.33]	.74*** [.66, .80]		
RRS-Brooding	154	.22** [.06, .37]	-.21* [-.36, -.05]	.21* [.05, .36]	.17* [.02, .32]	.14 [-.01, .29]	-.42*** [-.54, -.28]	.62*** [.51, .71]		
RRS-Reflection	154	.11 [.05,.26]	-.13 [-.28, .03]	.13 [.03,.28]	.14 [.02,.29]	-.01 [-.17,.15]	-.20* [-.35,-. 04]	.33** [.18,.46]		
PCL-5B Trauma Intrusions	154	.04 [-.12,.20]	-.05 [-.21, .11]	.05 [-.11, .21]	.04 [-.12,.20]	.03 [-13, .19]	-.26** [-.40,-.11]	.39** [.25,.52]	.48*** [.34,.59]	.85** [.80,.89]

* Correlation is significant at $p < .05$, ** Correlation is significant at $p < .01$, *** Correlation is significant at $p < .00$

We were also interested in the relationship between people's mind-wandering behaviour and trauma intrusions (Table S5). We found small, yet significant negative correlations between participants' MAAS and re-experiencing symptoms scores. This pattern indicates the less the participants' dispositional mindfulness, the greater their reported trauma intrusions. However, we found no significant correlations between reported trauma intrusions and subjective or behavioural mind-wandering, indicating no relationship between trauma intrusions and state mind-wandering.

Chapter 5: The Role of Negative Cognitions, Dissociation, and Meta-Awareness in the Relationship Between Mind-Wandering and Depression: A Serial Mediation Model

Author contributions: I developed the study design with the guidance of MKTT. I collected the data with some assistance, cleaned the data for analysis and performed the data analysis and interpretation. I drafted the manuscript and MKTT provided critical revisions.

Abstract

Background: Mind-wandering is associated with negative mood and depression. Factors potentially affecting this relationship include negative cognitions (i.e., perseverative thinking and brooding) and meta-awareness (i.e., explicit awareness of thoughts). However, how meta-awareness contributes to the relationship is unclear. Since meta-awareness characteristics (e.g., not being aware of our thoughts) overlap with dissociation, this study investigated a five-chain serial mediation model predicting that more mind-wandering would be related to more negative cognitions (perseverative thinking or brooding), that in turn would be related to greater dissociation, followed by decreased meta-awareness activation—to avoid/detach from the negative cognitions—which leads to increased depression symptomology. Method: 261 crowdsourced participants completed mind-wandering, dissociation, brooding, meta-awareness, and depression measures. We used serial mediation analyses to test the proposed models. Results: Perseverative thinking, brooding, dissociation, and meta-awareness independently mediated the relationship between mind-wandering and depression. Our five-chain serial mediation analyses did not support our proposed model. Instead, a four-chain serial mediation analysis supported a model that predicted mind-wandering with increased negative cognitions that influenced dissociation (amnestic, depersonalisation, absorption) and led to higher depression symptomology.
Limitations: Limitations include meta-awareness and dissociation measurements, recruitment of a non-clinical population and a cross-sectional design. Conclusions: People who mind-

wander with negative content tend to dissociate—rather than lack meta-awareness—by avoiding, detaching from, or become absorbed in thoughts, which leads to greater depression.

Introduction

Mind-wandering—the process of an unconstrained, internally generated thought, memory, or image (Smallwood & Schooler, 2006; 2015; Smallwood, 2013)—is involved in many adaptive functions, such as creativity, prospective planning, and goal setting (Klinger, 2009), while also being associated with poor outcomes such as negative mood and depression (Killingsworth & Gilbert, 2010). This latter relationship may be due, in part, to negative cognitions—e.g., brooding (self-critically pondering a negative mood, e.g., "What am I doing to deserve this?") and perseverative thinking (a pattern of repetitive and intrusive rumination about future or past stressful events, e.g., a recent argument)—that occur during mind-wandering (Ottaviani et al., 2015; Yip et al., 2023). Interestingly, mind-wandering can occur both with and without *meta-awareness*—an intermittent monitoring process that explicitly notices the contents of people's thoughts to ensure they align with current goals (Smallwood & O'Connor, 2011). However, we do not know how meta-awareness of negative mind-wandering content contributes to the relationship between mind-wandering and depression. Our aim here is to investigate possible mechanisms, (i.e., via mediation), that might explain how meta-awareness influences the relationship between mind-wandering, negative cognition tendencies (perseverative thinking/brooding) and depression.

Two dominant theories explain the onset of mind-wandering, First, *executive failure theory* assumes that mind-wandering results from a failure in the control processes necessary to maintain focus on a goal directed task (Kane & McVay, 2012; McVay & Kane, 2010; Smallwood, 2010). Second, *the decoupling hypothesis* assumes that mind-wandering occurs upon when attention decouples from a primary task and is redirected by executive resources toward an unresolved current concern or goal (Smallwood & Schooler, 2006). However, how a person detects the failure in control processes or redirection of resources is still unknown. The answer may lie in understanding how people become meta-aware of when their mind has wandered.

Meta-awareness is the explicit, intermittent, awareness of the processes and contents of consciousness—e.g., thinking, feeling, sensing—in a particular present moment (e.g., see Smallwood & Schooler, 2015). The meta-awareness process can also involve assessing/judging conscious experiences, particularly when faced with competing unresolved goals (Smallwood & Schooler, 2006). For example, when driving home from work, our thoughts may mind-wander to the day's incomplete tasks. We will continue to ponder the incomplete tasks until meta-awareness is activated, the discrepancy between focusing attention on driving or mind-wandering is detected, and a judgement is made about which goal is more important and needs attention.

Why might people tend to be more or less meta-aware during mind-wandering? One explanation may relate to people's tendency to dissociate. Dissociative symptoms—disruptions in consciousness, memory, identity, emotion, perception, behaviour, or self-concept—range from brief and transitory episodes occurring in daily life (e.g., driving home without knowing which route you took) to extremely distressing episodes (e.g., feeling detached from reality; Soffer-Dudek, 2014). Dissociation, present in many psychological disorders including MDD, is multifaceted with three main subcategories: amnestic (e.g., arriving without knowing how); depersonalisation/derealisation (e.g., not recognising yourself in the mirror, or seeing the world through fog); and absorption/imaginative involvement (e.g., being so absorbed in the fictional story that you become unsure whether it actually happened; Carlson & Putnam, 1993). These facets of dissociation have conceptual overlap with episodes of mind-wandering *without* meta-awareness.

When mind-wandering, particularly with negative cognitive behaviours, such as perseverative thinking and/or brooding, people may dissociate to protect against mood deterioration. For example, a person who unintentionally mind-wanders about incomplete tasks may engage in brooding thoughts such as "Why am I so bad at my job?”. On the one hand, someone with a greater tendency to dissociate may detach and/or avoid conscious awareness of negative thoughts (i.e., a type of dissociative amnesia) through reduced meta-awareness activation, such that these negative thoughts proceed undetected for a longer duration. Or perhaps they become so absorbed in their mind-wandering that they experience dissociative absorption and, through meta-aware, they are unable to objectively decide to either redirect their attention back to the primary task or resolve the concern. Without addressing these ongoing distressing thoughts, this person’s depressive symptoms are likely to exacerbate. On the other hand, someone who tends to dissociate less should have greater meta-awareness and therefore should be able to decide to either redirect their attention back to their current goal (e.g., driving), or resolve the concerns related to the negative thoughts (e.g., disagreement with a friend), and consequently experience fewer depressive symptoms.

Indeed, several lines of research support the idea that negative cognitive behaviours, dissociation, and possibly meta-awareness, mediate the relationship between mind-wandering and depressive symptoms. First, we know that negative cognitive behaviours (e.g., brooding) partially mediate the relationship between inattention (e.g., mind-wandering) and depression (Yip et al., 2023), and that people report greater depression symptom severity when engaged in perseverative thinking, compared to mind-wandering without perseverative content (Ottaviani et al., 2015). Second, mind-wandering is positively related to absorption-type dissociation (Vannikov-Lugassi & Soffer-Dudek, 2018), and brooding predicts derealisation dissociation overtime (Vannikov-Lugassi et al., 2021). Third, the relationship between derealisation type dissociation and sleeplessness is moderated by depression (Vannikov-

Lugassi & Soffer-Dudek, 2018). Similarly, we have found that people who report mind-wandering more often also report a greater tendency to ruminate in general (r = .283, p < .001, n = 570), to dissociate (r = .500, n = 570), and be more depressed (r = .461, p < .001, n = 570; Nayda & Takarangi, 2024). We also found rumination partially mediated the relationship between mind-wandering and depression. Finally, and importantly, we know that people who tend to mind-wander without meta-awareness tend to be more depressed (see Nayda & Takarangi, 2021). Together, these studies suggest that negative cognitive behaviours (i.e., rumination, perseverative thinking), dissociation and meta-awareness, are related to both mind-wandering and depression in various ways. However, what we do not know is how these different variables work together while people are mind-wandering to affect their depression symptoms.

Here we aimed to explore whether the relationship between people's dispositional mind-wandering tendencies and depression symptoms is mediated through a series of variables: negative cognitive behaviours (operationalised as brooding and perseverative thinking; PT), dissociation, and meta-awareness. We expected that mind-wandering would be positively associated with the tendency to dissociate, brood, engage in perseverative thinking and depression symptomology, but negatively associated with meta-awareness. To investigate possible mechanisms, we expected a mediation effect of mind-wandering on depression through the tendency to engage in perseverative thinking/brooding; the tendency to dissociate; and through the tendency to be less meta-aware, respectively. Further, we expected a serial mediation effect of mind-wandering on depression through a tendency to engage in negative thinking (PT/brooding) which in turn leads to increased dissociation and a decreased tendency to be meta-aware (serial indirect effect $a_1b_1d_1c_3$).

We tested our hypotheses using a serial mediation for our cross-sectional data. Although mediation analysis is often used with longitudinal designs to establish temporal order and then infer causation (Rizzo et al., 2022), it can also be applied to cross-sectional data when temporal order is theoretically justified (Wiedermann & Von Eye., 2015; Yoshida et al., 2023). Although the mind-wandering and depression relationship can be bidirectional (e.g., Welhaf et al., 2024), we argue a reverse serial pathway—where depression leads to decreased meta-awareness activation, which increases dissociation, and in turn leads to increased negative thought patterns like brooding/perseverative thinking, and then increased mind-wandering—is not theoretically plausible for the following reasons. First, if depression led to decreased meta-awareness activation, dissociation could not occur because a person cannot dissociate from an experience of which they are unaware. Unlike our proposal that people avoid negative cognitions to protect against mood deterioration, the reverse mediation suggests dissociation would be avoiding an emotion people were not aware they were experiencing. Second, dissociation would need to increase negative cognitions. Since dissociation is a temporary disruption of cognitive processes, influencing negative cognition during dissociation seems implausible. Finally, meta-awareness defined as an intermittent re-representation of thought contents into awareness to ensure they are in line with goals (Schooler, 2002), cannot precede rumination in the sequence because it requires being aware of a thought that had not yet occurred.

Based on the outlined theoretical rationale and the grounds to rule out reverse causation, the assumed temporal order in our model is justified, supporting the use of serial mediation as a valid statistical method to analyse our cross-sectional data.

Method

Flinders University Social and Behavioural Research Ethics committee approved our preregistered study (see: https://osf.io/t6ygz/ for materials, statistical rationale, and data exclusions). We have reported all measures, conditions, and data exclusions.

Participants

We used the CloudResearch's Mechanical Turk (MTurk) toolkit to recruit: the approved pool of MTurk workers who have passed attention and engagement measures, and who had completed 1000 or more studies with a Human Intelligence Task approval rating of at least 95%. We powered for the sample size deemed to produce stable correlations: $N = 260$ (Schönbrodt & Perugini, 2013; 2018). We ran Monte Carlo simulations for a three-mediator serial mediation using MPlus to power for direct and indirect effects. We based most of our estimates on previous data—simple regression analyses of planned paired variables—where standardized coefficients ranged between .300 to .659. We estimated the smallest meaningful effect for previously untested relationships—those involving meta-awareness—to be a medium effect (standardized coefficient =.3) and a small effect for the serial mediation (standardised co-efficient = .013). This simulation analysis produced a sample size of N = 203 for .80 power and $N = 252$ for .95 power, to detect the sequential indirect effect (Schoemann et al., 2017).

We recruited 297 participants. Despite including the "Prevent multiple submissions" Qualtrics setting, 25 participants had multiple attempts at the survey—recommencing the survey either before entering the completion code or commencing the survey a second time while already participating. We did not pre-register this exclusion, so we inspected these data to identify participants who could be included without compromising data quality. We included participants who attempted more than once if: they did not see a scale that contained an attention check and their response to the scale(s) matched their completed attempt (i.e., no difference in data reporting). Of the 25 repeaters, five participants met these criteria and were included. We excluded the remaining 20 participants for: failing the English proficiency test on their first or after multiple attempts ($n = 4$), and for previously seeing but still failing the attention checks and/or having mismatched data between their attempts ($n = 16$). We additionally excluded 14 participants—per our preregistration criteria—for failing our bot-check question with answers that suggested misunderstanding or potential “bot” responses (e.g., “experience was very much positive”, “PIZZS”, “focused”), or elaborate AI-generated paragraphs, and two participants who failed all three attention checks. Thus, our final sample comprised 261 useable participants.

Participants ranged from 18 to 77 years of age (M = 44.30; SD = 13.16; median = 41; mode = 38) with male (49.04%) participants equivalent to female (49.43%; non-binary = 1.15% and preferred not to say = 0.38%). Most participants identified as White or “Caucasian” (74.41%; Black or African American = 10.35%, Asian = 5.36%, European = 1.92%, = Hispanic = 1.6%, Indian = 1.53%, Chinese = 0.8%, Indigenous American = 0.8%, Italian = 0.8%, and Filipino = 0.8%). Some participants reported nationality[10] (e.g., American 2.8%), language of origin (Hebrew = 0.4%) or ethnicity unknown (0.4%).

Measures

After consenting to participate, participants completed the demographic questions described above, then completed the following measures in randomized order:

The Mindful Awareness and Attention Scale-Lapses Only (MAAS-LO; Carriere et al., 2008; see Appendix J)

The MAAS-LO is a 12-item questionnaire that assesses people’s attention lapses in everyday situations. Participants rate how frequently they experience each item (e.g., “I snack without being aware I’m eating”) from 1 (*Almost never*) to 6 (*Almost always*)—higher scores indicate greater mind-wandering (present study: α = .92).

The Mind-Wandering Questionnaire (MWQ; Mrazek et al., 2013; see Appendix L)

The MWQ is a 5-item measure that assesses everyday mind-wandering frequency and was developed to focus on the experience of the attention shift from a primary task. Items

[10] The Ethnicity question was an open textbox question which people interpreted differently. Although the age range is broad, age did not significantly influence the mediation pathways.

(e.g., "I have difficulty maintaining focus on simple or repetitive work") are rated from 1 (*Almost never*) to 6 (*Almost always*)—higher scores indicate greater mind-wandering. The MWQ has good internal consistency (α = .85; Mrazek et al., 2013; present study α = .88).

Dissociative Experience Scale (DES; Bernstein & Putman, 1986; see Appendix F)

The DES is a 28-item scale that measures the frequency of participant's dissociative experiences ranging from: *everyday dissociative experiences* (e.g. loss of awareness during driving) to more pathological dissociation *depersonalisation/derealisation* dissociative experiences (e.g. looking in a mirror and not recognising themselves); *amnesic dissociation* (e.g., find evidence that they have done things that they do not remember doing); and *absorption dissociation* (e.g., remembering a past event so vividly that they feel as if they were reliving that event). Participants rate the percentage of time spent in their dissociative experiences using an 11-point scale (0% = *Never* to 100% = *Always*) with higher scores indicating increasing symptom severity. Both DES total and subtypes have high test-retest reliability (*rs* =.84 to .96) and good internal consistency—αs ranging from .85 to .95 (Dubester & Braun, 1995), with αs = .89 to .95 for current data.

The Beck Depression Inventory II (BDI-II; Beck et al., 1996; see Appendix I)

The BDI-II is a self-report, 21-item measure of participants' depression symptom severity experienced over the previous two weeks. Items are rated on a 4-point scale, for example sadness is rated by selecting one of the following scores: 0 (*"I do not feel sad"*); 1 ("*I feel sad much of the time*"); 2 ("*I am sad all of the time*"); 3 ("*I am so sad or unhappy that I can't stand it*"). Cut-off score guidelines are used to evaluate depression severity from minimal (0–13), mild (14-19), moderate (20-28), to severe (29-63). The BDI-II has high internal consistency (present study: α = .95), and test-retest reliability (*r* = .60; Beck et al., 1996).

The Ruminative Responses Scale- Short Form (RRS-SF-Brooding; Treynor et al., 2003; see Appendix K)

The RRS-SF-Brooding is a 5-item measure of participants' tendency to brood. Items (e.g., "What am I doing to deserve this") are rated from 1 (*Almost never*) to 4 (*Almost always*). Higher scores indicate greater rumination tendencies. The RRS-SF has high internal consistency (α = .93; present study α = .85) and test-retest reliability (*r* = .67; Treynor et al., 2003).

Multidimensional Awareness Scale— (MAS-MA; DeMarree & Naragon-Gainey, 2022; see Appendix M)

The MAS-MA is a 25-item scale that measures individual differences in present-moment awareness across three subscales: meta-awareness of internal states (e.g., "I am aware of my thoughts and feelings as I experience them"); decentred awareness, i.e., people's ability to psychologically distance from, and be less emotionally reactive to, their thoughts and emotions (e.g., "I experience my thoughts and feelings without being carried away by them"); and external awareness, i.e., people's ability to notice their surroundings (e.g., "I am usually aware of what is going on around me"). Participants rated items on a 6-point scale from 1 (*Almost never*) to 6 (*Almost always*) with 10 items reverse coded. MAS has acceptable internal consistency (α = .93) and test-retest reliability (*r* = .58; DeMarree & Naragon-Gainey, 2022)

Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011; see Appendix N)

The PTQ is a 15-item content-measure of people's repetitive negative thinking. Items (e.g., "My thoughts take up all my attention") are rated on a 5-point Likert scale ranging from 0 (*Never*) to 4 (*Almost always*). The measure has high internal consistency (α = .89; present study, α = .97) and acceptable convergent validity with rumination (RRS) and anxiety scales (*r*s= .70 - .72; Devynck et al., 2017).

Results

Overview

To test our hypotheses, we measured mind-wandering using two scales—the MAAS-LO and the MWQ—then determined the best measure for our main analyses (see Table 5.1 for descriptive statistics of the key variables). We ran Pearson's correlations and reliability measures in SPSS (V28) for both the MAAS-LO and the MWQ. We found a large positive correlation between the MAAS-LO and MWQ ($r = .796$, $p < .001$) with Cronbach's αs of .925 and .883, respectively. These results suggested while both scales suitably measured mind-wandering, the MAAS-LO had slightly higher internal consistency than the MWQ. Although correlations between the MAAS-LO and other key variables (e.g., dissociation) were larger than the equivalent correlations using the MWQ, these differences were not significant (see Table 5.2; Cohen, 1988). Thus, we elected to report our key analyses using MWQ, which specifically measures attention shift experiences, and MAAS-LO, which measures mind-wandering as a function of decreased mindful awareness, in our supplementary material (see Supplementary Material at the end of Chapter 5). We ran mediations using the PROCESS macro in SPSS 29 with bias-corrected bootstrapping (5000 samples).

Table 5.1

Means and Standard Deviations for Key Variables

Variables	Min.	Max.	Mean	*SD*
Mind-wandering Questionnaire (MWQ)	5.00	27.00	13.74	5.18
Mindful Awareness and Attention Scale-Lapses Only (MAAS-LO)	12.00	58.00	29.47	11.24
Perseverative thinking Questionnaire (PTQ)	0.00	60.00	22.93	13.75
Brooding (RRS-BR)	5.00	19.00	9.75	3.39
Dissociation (DES)	0.00	171.00	35.92	34.70
Amnestic (DES-Amn)	0.00	50.00	5.87	9.31
Depersonalisation/derealisation (DES-Dep)	0.00	42.00	35.13	5.23
Absorption (DES-Abs)	0.00	64.00	15.34	13.47
Meta-awareness (MAS-MA)	15.00	49.00	37.93	5.86
Depression (BDI)	0.00	48.00	11.57	11.63

Note. $N = 261$ for all variables

Recall we expected mind-wandering to positively correlate with our key dependent variables: tendencies to engage in perseverative thinking, brooding, dissociation, and depression symptomology, but to negatively correlate with meta-awareness. As expected, we found small-to-moderate positive correlations between participants' tendency to mind-wander and their tendency to engage in perseverative thinking, brooding, and their depression symptoms (see Table 5.2). Thus, as participants mind-wandering increased, their perseverative thinking, brooding and depression symptoms also increased. We also found moderate negative correlations between mind-wandering and present moment awareness, and small-to-moderate correlations between mind-wandering and meta-awareness tendencies, suggesting that as people mind-wandered, they were less aware of their cognitive and environmental experiences (Table 5.2).

Table 5.2

Correlations for the Mind-wandering Questionnaire and Mindful Awareness, and Attention Scale – Lapses Only, with Key Variables

Variables		MWQ (n = 261)	MAAS-LO (n = 261)	Difference in Correlations	
		r	r	z	p
Brooding	RRS-BR	.583***	.605***	0.386	.699
Perseverative thinking	PTQ	.610***	.657***	0.893	.372
Depression	BDI	.529***	.561***	0.517	.605
Dissociation	DES	.441***	.550***	1.646	.100
Amnesic	DES-Am	.304***	.421***	1.533	.125
Depersonalisation	DES-Dep	.345***	.437***	1.125	.217
Absorption	DES-Abs	.465***	.587***	1.924	.054
Present moment awareness	MAS-Total	-.666***	-.729***	-1.398	.162
Meta-awareness	MAS-MA	-.375***	-.458**	-1.142	.253

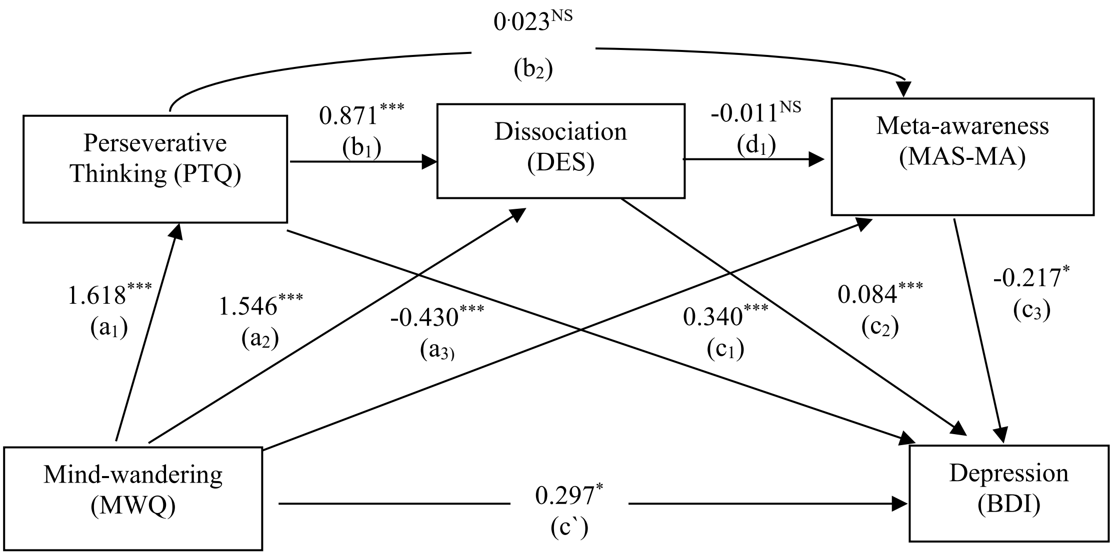
***p <.001, ** p <.01,

Mediations with Perseverative Thinking

Our main aim was to investigate whether the relationship between mind-wandering and depression was mediated through people's tendency to engage in *perseverative thinking,* leading to an increase in dissociation which in turn led to a decrease in meta-awareness. To address this aim, we entered mind-wandering as the predictor variable, perseverative thinking, dissociation, and meta-awareness respectively as the serial mediators, and depression scores as the outcome variable (see Figure 5.1).

Figure 5.1

Serial Mediation Model with Mind-Wandering as the Predictor, Perseverative Thinking, Dissociation and Meta-Awareness as Mediator Variables, and Depression as the Outcome



Note: ***p <.001, **p <.01, *p <.05

Direct Effect

We expected a significant positive direct effect of mind-wandering on depression (c`). The mediation analysis showed the direct effect of mind-wandering on depression scores did not cross zero (95% CI: 0.029, 0.565), supporting our prediction. Thus, an increase in mind-wandering leads to a direct increase in depression, indicating that any significant predicted indirect effects would be partial.

Indirect Effects

First, we expected a specific indirect effect of mind-wandering on depression through tendency to engage in perseverative thinking. The mediation analyses showed perseverative thinking scores partially mediated the relationship between mind-wandering and depression (a_1c_1; ß = 0.550, t = 5.91; 95% CI: 0.380, 0.744), suggesting mind-wandering leads to increased perseverative thinking, which in turn led to increased depression symptom severity, supporting our prediction.

Second, we expected an indirect effect of mind-wandering on depression through dissociation. Indeed, dissociation scores partially mediated the relationship between mind-wandering and depression (a_2c_2; ß = 0.131, $t = 2.62$; 95% CI: 0.046, 0.239), suggesting participants' mind-wandering led to increased dissociation, which in turn led to increased depression symptom severity.

Third, we expected a specific indirect effect of mind-wandering on depression through the tendency to be less meta-aware. Again, meta-awareness scores partially mediated the relationship between mind-wandering and depression (a_3c_3; ß = 0.09, $t = 1.82$; 95% CI: 0.003, 0.203), consistent with our prediction. This result suggests participants' mind-wandering led to decreased present moment awareness which in turn led to increased depression symptom severity.

Serial Mediations

We expected a serial indirect effect of mind-wandering on depression through a tendency to engage in perseverative thinking, which in turn led to increased dissociation and a decreased tendency to present moment awareness. However, the serial mediation analysis showed the effect of mind-wandering on depression through perseverative thinking, dissociation and meta-awareness scores crossed zero ($a_1b_1d_1c_3$; ß = 0.003, $t = 0.60$; 95% CIs: -0.005, 0.015), contrary to our hypothesis. Interestingly, the effect of mind-wandering on depression through perseverative thinking and meta-awareness without dissociation, entered in the model, also crossed zero ($a_1b_2c_3$; ß = -0.01, $t = 0.57$; 95% CIs: -0.042, 0.015), indicating that meta-awareness was not activated by either dissociative tendencies or perseverative thinking. However, the serial mediation analysis showed the indirect effect of mind-wandering on depression through perseverative thinking and dissociation—not listed in our preregistration—did not cross zero ($a_1b_1c_2$; ß = 0.12, $t = 2.90$; 95% CI: 0.051, 0.208).

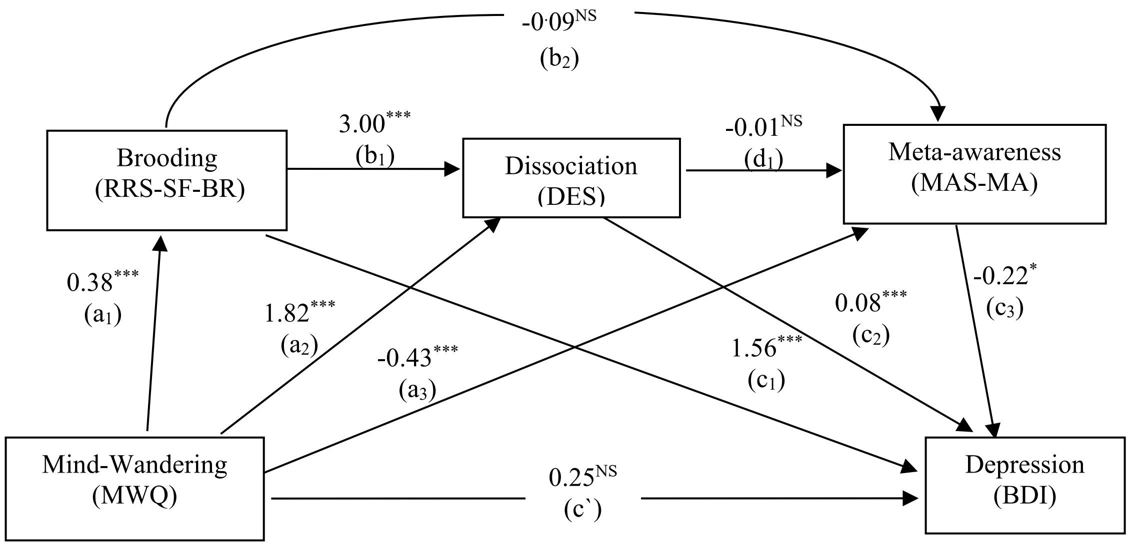
This result suggests that as mind-wandering increased perseverative thinking, participants dissociated more, which led to greater depression.

Mediations with Brooding

Recall our second aim was to investigate whether the relationship between mind-wandering and depression was mediated through people's tendency to engage in *brooding,* leading to an increase in dissociation which in turn led to a decrease in present moment awareness. To address our aim, we repeated the mediation analyses substituting brooding scores for perseverative thinking scores. We entered mind-wandering as the predictor variable, brooding, dissociation, and present moment awareness scores respectively as the serial mediators, and BDI scores as the outcome variable (see Figure 5.2).

Figure 5.2

Serial Mediation Model with Mind-Wandering as Predictor, Brooding, Dissociation and Present Moment Awareness as Mediator Variables, Depression as the Outcome



Note: $^{***}p$ <.001, $^{**}p$ <.01, $^{*}p$ <.05,

Direct Effect

Although we expected a significant positive direct effect of mind-wandering on depression (c`), the mediation analysis showed the direct effect of mind-wandering on depression scores crossed zero (95% CI: -0.01, 0.50). Thus, contrary to our prediction, mind-wandering did not have a direct effect on depression. Hence, any effect of mind-wandering on depression was solely explained through the mediating variables. We then analysed the indirect effects of the model to determine which pathway fully mediated the relationship between mind-wandering and depression.

Indirect Effects

First, we expected a specific indirect effect of mind-wandering on depression through tendency to engage in brooding. The mediation analyses showed brooding scores fully mediated the relationship between mind-wandering and depression (a_1c_1; ß = 0.60, t = 6.34; 95% CI: 0.415, 0.787), suggesting participants' mind-wandering tendency led to increased brooding which led to increased depression symptom severity, supporting our prediction.

Second, we expected an indirect effect of mind-wandering on depression through dissociation. The mediation analyses showed dissociative tendency scores fully mediated the relationship between mind-wandering and depression (a_2c_2; ß = 0.15, t = 2.88; 95% CI: 0.060, 0.266), suggesting participants' mind-wandering tendency led to increased dissociation, which led to increase depression symptom severity.

Third, we expected a specific indirect effect of mind-wandering on depression through tendency to be less present moment aware. The mediation analyses showed meta-awareness scores fully mediated the relationship between mind-wandering and depression (a_3c_3; ß = 0.09, t = 1.96; 95% CI: 0.009, 0.186), consistent with our prediction. These results suggest participants' mind-wandering led to decreased meta-awareness which led to increased depression symptom severity.

Serial Mediations

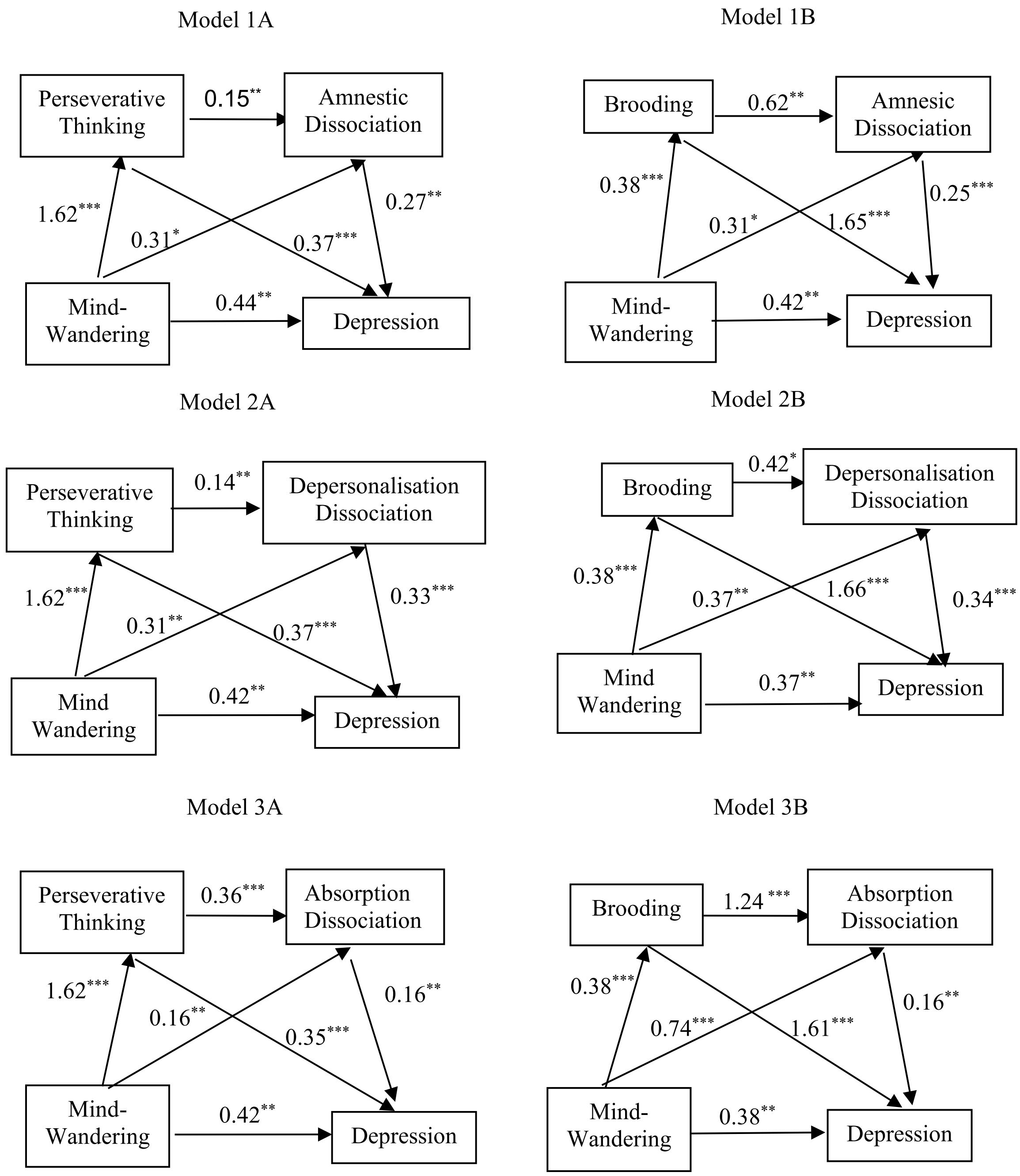
We expected a serial indirect effect of mind-wandering on depression through a tendency to brood, which in turn led to increased dissociation and a decreased tendency to be meta-aware. However, the serial mediation analysis showed the effect of mind-wandering on depression through brooding, dissociation and meta-awareness scores crossed zero ($a_1b_1d_1c_{3;}$ ß = 0.003, t = 0.64; 95% CI: -0.004, 0.012), not supporting our hypothesis. Similarly, the effect of mind-wandering on depression through brooding and meta-awareness without dissociation also crossed zero ($a_1b_2c_{3;}$ ß = -0.01, t = 0.58; 95% CI: -0.036, 0.013), indicating that meta-awareness was not activated by either dissociative tendencies or perseverative thinking. Importantly, the serial indirect effect of mind-wandering on depression through brooding and dissociation did not cross zero ($a_1b_1c_{2;}$ ß = 0.10, t = 2.82; 95% CI: 0.039, 0.171) suggesting that as mind-wandering increased brooding, participants dissociated more which led to depression.

Mediation with Dissociation Subtypes: Amnestic, Depersonalisation/Derealisation, Absorption

Recall we were interested in which dissociation subtype—amnestic, depersonalisation/derealisation and absorption—might explain these results. We ran serial mediation analyses entering mind-wandering as the predictor, perseverative thinking/brooding as Mediator 1, dissociation subtypes: absorption, derealisation and amnesic scores as Mediator 2, respectively, and depression as the outcome—removing meta-awareness as mediator 3 (see figure 5.3).

Figure 5.3

Unstandardised Coefficients for the Serial Mediation Model for the Effect of Mind-Wandering on Depression Through: (A) Perseverative Thinking, and Dissociation (1A = Amnesic; 2A= Depersonalisation/Derealisation; 3A = Absorption) and Through (B) Brooding and Dissociation (1B = Amnestic; 2B= Depersonalisation/Derealisation; 3B = Absorption)



Note: ***p <.001, **p <.01, *p <.05

The serial mediation analysis showed a significant direct effect of mind-wandering on depression in all serial mediation models, indicating that increased mind-wandering directly increased depression severity, regardless of whether perseverative thinking or brooding were entered as Mediator 1 (Table 5.3). Further, the analysis showed the effect of mind-wandering on depression was mediated through perseverative thinking/brooding and amnestic dissociation, depersonalisation dissociation and absorption dissociation, respectively.

Overall, our results suggest that while meta-awareness fully mediates the relationship between mind-wandering and depression, it is not activated by increased dissociation from mind-wandering with negative cognitive behaviours (perseverative thinking or brooding). Instead, our results indicate that as mind-wandering increases negative cognitions, participants tend to dissociate by becoming absorbed in, depersonalised from, or forgetting/avoiding these negative cognitions, which results in increased depression symptoms regardless of their meta-awareness tendency.

Table 5.3

Total, Direct, and Indirect Effects from a Serial Mediation Analysis of the Effect of Mind-Wandering (MW) on the Depression, with Perseverative Thinking/Brooding (M1) and Dissociation Subtype (Amnestic, Depersonalisation, Absorption; M2)

Mediator 2 (M2)		Mediator 1 (M1)					
		Perseverative Thinking			Brooding		
Effect	Slope	*b*	*t*	95%CI	*b*	*t*	95%CI
Amnestic Dissociation							
Total		1.19^{***}		0.95, 1.42	1.19^{***}		0.95, 1.42
Direct	c`	0.44^{**}		0.19, 0.70	0.42^{**}		0.18, 0.67
Total Indirect		0.75		0.55, 0.96	0.76		0.57, 0.98
Specific Indirect							

MW→M1→Depression	a_1c_1	0.60		0.42, 0.80	0.63		0.45, 0.81
MW→M2→Depression	a_2c_2	0.08		0.01, 0.18	0.08		0.12, 0.17
MW→M1→M2→Depression	$a_1b_1c_2$	0.06	2.15	0.02, 0.13	0.06	2.08	0.02, 0.12
Depersonalisation Dissociation							
Total		1.19^{***}		0.95, 1.42	1.19^{***}		0.95, 1.42
Direct	c`	0.42^{**}		0.17, 0.68	0.37^{**}		
Total Indirect		0.76		0.56, 0.99	0.81		0.62, 1.02
Specific Indirect							
MW→M1→Depression	a_1c_1	0.59		0.51, 0.79	0.63		0.46 0.82
MW→M2→Depression	a_2c_2	0.10		0.03, 0.19	0.13		0.05, 0.22
MW→M1→M2→Depression	$a_1b_1c_2$	0.07	2.27	0.02, 0.15	0.05	2.00	0.01, 0.11
Absorption Dissociation							
Total		1.19^{***}		0.95, 1.42	1.19^{***}		0.95, 1.42
Direct	c`	0.42^{**}		0.16, 0.69	0.38^{**}		0.13, 0.64
Total Indirect		0.76		0.57, 0.99	0.60		0.42, 1.02
Specific Indirect							
MW→M1→Depression	a_1c_1	0.57		0.40, 0.78	0.61		0.42, 0.81
MW→M2→Depression	a_2c_2	0.10		0.03, 0.20	0.12		0.04, 0.22
MW→M1→M2→Depression	$a_1b_1c_2$	0.09	2.52	0.03, 0.17	0.07	2.44	0.03, 0.14

Note: $^{***}p$ <.001, $^{**}p$ <.01, $^{*}p$ <.05

Discussion

We investigated how negative cognitive behaviours (perseverative thinking/brooding), dissociation and meta-awareness work together to affect depression symptoms when people mind-wander. Consistent with our hypotheses, people who reported more frequent mind-wandering also tended to experience more negative thinking (perseverative thinking and brooding) and dissociation (amnestic, depersonalisation and absorption) higher levels of depression symptoms and lower meta-awareness. Put differently, there were significant positive correlations between mind-wandering, negative cognitions, dissociation, and depression, and negative correlations between these variables and meta-awareness.

Next, we investigated the direction of these relationships. There were three important findings. First, consistent with our hypothesis, people who mind-wandered more experienced greater depression through increased negative thinking—perseverative thinking/brooding. These results converge with previous research showing that people with a greater tendency to brood mind-wandered more and had greater depression symptomology (e.g., Nayda & Takarangi, 2021), and that mind-wandering with negative content (e.g. perseverative thinking) leads to subsequent negative mood (e.g., Poerio et al., 2013). Second, aligning with Nayda and Takarangi (2021), people's mind-wandering tendencies led to increased depression symptoms through being less meta-aware of their thoughts. Third, and most importantly, people's tendency to dissociate mediated the relationship between mind-wandering and depression. Thus, each of our proposed mediators individually mediated the relationship between mind-wandering and depression.

We then tested our main prediction: the idea that as people's mind-wandering increases their negative thinking, they dissociate from those thoughts, initiating decreased meta-awareness, resulting in greater depression symptomology. Contrary to our predictions, we did not find evidence for this model, or for the idea that decreased meta-awareness is activated by dissociation tendencies. Instead, we found that mind-wandering increased depression partially through increased perseverative thinking, which activates dissociative tendencies. Further, the relationship between mind-wandering and depression was fully mediated through increased brooding tendencies, which activated dissociative tendencies.

Our novel finding is the mediating role dissociation plays both individually and serially in the relationship between mind-wandering and depression. Whilst prior research shows excessive mind-wandering directly increases dissociative experiences (Bayirli et al., 2023), our study builds on this finding in three ways. First, we showed that an increase in people's mind-wandering leads to an increase in dissociation, which further leads to an increase in depression. Second, we showed that when people's mind-wandering increases their negative thinking (perseverative thinking and brooding), their tendency to dissociate increases, which leads to an increase in depression. Third, we found that each subtype of dissociation (amnestic, depersonalisation and absorption) contributes to the relationship. Taken together, our results suggest that people who mind-wander more often experience greater depression symptoms due to their tendency to brood or engage in perseverating thoughts, which leads to avoidance of those thoughts (amnestic dissociation), detachment from those thoughts (depersonalisation/derealisation dissociation), or becoming so absorbed in the thoughts they cannot separate from them (absorption dissociation).

These findings add to our understanding about the role of meta-awareness in the relationship between mind-wandering and depression. More specifically, they suggest that while mind-wandering leads to depression partially through meta-awareness, meta-awareness is not activated by a dissociative tendency when brooding or engaging in perseverative thinking. One explanation for this pattern is related to our meta-awareness and dissociation measures. Meta-awareness involves attending to *ongoing experience* (Schooler, 2002), whereas dissociation is the *disconnection*. Since there is conceptual overlap between the constructs of dissociation and meta-awareness, it is possible the measures used to assess these constructs also overlap. For example, an item on the dissociative experience scale, "Some people have the experience of driving or riding in a car or bus or subway and suddenly realizing that they don't remember what has happened during all or part of the trip" is an example of a lack of meta-awareness during mind-wandering. Our measures of meta-awareness indexed people's tendency to notice their thoughts and feelings (e.g., "I can observe my feelings as they unfold" [MWQ], "I could be experiencing some emotion and not be conscious of it until sometime later" [MAAS-LO]). While measuring different constructs, both items measure awareness of internal experiences. Further, experience sampling protocols of mind-wandering, used to determine meta-awareness, typically ask the participant a question like "Were you aware you were not focused on the task just now: Y/N." This experience may also be a proxy for an amnestic dissociative experience, which raises the question: in mind-wandering research, are the meta-awareness scales being used actually measuring dissociative experiences?

Our findings have clinical implications for treating psychological disorders, specifically depression. Dissociation is considered a coping strategy during trauma exposure that protects people by reducing conscious awareness of overwhelming emotions immediately after the traumatic event (Horowitz, 1993). However, this impairment can affect how well people encode—and therefore how they later retrieve details about and process—the trauma which can, in some cases, lead to PTSD symptoms (e.g., mood changes; Dokkedahl & Lahav, 2024). Applying this idea to the depression context, people may dissociate to cope with negative cognitions when spontaneously mind-wandering, to reduce associated psychological distress. For example, brooding content such as "why do these things only happen to me, why am I so bad?" can produce negative feelings of sadness and hopelessness (Whitmer & Gotlib, 2013). Dissociation can therefore help someone to avoid/detach from negative cognitions and subsequently protect them from immediate psychological distress. However, over time dissociation may mean people have a reduced ability to process these cognitions and consequently they may experience mood changes, such as increased depressive symptoms. Many evidence-based treatments for depression involve people intentionally accessing their negative cognitions. Therefore, addressing people's dissociative and mind-wandering tendencies during treatment may facilitate identification and discussion of the negative cognitions that are perpetuating depression. Reframing these negative cognitions and developing strategies to address, rather than dissociate from, negative cognitions, may improve treatment outcomes.

Our study has limitations. First, our dissociation and meta-awareness measures may measure the same construct, confounding our understanding of whether people lack meta-awareness or if dissociation leads to depression. Second, we recruited non-clinical participants and consequently cannot generalize to a clinical population. Third, our design was cross-sectional so we cannot determine if the results are consistent over time. Using an experience sampling design that measures present moment thought content and mood several times a day over a week might disentangle dissociation from meta-awareness, and the impact of these thoughts on mood. Future research comparing clinically depressed participants and a control (general population) using a longitudinal design would also build on our findings.

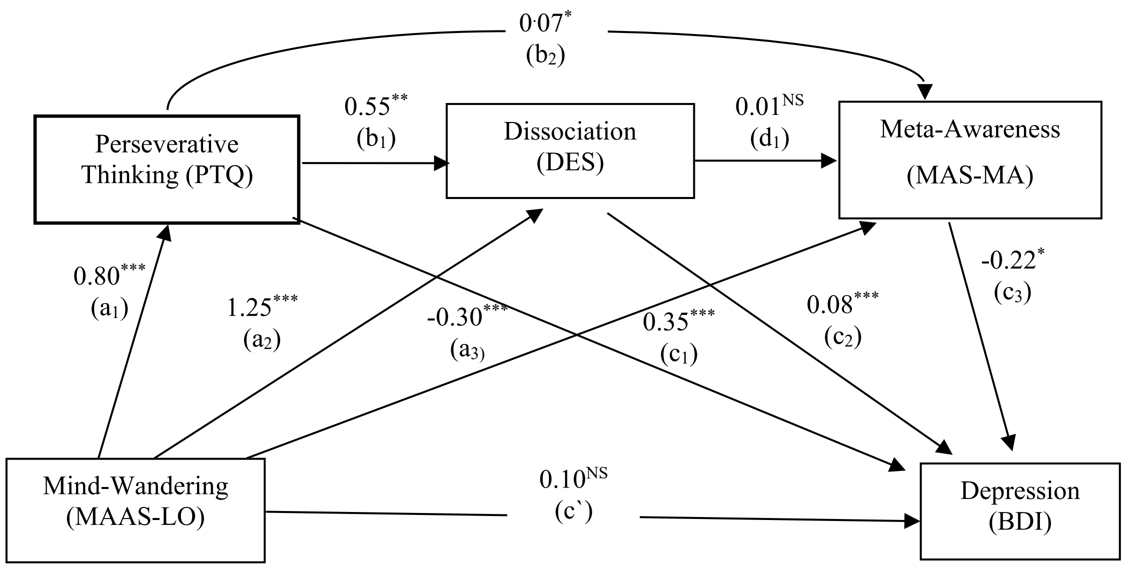
Conclusion

The present study improved our understanding of the relationship between mind-wandering and depression by investigating the serial mediating roles of negative cognitive content, dissociation, and meta-awareness. We found that people who mind-wander with negative content tend to dissociate by avoiding, detaching from, or becoming absorbed in thoughts, which lead to greater depression. Future research that measures present moment thought content over time should differentiate the roles of dissociation and meta-awareness in the relationship between mind-wandering with negative content and depression.

Supplementary Materials

Figure S1

Unstandardised Coefficients for the Serial Mediation Model with Mind-Wandering as Predictor Variable, Perseverative Thinking, Dissociation and Meta-Awareness as Mediator Variables, and Depression as the Outcome Variable



Note. $^{***}p < .001$, $^{**}p < .01$, $^{***}p < .05$

Table S1

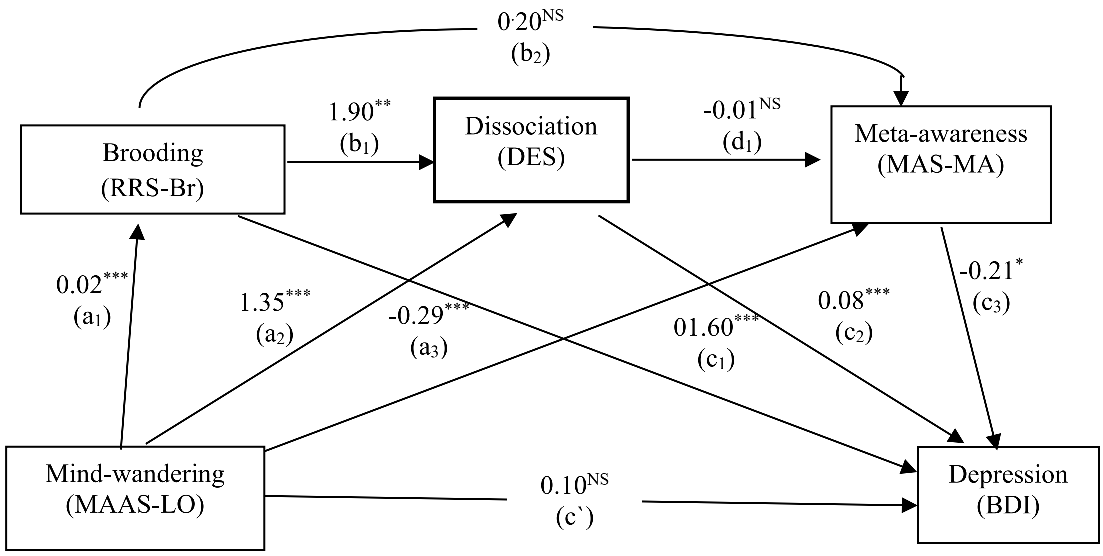
Total, Direct and Indirect Effects from the Serial Mediation Analysis of the Effect of Mind-Wandering on Depression with Perseverative Thinking (M1), Dissociation (M2) and Meta-Awareness (M3) as Mediators

Effect	Slope	*b*	*p*	95%CI (lower, upper)
Total		0.58	<.001	0.48, 0.69
Direct	(c`)	0.10	.15	-0.04, 0.25
Indirect		0.48		0.35, 0.61
MW →M1→Depression	(a_1) (c_1)	0.29		0.19, 0.39
MW →M2→ Depression	(a_2) (c_2)	0.10		0.04, 0.18
MW →M3→ Depression	(a_3) (c_3)	0.07		0.003, 0.14
MW → M1 →M2→ Depression	(a_1) (b_1) (c_2)	0.04		0.01, 0.07
MW → M1 →M3→ Depression	(a_1) (b_2) (c_3)	-0.01		-0.02, 0.002
MW → M2→M3→ Depression	(a_2) (d_1) (c_2)	-0.002		-0.12, 0.01
MW → M1 →M2→M3 → Depression	(a_1) (b_1) (d_1) (c_3)	-0.001		-0.003, 0.001

N = 261. *b* = unstandardized coefficients. CI = confidence intervals from 5000 bootstrap samples. MAAS-LO = mind-wandering; M1= perseverative thinking; M2 = dissociation; M3 = Meta-awareness; BDI = depression

Figure S2

Unstandardised Coefficients for the Serial Mediation Model with Mind-Wandering as the Predictor Variable, Brooding, Dissociation and Meta-Awareness as Mediator Variables, and Depression as the Outcome Variable



Note. $^{***}p < .001$, $^{**}p < .01$, $^{***}p < .05$

Table S2

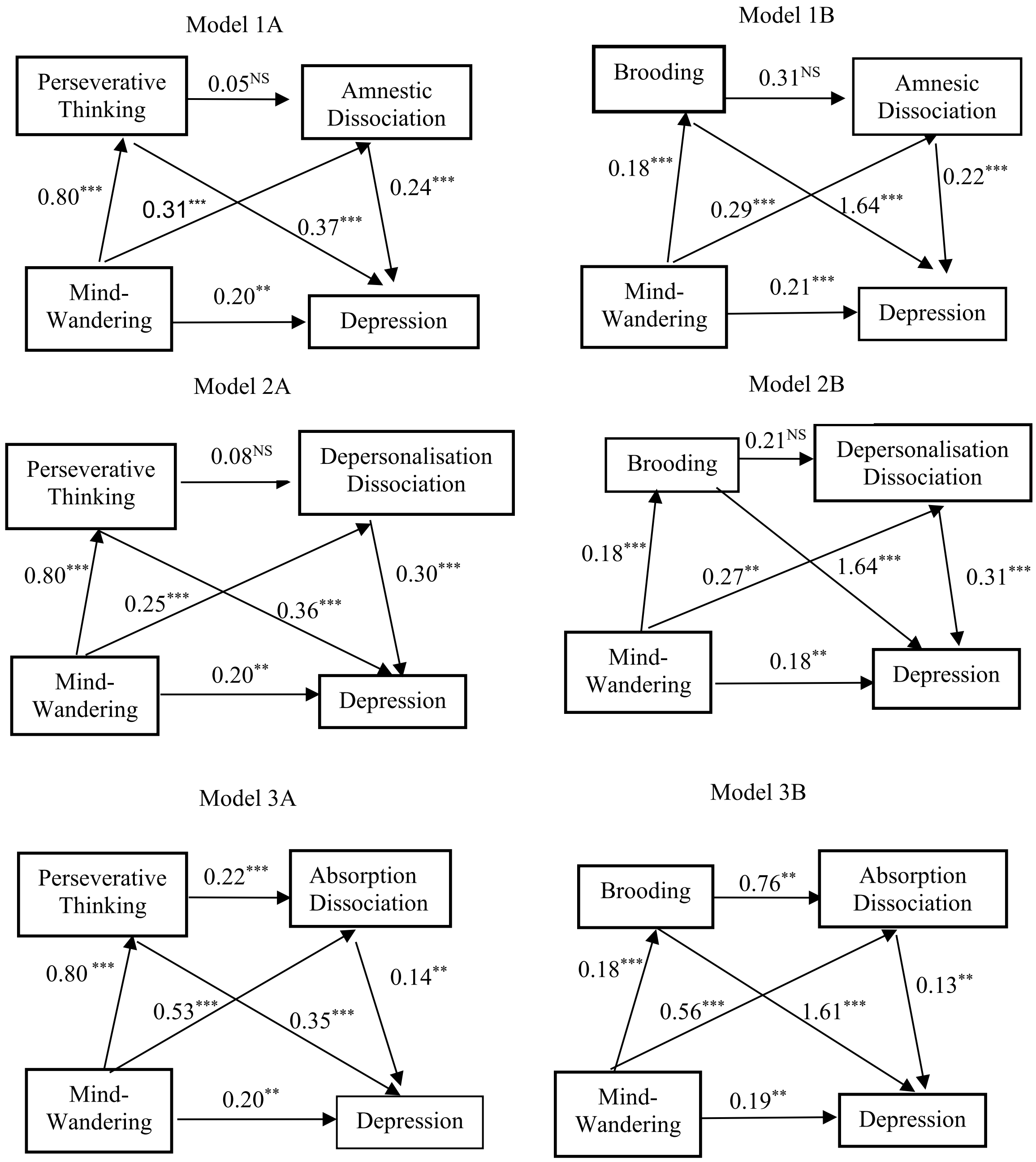
Total, Direct and Indirect Effects from the Serial Mediation Analysis of the Effect of Mind-Wandering on Depression with Perseverative Thinking (M1), Dissociation (M2) and Meta-Awareness (M3) as Mediators

Effect	Slope	*b*	*p*	95% CIs
Total		0.58	<.001	0.48, 0.69
Direct	(c`)	0.10	.14	-0.04, 0.25
Indirect		0.48		0.36, 0.61
MW →M1→Depression	(a_1) (c_1)	0.29		0.21, 0.38
MW →M2→ Depression	(a_2) (c_2)	0.11		0.05, 0.19
MW →M3→ Depression	(a_3) (c_3)	0.06		0.002, 0.13
MW → M1 →M2→ Depression	(a_1) (b_1) (c_2)	0.03		0.01, 0.06
MW → M1 →M3→ Depression	(a_1) (b_2) (c_3)	-0.01		-0.02, 0.001
MW → M2→M3→ Depression	(a_2) (d_1) (c_2)	-0.002		-0.13, 0.01
MW → M1 →M2→M3 → Depression	(a_1) (b_1) (d_1) (c_3)	-0.001		-0.003, 0.001

N = 261. *b* = unstandardized coefficients. CI = confidence intervals from 5000 bootstrap samples. MAAS-LO = mind-wandering; M1= perseverative thinking; M2 = dissociation; M3 = Meta-awareness; BDI = depression

Figure S3

Unstandardised Coefficients for the Serial Mediation Model for the Effect of Mind-Wandering (MAAS-LO) on Depression (BDI-II) Through: (A) Perseverative Thinking, and Dissociation (1A = Amnesic; 2A= Depersonalisation/Derealisation; 3A = Absorption) and Through (B) Brooding and Dissociation (1B = Amnestic; 2B= Depersonalisation/Derealisation; 3B = Absorption)



Note. $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$,

Table S3

Total, Direct, and Indirect Effects from a Serial Mediation Analysis of the Effect of Mind-Wandering (MAAS-LO) on the Depression, with Perseverative Thinking/Brooding (M1) and Dissociation Subtype (Amnestic, Depersonalisation, Absorption; M2)

Mediator 2 (M2)		Mediator 1 (M1)					
		Perseverative Thinking			Brooding		
Effect	Slope	*b*	*t*	95%CI	*b*	*t*	95%CI
Amnestic Dissociation							
Total		0.58^{***}		0.48, 0.69	0.58^{***}		0.48, 0.69
Direct	c`	0.20^{**}		0.07, 0.33	0.21^{**}		0.09, 0.32
Total Indirect		0.38		0.28, 0.50	0.37		0.27, 0.48
Specific Indirect							
MW→M1→Depression	a_1c_1	0.30		0.21, 0.40	0.30		0.21, 0.48
MW→M2→Depression	a_2c_2	0.07		0.02, 0.14	0.06		0.02, 0.13
MW→M1→M2→Depression	$a_1b_1c_2$	0.01		-0.01, 0.03	0.01		-0.001, 0.03
Depersonalization Dissociation							
Total		0.58^{***}		0.48, 0.69	0.58^{***}		0.48, 0.69
Direct	c`	0.20^{**}		0.07, 0.32	0.18^{**}		0.07, 0.30
Total Indirect		0.38		0.28, 0.50	0.40		0.30, 0.51
Specific Indirect							
MW→M1→Depression	a_1c_1	0.29		0.20, 0.39	0.30		0.21, 0.39
MW→M2→Depression	a_2c_2	0.08		0.03, 0.14	0.09		0.03, 0.15
MW→M1→M2→Depression	$a_1b_1c_2$	0.02		0.00, 0.04	0.01		-0.004, 0.03
Absorption Dissociation							
Total		0.80^{***}		0.48, 0.69	0.58^{***}		0.48, 0.69
Direct	c`	0.42^{**}		0.07, 0.34	0.19^{**}		0.07, 0.32
Total Indirect		0.38		0.26, 0.50	0.02		0.003, 0.04
Specific Indirect							

MW→M1→Depression	a_1c_1	0.29	0.19, 0.40	0.29	0.21, 0.39
MW→M2→Depression	a_2c_2	0.07	0.01, 0.14	0.07	0.02, 0.14
MW→M1→M2→Depression	$a_1b_1c_2$	0.02	0.004, 0.05	0.02	0.003, 0.04

Note: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$

Chapter 6: Does Mood Change When Performing the SART?

Author contributions: I developed the study design with the guidance of MKTT. I collected the data with some assistance, cleaned the data for analysis and performed the data analysis and interpretation. I drafted the manuscript and MKTT provided critical revisions.

Abstract

Purpose: People in a negative, compared to a positive, mood report they mind-wander more often. This pattern is demonstrated in-lab by inducing participants into a mood state (e.g., positive or negative), then assessing their mind-wandering as they complete a low-demand, repetitive task, such as the SART (Robertson et al., 1997), used in mind-wandering research. While inductions successfully alter participants' mood, we do not know whether the induced mood weakens during the task, confounding our understanding of the mood and mind-wandering relationship. Method: To investigate, we ran two studies. Study 1: Participants were induced into a mood state (positive, negative, neutral), then completed two 5-minute SART blocks. We measured positive and negative affect pre- and post-induction, and after each SART block. Study 2: We replicated Study 1, *excluding* the mood induction. Results: In Study 1, during the SART, participants' *positive affect decreased* in the *positive and neutral mood conditions; negative affect decreased* in the *negative mood condition.* In other words, participants' induced mood weakened during the SART. In Study 2, participants' *negative affect increased,* and *positive affect decreased* during the SART. Further, decreased positive affect during the first SART block occurred alongside increased mind-wandering (target-errors) in the first, and the second, SART blocks. Conclusions: Participants' induced mood weakened during the SART—positive mood became less positive while negative mood became less negative. Future research comparing the SART with an alternative task may be necessary to understand how task selection influences mood during mind-wandering assessments.

Introduction

Mind-wandering is a pervasive phenomenon characterized by a shift in attention from a primary task (e.g., driving) to an internally generated thought, memory, or image (e.g., a recent social event). This shift in attention can occur with or without conscious awareness (i.e., meta-awareness; Schooler et al., 2005). While mind-wandering has many *adaptive* functions (see Mooneyham & Schooler, 2013), it can also be *maladaptive,* with substantial evidence suggesting that mind-wandering is associated with negative mood. Studies have demonstrated that negative mood can lead to more mind-wandering (e.g., He et al., 2021; Marcusson-Clavertz et al., 2020; Smallwood et al., 2009), that mind-wandering can lead to dysphoria and depression (e.g., Ottaviani et al., 2015), and that the relationship can be bidirectional (Nayda & Takarangi, 2021). However, in laboratory studies, the task used when measuring mind-wandering may also influence mood. Such tasks—including n-back vigilance and go/no-go (e.g., the SART)—are repetitive, minimally engaging and enhance boredom, known to correlate with poorer mood (see Jangraw et al., 2023; Raffaelli et al., 2017). If tasks such as the SART influence mood, we may not be able to isolate the mood effect on mind-wandering. Therefore, we tested whether participants' mood changes when performing the SART, a task used extensively in mind-wandering research (e.g., Belardi et al., 2022; Deng et al., 2014; Jonkman et al., 2017; Shrimpton et al., 2017); we also examined participants' mind-wandering during the SART.

Accurately capturing the frequency and content of people's mind-wandering is challenging. One approach uses naturalistic methodologies. For example, participants might record their mood and thoughts in response to a prompt received on their smartphone at random intervals throughout the day (e.g., Killingsworth & Gilbert, 2010; Poerio et al., 2013; Kuehner et al., 2017). Importantly however, these methods rely on people's *natural* shifts in negative mood, which for some people may not be sufficiently large to reliably detect a relationship between negative mood and mind-wandering. Further, extraneous factors unrelated to mind-wandering (e.g., frustration with being probed at an inopportune time) may also influence mood fluctuations. Thus, we look to laboratory studies that manipulate mood in a controlled environment to isolate the mood and mind-wandering relationship.

Mood Induction Procedures (MIPs)—e.g., valenced videos, music, statements, film, and personal memories—are widely used in laboratory studies for emotion-related research to manipulate participants' mood into a desired mood state (Joseph et al., 2020; Smallwood et al., 2009). The concept of MIPs is based in schema and spreading activation theories. People use schemas—clusters of stored knowledge, beliefs, and assumptions built from life experiences—to make sense of themselves and the world, and to interpret new events and information (Martin, 1990). This process can lead to a change in mood (Hawke & Provencher, 2011). For example, failing an exam may activate a person's previously developed schema—"failure is bad"—which then may activate related concepts such as "I am bad", leading to intense feelings of low self-worth and depression (see Collins & Loftus, 1975). In laboratory settings, MIPs are purported to activate schemata by exposing participants to events like those involved in forming the schema (e.g., film, music, memory), or through schema-related self-referential statements (e.g., the Velten statements used to induce mood; Martin, 1990), which activate associated concepts (e.g., "I'm no good"), leading to a mood change.

Mood and mind-wandering laboratory research typically uses MIPs to induce an allocated mood state (positive, negative, neutral). Once in the desired mood state, participants complete a task, typically the SART—a go/no-go task that involves participants responding to frequently presented non-target stimuli (e.g., types of animals) while withholding their response to an infrequent target stimulus (e.g., dog; see Welhaf et al., 2020). During the task, mind-wandering is measured using several indices. Behaviourally, for example, one measure is the frequency of participants' failure to withhold a response to the target stimulus (commission errors also referred to as target-errors), occurring when participants' attention shifts away from the task. Another index is participants' reaction time, including the response time coefficient of variability (RTCV), the variability in time taken to respond to a non-target stimulus. This variability reflects how participants speed up or slow down their responses when their mind drifts from the task due to task disengagement or fatigue from sustaining attention (Thomson et al., 2014; Wang et al., 2014). Subjectively, participants' mind-wandering is indexed using randomly presented probe questions that ask them to report their task focus (e.g., on vs. off task), and if off-task, a further question may be presented to measure the participant's thought awareness. Further, retrospectively, mind-wandering is measured using questionnaires (e.g., task engagement of the Dundee Stress State Questionnaire such as "my mind wandered a great deal"; Matthews et al., 2002).

In one example laboratory study, Smallwood et al. (2009) used video clips to induce a negative, positive, or neutral mood state. Mood changes were operationalised as the difference in positive and negative affect scores between pre- and post-induction of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). As expected, participants in the *positive* and *neutral* conditions felt significantly less negative and significantly more positive than participants in the negative condition at post- compared to pre-induction. Participants then completed a symbol SART (target '='; non-target 'O'). Mind-wandering was measured as commission errors during the SART, and a post-SART questionnaire that classified mind-wandering thoughts as task unrelated thoughts (or 'tune-outs') and task-relevant interference thoughts. Importantly, participants in the negative mood condition committed more commission errors and reported more tune-outs than participants in the neutral and positive conditions, suggesting that people in a more negative mood mind-wandered more often. Similarly, in He et al. (2021), participants induced into a negative mood reported greater mind-wandering while completing the SART compared to participants in the neutral or positive condition. However, in either study, we do not know what happened to participants' induced mood *as* they performed the task.

Stawarczyk et al. (2013) explored mood changes during the SART. Participants (N = 32) were induced into a mood state by either anticipating delivering a 5-minute speech about a negative event (future-concern group, similar to negative mood induction) or completing a problem-solving task (control group), after they completed an unrelated attention task (i.e., mood induction phase). Participants then completed a 22.5-minute SART with thought probes to measure the content and frequency, but not meta-awareness, of their mind-wandering (mind-wandering phase). Positive and negative affect was measured at 3-time points—pre- and post-induction, and post-SART—using the PANAS. Participants in the future-concern group reported a significantly greater increase in negative affect from pre- to post-induction compared to the control group, consistent with a successful mood induction procedure. But during the SART, negative affect significantly decreased in the future-concern group while remaining stable in the control group. Positive affect decreased over time in both groups. Additionally, the increase in negative affect following the future-concern induction was associated with greater mind-wandering, and participants' negative affect decreased less during the SART when their mind-wandered focused on future-concern related content. These data suggest that the emotions induced during a negative MIP begin to subside during the SART, and participants' negative affect falls less when they mind-wander about future negative content, indicating that mind-wandering might 'maintain' negative affect.

Another explanation for the shift in mood—particularly the fall in positive affect)—during the SART is the natural tendency for mood to drift negatively during rest and simple tasks, known as the *Mood Drift Over Time* effect, which has been observed in tasks ranging from gambling to visuomotor activities (Jangraw et al., 2023). This negative mood shift is a robust, medium effect (estimated as $d = 0.57$) found across multiple in-lab and online studies (total $N = 28,482$) and was only absent when participants freely chose their activities during rest (e.g., standing, reading the news, thinking). Considering that laboratory tasks are not freely chosen, it is reasonable to suggest that mood shifts *larger* than the Mood Drift Over Time effect may indicate that participants' mood is influenced by task characteristics. However, Jangraw's data operationalised mood using a single item measure "*How happy are you at this moment*?" rated on a slider (Very unhappy to Very happy) or a Likert scale (1 = Very unhappy, 9 = Very happy) making direct effect size comparisons to other studies difficult. Consequently, we use this effect as a benchmark to consider how much of an observed mood shift might be attributable to a natural mood drift, and how much might be attributed to performing a particular task, like the SART. The overall fall in positive affect reported by Stawarcyzk et al. (2013b) was large; but because no comparisons between baseline and post-induction or post-induction to post SART were conducted for positive affect, we do not know whether the mood shift can be attributed to performing the SART. Further, Stawarcyzk et al. did not include a positive induction condition and consequently we do not know how a positively induced mood behaves during the SART compared to a negative or control condition.

In another laboratory study, Jonkman et al. (2017) investigated both positive and negative mood states in relation to mind-wandering among participants who scored high (n = 46) or low (n = 44) on attention deficit/hyperactivity disorder (ADHD) symptomology. Participants' mood state was induced by reading valenced statements (Velten Mood Induction; Velten, 1968) paired with matched valenced music, prior to each of the two tasks in fixed order; the digit *SART* (target '3'; non-target '1-2, 4-9') and the *reading task*. Mood (i.e., positive, and negative affect) was measured at four time points—pre- and post-mood induction, and at the end of each task—using the PANAS. Mind-wandering frequency was measured using thought probes in both tasks that captured temporal orientation. Mind-wandering was also measured retrospectively using a post-SART mind-wandering questionnaire[11]. Mood was successfully manipulated prior to both tasks: participants in the negative mood condition felt less positive and more negative while participants in the positive condition felt less negative—with no change in positive affect.

Interestingly, mood differentially changed during the subsequent SART and reading tasks. Specifically, from before to after the SART, participants in the positive mood condition reported decreased positive affect and increased negative affect, whereas participants' affect in the negative condition was unchanged. However, affect changes from after the SART to after the reading task showed negative affect significantly reduced in both mood conditions, however there was no difference in positive affect. This pattern indicates that participants felt less negative after the reading task but less positive after the SART, suggesting the *tasks* altered mood beyond the induction procedure.

So why, in this study, did participants' induced mood change differentially by task? If the differential mood change in Jonkman et al. (2017) was attributed to the Mood Drift Over Time effect, we would expect participants to report feeling more negative after both tasks, which was not the observed pattern. Two other possibilities may account for the differential change in mood: mood induction potency weakened over time *regardless* of the subsequent task, or mood induction potency weakened over time *because* of the subsequent task. If the mood induction potency weakened over time *regardless* of the task, we would expect mood to return to baseline at the end of both the SART and the reading tasks. Again, this was not the observed pattern. Possibly then, the mood induction potency differentially weakened over time *because* of the subsequent task.

[11] Other trait mind-wandering and attention measures (e.g., Daydream Frequency Scale) were administered here as part of a larger study; but we do not examine them here.

Because mood is manipulated through schema activation, perhaps the associated task activates an aligning or opposing schema that maintains or weakens the mood during a task. For example, due to the nature of the SART—monotonous, repetitive, and boring—frequent errors are common, which might activate and maintain negative schema (e.g., "I'm a failure"). For participants induced into a positive mood, a subsequently activated negative schema might lead them to become frustrated (increased negative affect) and/or bored (decreased positive affect). For participants induced in a negative mood, the same SART characteristics may result in one of two outcomes. The SART may reinforce the induced negative schema (i.e., beliefs about failure), sustaining negative mood—as indicated in Stawarczyk et al. (2013), who found that negative affect decreased less when participants mind-wandered about concern-induced content during the SART. Alternatively, it may provide a distraction from activated negative schema, potentially repairing people's more negative mood (decrease negative affect, maintaining positive affect). Indeed, Jonkman et al. (2017) found that positive affect decreased during the SART for participants induced into a positive but not a negative mood, suggesting a mood maintaining effect in the negative condition.

If mood induction weakens during the SART, there are important implications for understanding the relationship between negative mood and mind-wandering, and its use in wider research. For example, if participants following a positive mood induction feel less positive/more negative as they perform the task, then this mood deterioration could lead to greater mind-wandering compared to if their induced mood remained positive. In contrast, if participants following a negative mood induction feel less negative and/or more positive as they perform the SART, then the mood deterioration could lead to less mind-wandering than if their induced mood remained negative. Consequently, participants in a positive mood condition may begin to mimic participants in a negative mood condition. In other words, the difference in mind-wandering behaviour between positive and negative mood condition may narrow, confounding our understanding of the mood and mind-wandering relationship. Beyond the mood and mind-wandering literature, for example, the deterioration in mood that may lead to increased mind-wandering could confound our understanding of dispositional inattention.

Overview of Studies

To investigate these potential confounds, we conducted two studies. Our primary aim was to investigate the effect of the SART on induced mood states (Study 1). Participants were induced into a positive, negative, or neutral/control mood (hereafter referred to as the neutral mood condition), followed by a 3-minute incubation period—shown to successfully extend the duration of an induced mood of up to 25-minutes (see also: Sinclair et al., 1994; Zoellner et al. 2003). Participants then completed two 5-minute SART blocks (SART-1 and SART-2) with random probes to index mind-wandering and meta-awareness to measure the frequency of tune-outs (i.e., mind-wandering with awareness), as well as zone-outs (i.e., mind-wandering without awareness), which was not captured in the any of the above studies. We measured positive affect (PA) and negative affect (NA) pre- and post-induction, and at the end of each SART block.

Based on our proposition that the SART (repetitive, monotonous, boring) activates negative schema, we expected that participants in the positive and neutral mood condition would report a decrease in PA and an increase in NA between post-induction and SART-1, and between SART-1 and SART-2. Based on the idea that the SART provides a distraction from the activated negative schema, we expected that participants in the negative condition would report a decrease in NA with stable PA between post-induction and SART-1, and between SART-1 and SART-2.

Our secondary aim was to examine if changes in self-reported mind-wandering, *both with and without awareness*, and behavioural mind-wandering indices occur alongside mood changes during the SART. Based on evidence that people mind-wander more in a negative mood, we expected that if NA increases and PA decreases (i.e., as participants' mood becomes worse), we might see an accompanying increase in tune-outs (mind-wandering with awareness), zone-outs (mind-wandering without awareness), and target-errors (see Nayda & Takarangi, 2021). We expected this effect to be greater later in the task (i.e., during SART-2 compared to SART-1), as participants become more familiar with the task, and the intensity of boredom and monotony increases (Hunter & Eastwood, 2018), hence negative mood increases over time.

Study 1

Method

Participants

Our research was approved by the Social and Behavioural Research Ethics Committee at Flinders University and was preregistered (see: https://osf.io/rwdgu). We calculated the power needed to detect the effect size $\eta_p^2 = 0.10$ (just under our smallest effect size of interest, which we determined based on our pilot data) for a two-way repeated measures ANOVA with condition (mood induction: positive, negative, and neutral) as the between-subjects factor and time (4 time points: pre-induction, post-induction, SART-1, SART-2) as the within-subjects factor. Using G*Power calculations (Erdfelder et al., 1996) where *f(U)* = .33, alpha = .05, power = .95, the recommended sample size was 69 usable participants—23 per condition. To ensure our sample size was adequate to detect effect sizes larger than the Mood Drift Over Time effect (Cohen's *d* = 0.57*;* Jangraw et al., 2023)—i.e., the smallest effect size of interest indicating the SART negatively influenced mood more than a natural negative shift—we ran a sensitivity analysis. The smallest reliable effect we could detect with a sample size of 23 per condition across four time points (alpha = .05, power = .80) was *d* = 0.61, a medium effect. We recruited 72 participants (64.3% female, $M(SD)_{age}$ = 23.6 [7.62] years) from the Flinders University participation pool in exchange for course credit or $15 (AUD). We excluded two participants—one who failed to follow instructions and one for technical problems—leaving a usable sample of 70 who were randomly allocated to one of three mood induction conditions: positive *n* = 24; negative *n* = 23; and neutral *n* = 23. We told participants prior to commencing the study that we were interested in how attention relates to our wellbeing.

Materials

The Beck Depression Inventory II (BDI-II; Beck et al., 1996; see Appendix I) is a 21-item measure of participants' depression symptom severity experienced over the previous two weeks. Items are rated on a 4-point scale; for example, sadness is rated by selecting one of the following scores: 0 (*I do not feel sad*); 1 (*I feel sad much of the time*); 2 (*I am sad all of the time*); 3 (*I am so sad or unhappy that I can't stand it*) with higher scores indicating greater depression symptomatology. The BDI-II has high internal consistency (our sample, α = .88; Beck et al., 1996).

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988; see Appendix O) is a 20-item measure of participants' state affect. Affect items—10 positive (e.g., interested) and 10 negative (e.g., distressed) adjectives—are rated according to how these apply to the participant at that moment (1 = *Very slightly, or not at all*, to 5 = *Extremely*). Positive affect (PA) is a state of feeling highly energetic, pleasurably engaged; higher scores indicate feeling active and alert, while lower scores indicate lethargy and sadness, predictive of depression (Díaz-García et al., 2020). Negative affect (NA) is a state of feeling distressed and unpleasurably engaged, where higher scores indicate feelings of anger, contempt, and nervousness predictive of anxiety, and lower scores indicate calmness and serenity (Watson et al., 1988). The PANAS has high internal consistency (our sample: αs = .89 - .95 PA; 75 - .92 NA) good test-retest reliability (our sample, *rs* = .60 - .87 PA; .53 - .70 NA). The PANAS has been frequently used to measure mood induction effects in mood and mind-wandering research (e.g., Smallwood et al., 2009).

The Mood Induction Protocol (MIP). We paired the Velten Mood Induction Procedure (VMIP; see Seibert & Ellis, 1991; see Appendix P) with valenced music to induce mood states: positive, negative, and neutral (e.g., Jonkman et al., 2017) followed by an incubation phase.

The mood induction phase: Participants read 25 successive self-referential statements (e.g., positive: "*I've got some good friends*"; negative: "*I'm tired of trying*"; neutral "*A neuron fires rapidly*") that appeared on a computer screen for 12-seconds each, while simultaneously listening to matched valence music through headphones (Positive: *Coppélia, tableau 1 No. 6 Thèm*; Negative: *Adagio in G Minor for Strings*; Neutral: *Prelude À L'après-midi D'un Faune*).

The 3-minute incubation phase: Participants in the negative and positive conditions were instructed to feel the experience, to recall a scene when they experienced the intended feeling, and then expand on the intended feeling—i.e., ".... concentrate on this feeling. Let it flow. Let it build. Feel the mood. Feel it get stronger" (Sinclair et al., 1994). Participants in the neutral condition were instructed to only read the neutral statements during the MIP (e.g., "*A neuron fires rapidly*") then to "clear your mind of any mood-related thoughts". All participants continued to listen to matched valence music for the duration of the incubation.

Research shows the mood induction protocol with incubation increases the duration and potency of the mood effect and minimizes the impact of non-responders (participants who do not report a mood change; Sinclair et al., 1994; Rottenberg et al., 2018; Westermann et al., 1996).

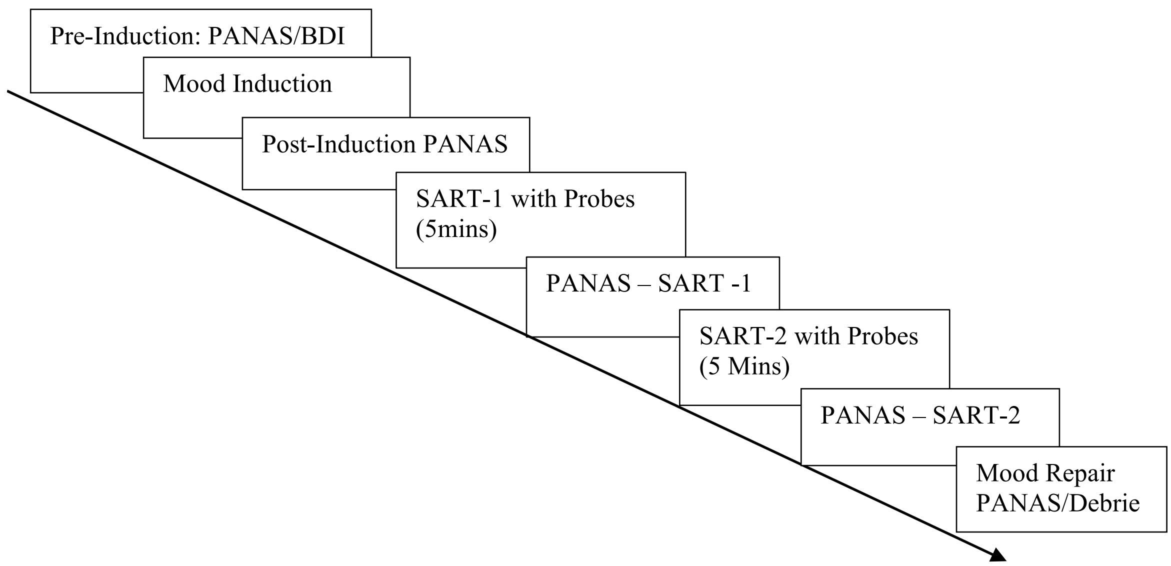
The Sustained Attention to Response Task (SART; Robertson et al., 1997). Our SART was programmed using E-Prime 2.0. Each SART block—SART-1 and SART-2—comprised 25 cycles of 9 digits ranging from 1-9 in random order. Non-target digits *(1-2; 4-9)* and the target digit *(3)* therefore appeared 25 times in each 225 trial SART block. Participants were instructed to press the spacebar on the keyboard for all non-target digits but withhold a response for the target digit. Each stimulus appeared for 750 ms with an inter-stimulus interval of 1250 ms. Digit font sizes varied randomly between 48 and 120 to prevent the task from becoming predictable or automatic and to increase the detection of mind-wandering through errors (Robertson et al., 1997). Participants responded to 18 thought probes (nine in each SART block) asking "Was your attention focused on the task just now?". The thought probes were presented pseudo-randomly after a minimum of seven, and a maximum of 43, trials, to ensure probes did not appear consecutively. The probe remained on screen until the participant responded. If the participant responded "no" to the first question, we then asked: "Were you aware that your attention was not focused on the task just now?" (Y/N), to index participants' meta-awareness of mind-wandering (Christoff et al. 2009; Deng et al., 2014; Robertson et al., 1997). Behavioural indices of mind-wandering were the frequency of commission errors—responding to the target stimulus 3—during the SART. We also computed the Response Time Coefficient of Variability (RTCV: standard deviation/mean) for non-target trials, a measure of trial-to-trial fluctuations in participants' responses that is considered an indirect indicator of mind-wandering as well as task disengagement and cognitive fatigue (Cheyne et al., 2009; Thomson et al., 2014; Wang, et al., 2014).

Procedure

After providing informed consent, participants completed the following steps (see Figure 6.1). Participants first completed a baseline BDI and PANAS *(Pre-induction)* followed by the Mood Induction Procedure and incubation period. They then completed the second PANAS *(Post-induction)* followed by a 5-minute SART block with random mind-wandering probes administered. Participants then completed a third PANAS (PANAS – *SART-1*) and a second 5-minute SART block identical to the first, followed by a fourth PANAS (PANAS – *SART-2*). Finally, all participants completed the positive MIP as a mood repair task followed by a final PANAS as a mood repair check—not included in analyses—and were fully debriefed.

Figure 6.1

Study 1 Procedure



Results

Statistical Analysis[12]

To test whether mood induction effects weaken as participants complete the SART, we used Null Hypothesis Significance Testing (NHST) and ran multiple two-way mixed ANOVAs with condition (mood induction: positive, negative, and neutral) as the between-subjects factor and time (four time points: pre-induction, post-induction, SART-1, SART-2) as the within-subjects factor, for PA and NA separately. These data appear in Figure 6.2 (see also Table S1 in supplementary material for descriptive statistics).[13] To examine PA and NA changes across timepoints, we ran planned paired samples t-tests in each condition (pre- and post-induction; post-induction and SART-1; SART-1 and SART-2). We also calculated Bayes Factors[14] (see Table S2 in supplementary material at the end of Chapter 6; note that, for brevity, because these analyses support the primary NHST results we do not report them in the main text).

To test whether a mood change through the SART affected mind-wandering behaviour, we ran three 3 x 2 repeated measures ANOVA with condition (mood induction: positive, negative and neutral) as the between-subjects factor and time (two time points: SART-1, SART-2) as the within-subjects factor, for zone-outs (i.e., without awareness), tune-outs (i.e.,

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[12] Both NA and PA data were positively skewed across different time points. We used a logarithm transformation and ran our analyses to compare the results with the raw data. We found no difference between results, except an increasing trend in NA pre- and post-induction in the neutral condition which were shown to be inconclusive using Bayes analyses (see: Table S9 and S10 in supplementary materials at the end of Chapter 6).

[13] Per our pre-registration, we planned to control for depression as a covariate, but 18% of BDI data were missing and non-randomly distributed (these participants failed to complete page 2 of the measure). We ran multiple imputation analyses to replace missing data. We entered BDI as a covariate in our main analyses, then compared these results to analyses without BDI as a covariate. All analyses were consistent except there was a significant overall main effect of time for NA for three of five imputations when BDI was entered as a covariate. We were most interested in whether underlying depression symptoms neutralize a positive mood induction, but we found no evidence for this possibility. Since BDI did not appear to have an impact on the outcome of the mood induction, we opted not to report results that include BDI as a covariate here. However, please refer to Table S5 in supplementary material for analyses using imputed data with BDI included as a covariate.

[14] We ran Bayes analyses using JASP 0.16.4.0 with default prior odds and selected compare to null model for the repeated measures ANOVAs. We referred to van Doorn et al. (2021) for Bayes Factor interpretations.

with awareness) target-errors and mean RTCV (see Figure 6.3; also Table S3 in supplementary material for descriptive statistics). To determine the change in tune-outs, zone-outs, target-errors, and RTCV we ran planned samples t-tests in each condition with time (SART-1; SART-2) as the independent factor for each of the mind-wandering indices. Finally, we ran correlations between the change in affect—the difference in PA and NA between post-induction and the end of SART-1 (T1), and between SART-1 and SART-2 (T2)—with zone-outs, tune-outs, and target-errors, to determine if a change in mind-wandering was related to a change in affect.[15]

Overall, for NA, there was no main effect of time (F (3, 201) = 1.83, p = .14, η_p^2= 0.03), but a significant main effect for condition (F (2, 67) = 6.90, p = .002, η_p^2 = 0.17), and a significant large interaction between condition and time (F (6, 201) = 13.13, < .001, η_p^2 = 0.28), For PA, we found a significant change over time (F (3, 201) = 11.31, p <.001, η_p^2 = 0.14) but not by condition (F (2, 67) = 0.75, p = .48, η_p^2 = 0.02), and a significant interaction between condition and time (F (6, 201) = 10.80, p < .001, η_p^2 = 0.24).

Affect Changes During Mood Induction

As evidence for the effectiveness of our mood induction procedure, we expected a decrease in PA and increase in NA (negative mood induction), an increase in PA and decrease in NA (positive mood induction), and no change in PA or NA (neutral mood induction) *between pre- and post- mood induction.* We first assessed individual participant shifts in PA and NA affect between pre- and post- induction for each mood condition. For the *negative mood induction* condition, 100% of participants reported a decrease in PA, of which 91.30% reported an increase in NA as intended. The remaining 8.70% reported a decrease in NA. In the *positive mood induction condition*, 91.67% of participants reported an increase in

[15] See Tables S6-S8 in supplementary material of Chapter 6 for correlations between the change in affect—the difference in PA and NA with zone-outs, tune-outs, and target-errors.

PA. Of those 70.83% reported a decrease as intended, with 20.84% reporting no change in NA. Of the remaining 8.33%, all reported an increase in NA, with 4.17% reporting no change, and 4.17% reporting a decrease, in PA.

Per our pre-registration, we next investigated the changes within each mood induction condition. Overall, in the *negative mood condition*, NA increased significantly ($t(22) = -6.31$, $p < .001$, $d = 1.32$; see Figure 6.2A) and PA decreased significantly ($t(22) = 6.32$, $p < .001$, $d = 1.32$; see Figure 6.2B)[16]. These data are consistent with our predictions and with previous research showing the Velten-music mood induction procedure effectively increases participants' negative mood and decreases positive mood (see Joseph et al. 2020; meta-analysis of effect sizes for Velten-music mood induction). In the *positive mood condition*, PA increased significantly ($t(23) = -6.12$, $p < .001$, $d = 1.25$; see Figure 6.2A), but NA remained stable ($t(23) = 1.89$, $p =.07$, $d = 0.39$; see Figure 6.2B). In the *neutral mood condition*, there was no significant change in PA ($t(22) = 1.16$, $p = .26$, $d = 0.24$; see Figure 6.2A) or NA ($t(22) = 1.83$, $p = .08$, $d = 0.38$; see Figure 6.2B) as expected. Taken together, the mood manipulation successfully shifted participants' mood in the predicted direction. Using a Bonferroni-corrected significance level of $p = .0083$ across these six tests would not change the interpretation.

Affect Changes During the SART

As evidence for induced PA and NA weakening through the SART, we expected—based on our pilot data—that during the SART, participants would report a decrease in NA with a stable PA (negative condition), and a decrease in PA and an increase in NA (positive and neutral conditions). Turning first to the *negative condition*, we found a large and significant decrease in NA between post-induction and end SART-1, ($t(22) = 4.79$, $p < .001$,

[16] Post hoc comparisons between PANAS-2 with PANAS-1 PA and NA were conducted for each participant to ensure a mood shifted in the intended direction (See Figure S1 in supplementary materials of Chapter 6).

d = 1.00) but no significant change between SART-1 and SART-2. (z (22) = 0.55, *p* = .59, *d* = 0.15; see Figure 6.2A). We found no significant change in PA from post-induction to the end of SART-1 (*t*(22) = 2.30, *p* = .03, *d* = 0.48); or between SART-1 and SART-2 (*t*(22) = -0.07, *p* = .94, *d* = 0.02; Bonferroni-corrected *p* = .0042, see Figure 6.2B), supporting our hypothesis. Interestingly, we found no difference in participants' NA between pre-induction scores and SART-2 (*t*(22) = 0.68, *p* = .50, *d* = 0.14) indicating that participants' NA returned to pre-induction levels during the SART. However, PA was significantly lower at SART-2 than at pre-induction levels (*t*(22) = 3.91, *p* < .001, *d* = 0.81), indicating that whilst PA improved during the SART, it had not fully repaired to pre-induction levels.

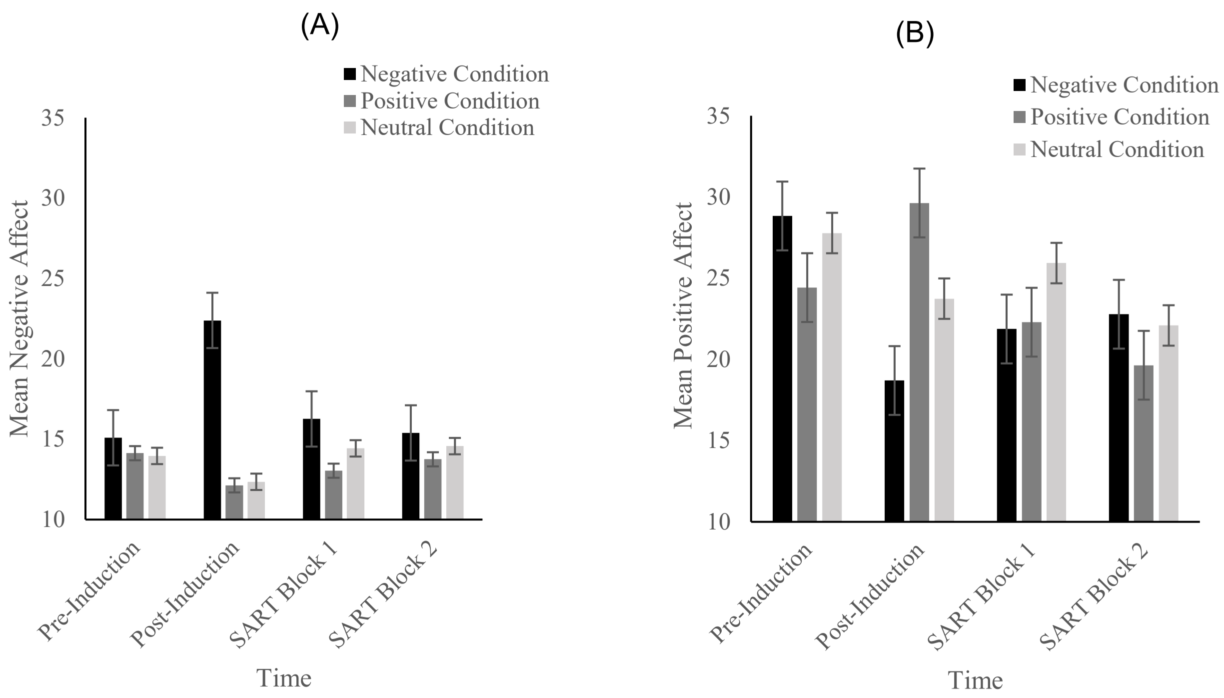
We next examined mood changes in the *positive mood condition.* We found no significant change in NA between post-induction and SART-1 (*t*(23) = 1.35, *p* = .19, *d* = 0.26) or between SART-1 and SART-2 (*t*(23) = 2.81, *p* = .01, *d* = 0.57; see Figure 6.2A) after Bonferroni-corrected *p* = .003 for 18 tests. However, we found large significant decreases in PA between both post-induction and SART-1 (*t*(23) = -6.58, *p* < .001, *d* = 1.25) and between SART-1 and SART-2 (*t*(23) = -3.79, *p* = .001, *d* = 0.79; see Figure 6.2B). Interestingly, participants' PA was significantly lower at the end of SART-2 than pre-induction levels (*t*(23) = 3.22, *p* = .004, *d* = 0.66). This change in PA was larger than an observed Mood Drift effect (*d* = 0.57; Jangraw et al., 2023).

Finally, we examined mood change in the *neutral mood condition***.** We found no change in NA between post-induction and SART-1, (*t*(22) = -2.27, *p* = .02, *d* = 0.47 or between SART-1 and SART-2 (*t*(22) = 0.57, *p* = .58, *d* = 0.12; see Figure 6.2A) after Bonferroni-corrected *p* = .003 for these 18 tests. We found no change in PA between post-induction and SART-1 (*t*(22) = 0.62, *p* = .54, *d* = 0.13) but a large significant decrease between SART-1 and SART-2 (*t*(22) = 5.33, *p* < .001 *d* = 1.11; see Figure 6.2B) over and above the observed Mood Drift effect (Jangraw et al., 2023).

Overall, our results suggest that while the mood induction procedure was effective in eliciting the desired mood, performing the SART significantly weakened the positive and negative induced mood states by reducing NA in the negative condition and reducing PA beyond baseline levels in the positive and neutral conditions, with effect sizes larger than those reported for the Mood Drift Over Time effect. The largest change in both PA and NA occurred within the first 5 minutes during SART-1, however in the neutral/control condition, mood also deteriorated during SART-2. This pattern indicates that the change in mood during the SART is at least in part due to performing the SART.

Figure 6.2

Mean NA (A) and Mean PA (B) for Negative, Positive and Neutral Conditions at Each Time Point (Pre-induction, Post-induction, SART-1, and SART-2)



Mind-Wandering Frequency Over Time

We next examined participants' mind-wandering frequency. We expected that as mood becomes more negative, mind-wandering frequency—both self-report and behavioural—would increase. Using a Bonferroni-corrected significance level of p = .002 for these 24 tests, the repeated measures ANOVA across the various outcome measures showed a main effect of time for *tune-outs* ($F(1, 67) = 11.30$, p =.001, η_p^2= .14), but not for *zone-outs* ($F(1, 67)$ = 5.00, p = .03, η_p^2= .07), *target-errors* ($F(1, 67) = 8.51$, p = .005, η_p^2= .11) or *RTCV* ($F(1, 67)$ = 1.96, p = .17, $\eta_p^2 < 0.03$) between SART-1 and SART-2 (see Figure 6.3). There was no main effect of condition for *tune-outs* ($F(2, 67) = 1.36$, p = .27, η_p^2 = .04), *zone-outs, target-errors*, or *RTCV* (all Fs < 1); nor a condition by time interaction for *tune-outs* ($F(2, 67)$ = 1.65, p = .20, η_p^2 = .05), *zone-outs* ($F(2, 67) = 1.20$, p = .31, η_p^2= .04), *target-errors* ($F(2, 67)$ = 1.69, p = .19, η_p^2 = .05) or *RTCV* ($F(2, 67) = 2.31$, p = .11, η_p^2 = 0.07).

Planned comparisons showed no significant difference in tune-outs (ps: .331 – 1.000) zone-outs (ps = 1.00), or target-errors (ps = 1.00) or RTCV (ps: .09 - .22) over time between SART-1 and SART-2 for the positive, negative, or neutral conditions. These data suggest that participants' mind-wandering pattern was similar across mood induction conditions. Over time, participants tuned-out significantly more often but did not zone-out or commit more errors. Importantly, RTCV was similar across conditions and time suggesting participants' task performance was not affected by disengagement from time-on-task (Mrazek et al., 2011; Thomson et al., 2014; Wang et al., 2014). Given the mood deterioration in the positive and neutral mood conditions through the SART, participants' mind-wandering behaviour may be mimicking participants in the negative mood condition.

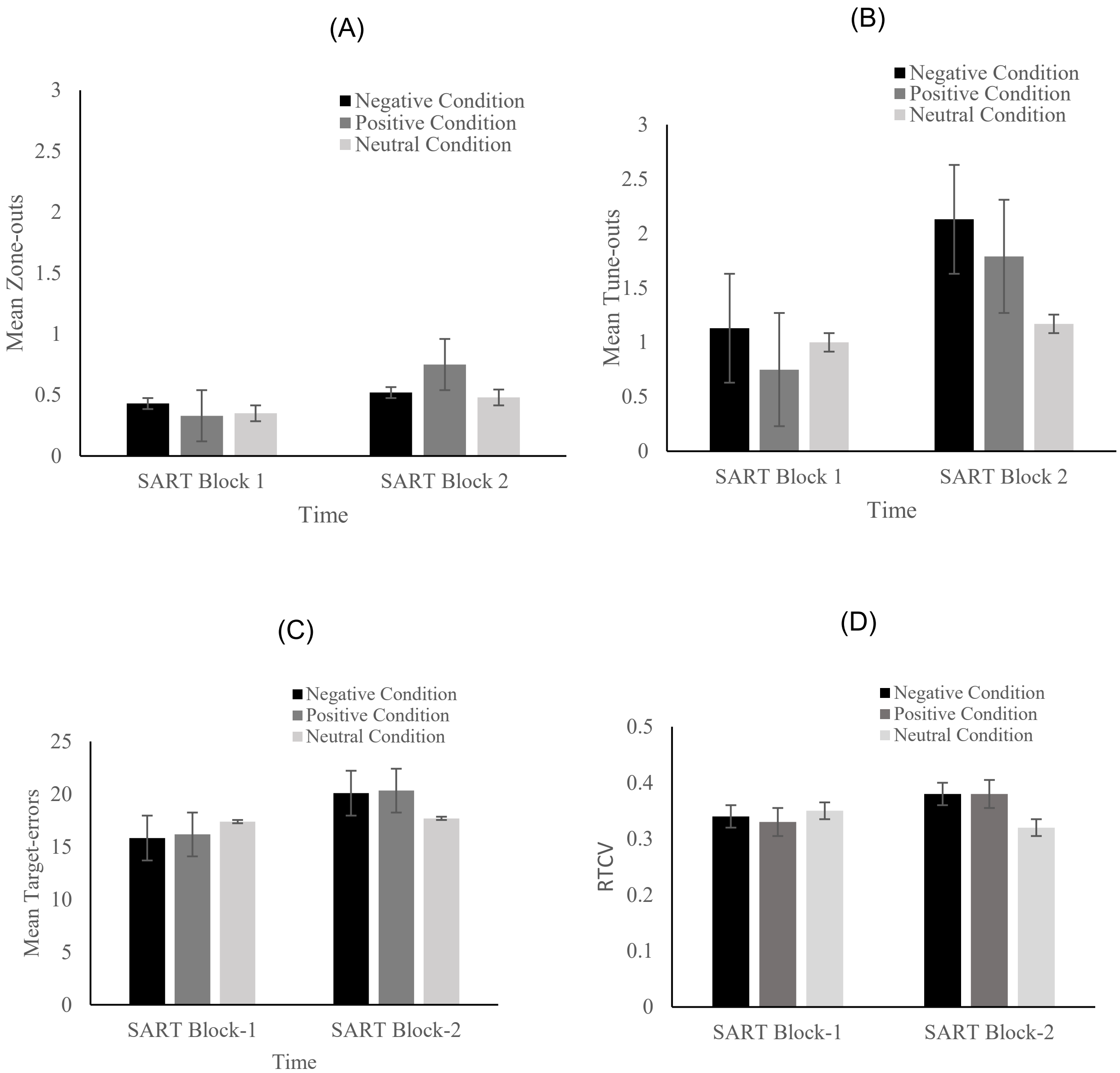
Further, to examine the relationship between affect changes and task performance,[17] we correlated changes in PA and NA—from post induction to SART-1, and from SART-1

[17] We thank the anonymous reviewer for this suggestion

and SART-2—with target-errors and RTCV (performance indicators) separately for each mood induction condition. For changes in NA, we found no significant correlations with target-errors or RTCV in SART-1 or SART-2 across any mood induction conditions (*p*s > .13). Similarly, we found no significant correlations for change in PA and target-errors for the negative and neutral conditions. However, in the *positive condition* we found significant negative correlations between changes in PA (from post-induction to SART-1) and target-errors in both SART-1 ($r = -.43$, $p = .04$) and SART-2 ($r = -.43$, $p = .03$) but no significant correlations with RTCV (*p*s > .22). These results—though interpreted with caution given the small sample size (Schönbrodt & Perugini, 2013; 2018)—suggest only participants in the *positive mood induction* condition showed a decrease in PA in the first SART block that was associated with an increase in target-errors across both SART-1 and SART-2.

Figure 6.3

Mean Zone-outs (A), Tune-Outs (B), and Target-Errors (C) and Response Time Variability (RTCV;D) During SART-1 and SART-2 by Condition



In summary, these data suggest that performing the SART after a mood induction affects participants' PA differently to their NA. Further, decreased PA may influence mind-wandering frequency, as evidenced by participants' similar mind-wandering frequencies in the positive and neutral conditions with participants in the negative condition. Recall that both the positive and neutral groups reported large falls in PA during the SART.

Several factors could explain the change in PA during the SART: (1) the potency of the mood induction is not robust; (2) the MIP itself had unintended mood effects during the SART; or a Mood Drift effect *and/or* the SART had a modifying effect on an induced mood. First, we wondered if the potency of the mood induction was sufficient to effectively change mood. Given the effect sizes for changes in NA and PA during the MIP (*negative condition:* NA increase, PA decrease *ds* > 1.3; *positive condition:* PA increase, NA no change *ds* > 0.89, 0.39; *neutral condition:* no change *ds* < 0.38., 0.39) were large and consistent with previous research (e.g., Blackburn et al., 1990), it is unlikely the potency of the mood induction explains the change in PA during the SART. Second, we observed the opposite pattern of the Mood Drift effect in the negative mood condition: NA decreased during the SART rather than increasing or remaining high, indicating participants felt less distressed and disengaged than during the mood induction. Further, the effect sizes for the decrease in PA in the positive and neutral conditions were larger than observed for a Mood Drift Over Time effect, suggesting mood drift alone may not explain participants' fall in energy and alertness. Thus, possibly the nature of the task (repetitive, low-cognitive load, boring) may account for the decrease in PA. To empirically test this idea, and because we could not rule out the possibility that the MIP had unintended effects on mood during the SART (i.e., given the decrease in PA in the neutral mood condition), we ran Study 2—a replication of Study 1—*without* the mood induction.

As evidence the MIP did not have unintended mood effects through the SART, we expected that the pattern of results when performing the SART without a mood induction would be similar to the neutral mood induction condition in Study 1—i.e., that participants would report a large decrease in PA and an increasing trend in NA across the SART.

Study 2

Method

Participants

We determined from Study 1 that for the mood induction effects to weaken through the SART—ranging from Cohen's *d* = 1.30 to 1.32—it would need to have at least a medium effect. We therefore calculated our sample size using *d* = 0.50, *α* = .05, power = .95, for a paired samples t-test in G*Power (Erdfelder et al., 1996), generating a recommended sample size of 54 usable participants. We recruited 55 participants—72.0% female, $M(SD)_{age}$ = 24.3 (8.4) years—from the Flinders University participation pool in exchange for course credit. We preregistered this study (see: https://osf.io/fsvc5).

Materials and Procedure

All materials were consistent with Study 1 except for the exclusion of the Mood Induction Procedure and baseline BDI. Thus, all participants completed a pre-SART PANAS followed by a 5-minute SART block (SART-1), a second PANAS followed by a second SART block (SART-2) and then a final PANAS.

Results

Statistical Analyses

We ran paired samples t-tests to examine the change in PA and NA at each pair of time points: Pre-SART and SART-1; Pre-SART and SART-2; SART-1 and SART-2. We ran paired samples t-tests to examine the change in mind-wandering frequency (tune-outs, zone-outs, and target-errors) across the two time points (SART-1 and SART-2) as mood deteriorated (and Table S4 in supplementary material for descriptive statistics).

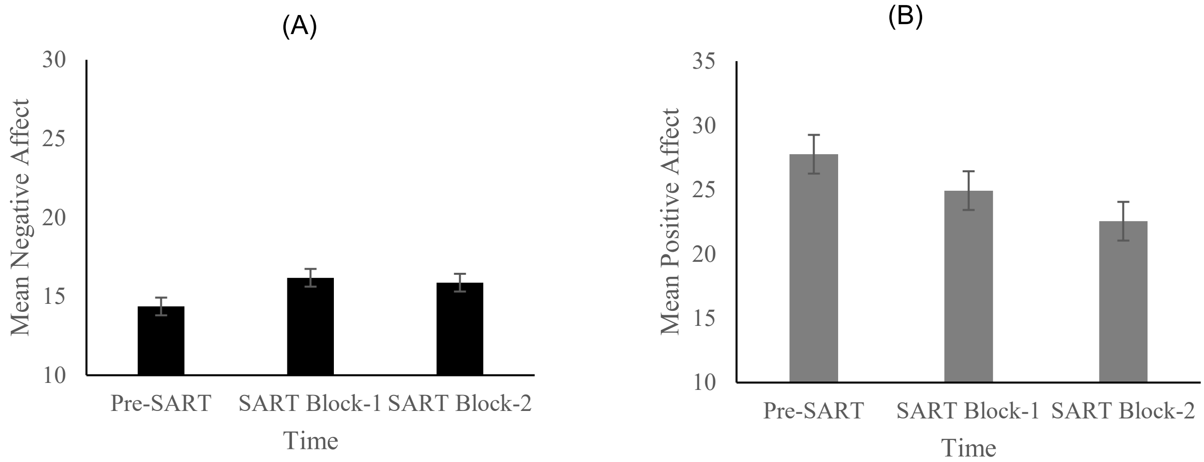
Affect Changes During the SART

We found a significant small *increase* in NA between Pre-SART and SART-1 ($t(54) = 2.87$ $p < .001$, $d = 0.39$), and no difference between SART-1 and SART-2 ($d = 0.09$). We found a significant large *decrease* in PA between Pre-SART and SART-1 ($t(54) = 4.89$, $p < .001$, $d = 0.66$), with a further decrease between SART-1 and SART-2 ($t(54) = 4.32$, $p < .001$, $d = 0.58$). Naturally then, PA was different at the end of the SART task (SART-2) compared with baseline (pre-SART; $t(54) = 6.51$, $p < .001$, $d = 0.88$). Again, this effect size was larger than the observed Mood Drift effect ($d = 0.57$; Jangraw et al., 2023)

Taken together, these results suggest that participants' mood deteriorates when they perform the SART—PA decreases and NA remains stable. The largest fall in PA occurred during the first 5 minutes of performing the SART (SART-1) then the rate of change decreased during the second 5-minute block (SART-2).

Figure 6.4

Mean Negative (A) and Positive Affect (B) Over Time



Mind-Wandering Changes Over Time

We were also interested in mind-wandering changes over time whilst participants performed the SART. We found a significant increase in tune-outs ($M(SD)_{\text{Diff}} = 0.67$ (1.07), $t(26) = -3.23$, $p = .003$, $d = 0.62$), an increasing trend in target-errors with a small effect ($M(SD)_{\text{Diff}} = 1.79$ (6.94), $t(50) = -1.90$, $p = .07$, $d = 0.28$), and a significant difference in

RTCV ($M(SD)_{\text{Diff}}$ = 0.06 (0.14), $t(53) = 3.02$, $p = .004$, $d = 0.41$) between SART-1 and SART-2, but no difference in reported zone-outs ($M(SD)_{\text{Diff}}$ = 0.36 (1.03), $t(10) = -1.17$, $p = .27$, $d = 0.35$; Bonferroni corrected $p = .0063$ for eight tests).

Taken together, the data from Study 2 suggest that participants feel less happy and engaged (decreased PA) when they perform the SART. Over time, as participants felt less happy, they tuned-out more often and their RTCV increased, but there was no change over time in the number of zone-outs and target-errors they reported. The increased RTCV also indicates that participants may have mind-wandered more the longer they spent on the task, but their task performance was not impaired.

While these data are consistent with our expectations, they differ slightly to the neutral condition in Study 1, where we found a significant fall in PA in SART-2 but not SART-1, with no change to tune-outs and zone-outs or RTCV. One possible explanation is the neutral mood induction in Study 1 may have unintentionally sustained participants' interest for longer during the SART, preventing disengagement to the extent found in SART-2.

General Discussion

In two studies, we assessed whether performing the SART—commonly used in mind-wandering and mood research—weakens an induced mood state or has an overall negative impact on participants' mood. Further, we examined whether a change in participants' mind-wandering occurred alongside a change in affect. Mood was operationalised as PA (high scores indicate feeling active and alert; low scores indicate lethargy and sadness) and NA (high scores indicate feelings anger, and nervous; low scores indicate calmness and serenity; Watson et al., 1988).

In Study 1 we assessed mood changes during the SART after participants had been induced into a specified mood state: either negative, positive, or neutral. As predicted, participants' mood initially changed in the direction of the manipulation: participants in the negative condition felt more negative while participants in the positive condition felt more positive. However, while completing the SART, participants' induced mood weakened. Participants induced into a negative mood reported less NA but maintained a lower PA as expected. These results are consistent with Stawarczyk et al. (2013) but diverge from Jonkman et al. (2017) who found lower positive affect over the course of the SART but no change in NA. Overall, these studies show that participants induced in a negative mood felt improved after the SART. Conversely, participants induced into a positive mood reported less PA as expected but maintained their baseline NA which was contrary to expectations. Again, whilst the change in positive affect is consistent with Jonkman et al. (2017), the stable NA we found here diverges from their findings (i.e. increase in NA). However, overall, these studies show participants induced into a positive mood felt worse after the SART. Together, these data suggest that the mood induction procedure was effective in eliciting the targeted mood, but this mood shift was weakened when performing the SART.

In Study 2, we replicated Study 1 without the MIP to ensure the mood induction in our neutral condition (our mood control condition) did not affect the change in mood through the SART. After completing the SART, participants reported less PA with an increase in NA—compared to baseline affect. These results differ from the neutral condition in Study 1, which showed participants' NA remained stable across both SART blocks, and PA decreased only in SART-2. Overall, in line with our prediction, participants' induced mood weakens following a mood induction, and becomes more negative in the absence of a mood induction while performing the SART. However, participants may have felt less engaged during the SART when they were not induced into a neutral mood (Study 2), indicating the neutral mood induction may have sustained participants' engagement with the SART, an unintended consequence of the mood induction.

The change in affect can be explained by the nature of the SART. For participants in the *positive condition,* the activation of positive schema and associated spreading activation that initially made participants feel more energetic, engaged, and self-confident was not sustained through the SART. Instead, the "uh oh" reaction made repeatedly when making errors rate may have activated opposing negative schema such as "I am a failure", decreasing participants' self-confidence and engagement, and increasing lethargy as the task proceeded. Participants' NA was unchanged after the induction, possibly because the activated negative schema were associated with depressive feelings rather than heightened nervousness. For participants in the *neutral condition* (Study 1), and those who did not receive a mood induction (Study 2), the decrease in PA was similar to the positive condition, suggesting that when the experience of performing the SART is negative—e.g., potentially producing lethargy, disengagement, and decreased self-confidence—and aligns with existing schema, these schemas are activated.

Conversely, participants in the *negative condition* showed the opposite pattern of results, i.e., an increase in PA and a decrease in NA. Possibly the negative MIP-activated negative schema increased NA and reduced PA, making participants feel nervous, disengaged, sadder and less self-confident. However, performing the SART may have distracted participants from focusing on their negative schema, making them feel less nervous and agitated, but performing the SART was not sufficient to repair participants' induced feelings of sadness and disengagement.

An alternative explanation for our results is that participants' mood changed due to the time spent on the SART (two 5-minute blocks), which may have led them to experience cognitive fatigue or disengagement from sustaining attention (i.e., increase in NA; Randall et al., 2014; Robertson et al., 1997)._ Matthews et al. (2002) argue that pre-task post-task mood change depends on task type and demands. More demanding tasks such as WMC tasks, activate an “overload mode”—characterised by increased energy and tension—leading to distress with longer time on the task. But less demanding tasks requiring sustained attention, such as vigilance tasks, activate the “fatigue mode”—characterised by decreased motivation and task disengagement—that is associated with poorer task performance. Because the SART is monotonous and boring, it arguably resembles a vigilance task and may have led to the fall in PA. However, task performance measured as target-errors was not significantly different over the two SART blocks across mood induction conditions, even after controlling for response variability. This result suggests that while the task itself may facilitate a fatigue or disengagement response, perhaps the shorter 10-minute length of the SART was not sufficient for vigilance decrement (poorer task performance) or to account for the decreased PA.

As a secondary aim, we examined participants’ mind-wandering according to induction condition and alongside mood changes during the SART. In Study 1, mind-wandering frequency over time was similar across negative, positive, and neutral induction mood conditions. As participants’ PA in the positive and neutral mood induction decreased, they became sadder and more lethargic and their mind-wandering behaviour resembled those in the negative mood condition (i.e., mind-wandered more as their PA fell). Study 2 supported this pattern of results, showing an increase in participants’ mind-wandering as their PA decreased. While Stawarczyk et al. (2013) showed increased NA was associated with an increase in mind-wandering, our findings both support (Study 2) and extend prior research by showing that a fall in PA is also related to more mind-wandering.

This research develops our understanding of the mind-wandering and mood relationship. Specifically, when we induce participants in a specific mood state, the subsequent task the participant performs may weaken that induction and consequently confound the outcomes of interest, in this case mind-wandering. When performing the

SART—a repetitive, monotonous, and boring task— participants' PA fell following a positive mood induction. Thus, during the SART, the level of PA became like that of participants induced in a negative mood. Consequently, participants' mind-wandering behaviour begins to equalise across conditions. Conversely, participants induced into a negative mood reported a decrease in NA while PA remained low during the SART. Perhaps participants felt less anxious and angry over time, which may have coincided with reduced mind-wandering compared to if their mood remained low. Again, mind-wandering behaviour begins to equalise across conditions as PA equalises. This pattern is important because previous mind-wandering research that has used a MIP followed by a task to assess mind-wandering—specifically the SART—may be underreporting the size of mood effect on mind-wandering due to the equalizing of PA across induction conditions (see Smallwood et al., 2009).

Our findings may have implications more broadly in research that uses the SART to measure constructs such as sustained attention or response inhibition in ADHD (e.g., Machida et al., 2022). We have shown that people performing the SART experience a deterioration in positive affect indicating they feel less task-engaged and more lethargic. Inattention measured using the SART might, in part, result from an affect change rather than from dispositional inattention alone. Researchers might consider the impact of SART on mood as a potential confound when interpreting results.

Methodological adaptations to the SART may minimise the mood modifying effect in mood research. One adaptation might be to integrate the mood induction protocol into the task used to assess mind-wandering. For example, designing a SART with valenced words as non-target stimuli and non-words as target stimuli might help to maintain a positive or negative mood throughout the SART by continuing to activate the associated schema.

Alternatively, continuing valenced music throughout the SART might overcome the negative impact of the SART.

Our research is limited by factors we did not address. First, we did not capture the content of participants' mind-wandering when performing the task to determine if indeed the SART was activating opposing or aligning schema to the mood induction. Without these data we cannot determine whether participants' negative thoughts are related to the task itself (e.g., "this is so boring, when will it finish") or if the task is inducing more negative schematic thoughts (e.g., "I'm so bad at this, I'm stupid"). Second, we focused on *affect changes* that occur when performing a single task—the SART—and consequently cannot make causal claims that the SART alone alters mood. We observed that the induced mood weakened as participants completed the SART and suggest that this weakening occurred because of the nature of the task (i.e., repetitive, low-cognitive load, boring). As such, the SART may induce negative schema associated with a negative mood. However, future research comparing the SART to a control task, such as a n-back task, that matches the SART on duration (e.g., controlling for the overload mode effect) and cognitive load (e.g., controlling for the fatigue mode effect) would support more causal claims. Third, we compared our effect sizes with the *Mood Drift Over Time effect,* which was measured using a single item. Future research using a similar scale would enable a more precise effect size comparison to determine whether affect changes are solely due to the weakening of mood during the SART or to a Mood Drift Over Time effect. Fourth, following the Sinclair et al. (1994) incubation protocol, participants in the neutral condition were instructed to "clear your mind of any mood-related thoughts". Participants potentially interpreted this as an instruction to clear their mind of all thoughts, which resembles a brief mindfulness meditation instruction[18]—a practice known to promote positive emotions (e.g., Lindsay et al., 2018).

[18] We thank the anonymous reviewer who suggested this possibility.

Future research using this protocol might remove this instruction to minimize unintended mood changes in the neutral condition. Fifth, we did not measure mood concurrently with mind-wandering during the SART blocks, so we cannot determine whether changes in mood occur at the same time as episodes of mind-wandering. Future research could explore this further by assessing momentary mood and thought content simultaneously to identify more immediate associations. Sixth, we assumed that negative schemas were uniformly activated in the negative mood induction condition. But it is possible that participants with current and remitted depression experienced greater negative schema activation than healthy participants, considering negative schemas are a vulnerability factor in the development of MDD (e.g., Gibb & Coles, 2005). Nonetheless, in the negative mood condition, all participants reported a decrease in positive affect, and 91.3% reported an increase in negative affect suggesting that all participants identified with enough of the Velten statements to induce a meaningful mood shift—achieving the intended outcome of the induction. Finally, we cannot conclude that our neutral mood condition controlled for regression to the mean. Future research including a control condition may clarify if the mood effect is the result of participants' natural return to baseline or if it is task-related. Additionally, future research that includes an arousal measure (e.g., ratings of excitement/calmness) alongside the thought probes could be used to control for arousal-related changes that may have influenced mood during the SART.

Conclusion

Laboratory research investigating the mood, mind-wandering relationship is challenged by the ability to reliably measure mind-wandering. While an in-lab task performed when measuring mind-wandering—e.g., the SART—shares characteristics with tasks performed during naturally occurring mind-wandering, their use with a mood induction protocol is questionable. We have shown that participants' induced mood weakens as they complete the subsequent SART so that participants induced into a negative mood feel better whilst those in a positive induced mood feel worse. This equalising of moods potentially leads to a merging of mind-wandering rates between the groups—participants in the positive condition report greater mind-wandering alongside their declining mood while participants in the negative condition report less mind-wandering alongside their improving mood. Further, we showed when participants perform the SART without a mood manipulation, they feel less happy and less engaged. Adapting the SART to minimize mood effects could help overcome the confounding effect of the SART.

Supplementary Materials

Table S1

Study 1: Mean (Standard Deviation) Negative Affect (NA) and Positive Affect (PA) for Overall and Split by Condition at Four Time Points

Condition	Affect	Range	Time			
			Pre-Induction	Post-Induction	SART-1	SART-2
Overall (*n* = 70)	NA	10 - 50	14.39 (4.99)	15.57 (7.14)	14.56 (4.84)	14.56 (4.27)
	PA	10 - 50	26.97 (9.65)	24.10 (9.45)	23.17 (8.25)	21.40 (9.07)
Negative (*n* = 23)	NA	10 - 50	15.09 (4.93)	22.39 (7.03)	16.26 (5.59)	15.70 (4.69)
	PA	10 - 50	27.22 (7.10)	18.70 (5.76)	21.87 (7.12)	21.96 (9.03)
Positive (*n* = 24)	NA	10 - 50	14.13 (4.88)	12.13 (5.19)	13.04 (4.08)	14.25 (4.31)
	PA	10 - 50	23.71 (7.77)	29.88 (8.82)	22.42 (8.73)	19.33 (8.60)
Neutral (*n* = 23)	NA	10 - 50	13.96 (5.33)	12.35 (3.16)	14.43 (4.38)	14.67 (4.65)
	PA	10 - 0	27.22 (9.16)	24.87 (8.92)	25.61 (8.77)	22.30 (9.86)

Table S2

Study 1: Change in Positive Affect (PA) and Negative Affect (NA) Across Conditions and Time Using Bayesian Analyses

Condition	Affect	Bayes Factor – Repeated Measures ANOVA		Bayes Factor Pair Samples *t* test		
				Pre–Induction /Post-Induction	Post-Induction /SART-1	SART-1 /SART-2
Negative	NA	BF_{10}	$3.617\text{x}10^{+6}$	8023.55	303.1	0.3
		Evidence	Strong for H_1	Strong for H_1	Strong for H_1	Weak for H_1
	PA	BF_{10}	24608.63	8946.5	1.93	0.3
		Evidence	Strong for H_1	Strong for H_1	Weak for H_1	Weak for H_0
Positive	NA	BF_{10}	0.34	0.99	0.48	0.36
		Evidence	Weak for H_1	Weak for H_1	Weak for H_1	Weak for H_0
	PA	BF_{10}	$1.67\ \text{x}10^{+7}$	128.57	10498.61	43.8
		Evidence	Strong for H_1	Strong for H_1	Strong for H_1	Strong for H_1
Neutral	NA	BF_{10}	0.09	0.91	1.82	0.23
		Evidence	Weak for H_1	Weak for $H_{1/0}$	Weak for H_1	Moderate for H_0
	PA	BF_{10}	1.66	0.97	0.37	981.78
		Evidence	Weak for H_1	Weak for $H_{1/0}$	Weak for H_0	Strong for H_1

H_0 =Null Hypothesis, H_1 = Alternative Hypothesis

Table S3

Study 1: Descriptives of, and Changes in, Mind-Wandering Indices (Zone-Outs, Tune-Outs and Target-Errors) Across the SART for Each Condition Using Bayesian Analyses

Condition			*Means (Standard Deviations)*		Bayes Factor - Paired Samples t-test	
	n		SART-1	SART-2		SART-1/SART-2
Negative	23	Zone-outs	0.43 (0.59)	0.52 (0.85)	BF_{10}	0.27
					Evidence	Moderate evidence for H_0
		Tune-outs	1.13 (1.25)	2.13 (1.74)	BF_{10}	5.28
					Evidence	Moderate evidence for H_1
		Target-errors	10.65 (4.94)	12.44 (5.66)	BF_{10}	0.38
					Evidence	Moderate evidence for H_0
		Reaction Time Variability	0.34 (0.17)	0.38 (0.20)	BF_{10}	0.33
					Evidence	Moderate evidence for H_0
Positive	24	Zone-outs	0.33 (0.64)	0.75 (0.90)	BF_{10}	1.97
					Evidence	Weak evidence for H_1
		Tune-outs	0.75 (1.19)	1.79 (1.64)	BF_{10}	2.78
					Evidence	Weak evidence for H_1
		Target-errors	10.54 (5.79)	12.42 (6.47)	BF_{10}	0.30
					Evidence	Moderate evidence for H_0
		Reaction Time Variability	0.33 (0.11)	0.38 (0.20)	BF_{10}	0.66
					Evidence	Moderate evidence for H_0
Neutral	23	Zone-outs	0.35 (0.65)	0.48 (0.73)	BF_{10}	0.28
					Evidence	Moderate evidence for H_0
		Tune-outs	1.00 (1.28)	1.17 (1.59)	BF_{10}	0.24
					Evidence	Moderate evidence for H_0
		Target-errors	10.78 (4.81)	10.74 (5.98)	BF_{10}	0.22
					Evidence	Moderate evidence for H_0
		Reaction Time Variability	0.35 (0.09)	0.32 (0.12)	BF_{10}	0.58
					Evidence	Moderate evidence for H_0

H_0 =Null Hypothesis; H_1 = Alternative Hypothesis

Table S4

Study 2: Descriptives of, and Changes in, Negative Affect (NA), Positive Affect (PA) and Mind-Wandering Indices (Zone-Outs, Tune-Outs and Target-Errors) Across the SART for Each Condition Using Bayesian Analyses (n = 55)

	Mean (Standard Deviations)						Bayes Factor - Paired Samples *t* test	
	Pre-SART	*n*	SART-1	*n*	SART-2		Pre-SART/SART-1	SART-1/SART-2
NA	14.36 (4.21)	55	16.18 (5.67)	55	15.87 (5.71)	BF_{10}	5.70	0.19
						Evidence	Moderate evidence for H_1	Moderate evidence for H_0
PA	27.76 (4.94)	55	24.93 (6.80)	55	22.55 (7.76)	BF_{10}	1967.54	320.8
						Evidence	Strong Evidence for H_1	Strong Evidence for H_1
Zone-Outs		24	1.25 (0.53)	16	1.56 (1.03)	BF_{10}		0.52
						Evidence		Weak evidence for H_0
Tune-Outs		29	1.82 (1.00)	41	2.07 (1.37)	BF_{10}		11.75
						Evidence		Strong Evidence for H_1
Target-Errors		54	17.91 (9.61)	54	19.72 (1.74)	BF_{10}		0.77
						Evidence		Weak evidence for H_0
Reaction Time Variability		54	0.11 (0.02)	54	0.22 (0.03)	BF_{10}		6.67
								Moderate Evidence for H_1

Table S5

Repeated Measure ANOVA Results of Multiple Imputation Datasets with BDI Entered as Co-Variate

Dataset (*df*)		Repeated Measures ANOVA								
		Time			Condition			Time* Condition		
		F	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Original (4,53)	NA	2.17	.09,	.04	9.38	<.001	.26	13.05	<.001	.33
	PA	9.65	<.001	.15	0.21	.81	.01	11.30	<.001	.3
Imputation 1 (4,65)	NA	2.50	.06	.04	10.42	<.001	.24	12.35	<.001	.28
	PA	6.94	<.001	.10	0.48	.63	.01	9.30	<.001	.22
Imputation 2 (4,65)	NA	2.94	.03	.04	10.44	<.001	.24	12.46	<.001	.28
	PA	4.81	.003	.07	0.65	.63	.01	9.24	<.001	.22
Imputation 3 (4,65)	NA	2.90	.04	.04	9.92	<.001	.23	12.51	<.001	.27
	PA	6.26	<.001	.09	0.43	.66	.01	9.35	<.001	.22
Imputation 4 (4,65)	NA	2.47	.06	.04	9.91	<.001	.23	12.43	<.001	.28
	PA	6.62	<.001	.09	0.45	.64	.01	9.34	<.001	.22
Imputation 5 (4,65)	NA	2.81	.04	.04	10.11	<.001	.24	12.42	<.001	.28
	PA	5.51	<.001	.08	0.46	.64	.01	9.30	<.001	.22

Table S6

Correlations Between the Change in PA and NA for Each Time Pair (Post-induction and SART Block-1; SART Block-1 and SART Block-2) with Mind-Wandering Indices (Tune-Outs, Zone-Outs and Target-Errors) for the Positive Mood Induction Condition

		PA Change T2T3	NA Change T2T3	Tune-Outs S1	Zone-Outs S1	Target-Errors S1	PA Change T3T4	NA Change T3T4	Target-Error S2	Tune-Outs S2
NA Change T2T3	*r*	-0.278	—							
	p	0.189	—							
Tune-Outs S1	*r*	-0.304	0.126	—						
	p	0.149	0.557	—						
Zone-Outs S1	*r*	-0.052	-0.089	0.287	—					
	p	0.808	0.680	0.174	—					
Target-Errors S1	*r*	-0.426	0.307	-0.010	-0.187	—				
	p	0.038	0.145	0.962	0.382	—				
PA Change T3T4	*r*	0.114	0.030	0.309	-0.038	-0.138	—			
	p	0.596	0.891	0.142	0.862	0.521	—			
NA Change T3T4	*r*	-0.121	0.313	0.272	0.132	0.300	0.186	—		
	p	0.574	0.136	0.199	0.537	0.155	0.384	—		
Target-Error S2	*r*	-0.433	0.284	0.077	-0.119	0.917	-0.143	0.320	—	
	p	0.035	0.179	0.721	0.581	< .001	0.504	0.128	—	
Tune-Outs S2	*r*	-0.401	-0.083	-0.006	-0.180	0.583	-0.272	-0.061	0.595	—
	p	0.052	0.701	0.979	0.399	0.003	0.198	0.779	0.002	—

		PA Change T2T3	NA Change T2T3	Tune-Outs S1	Zone-Outs S1	Target-Errors S1	PA Change T3T4	NA Change T3T4	Target-Error S2	Tune-Outs S2
Zone-Outs S2	*r*	-0.163	0.051	0.265	0.381	0.095	0.210	0.033	0.033	-0.214
	p	0.448	0.813	0.211	0.067	0.659	0.325	0.877	0.879	0.315

Note: T2 = Post-induction; T3 = SART Block-1; T4 = SART Block-2

Table S7

Correlations Between the Change in PA and NA for Each Time Pair (Post-induction and SART Block-1; SARTBlock-1 and SART Block-2) with Mind-Wandering Indices (Tune-Outs, Zone-Outs and Target-Errors) for the Negative Mood Induction Condition

		PA Change T2T3	NA Change T2T3	Tune-Outs S1	Zone-Outs S1	Target-Errors S1	PA Change T3T4	NA Change T3T4	Target-Error S2	Tune-Outs S2
NA Change T2T3	*r*	-0.399	—							
	p	0.059	—							
Tune Outs S1	*r*	-0.403	0.191	—						
	p	0.057	0.383	—						
Zone Outs S1	*r*	0.318	-0.034	0.289	—					
	p	0.139	0.878	0.182	—					
Target Errors S1	*r*	-0.248	0.138	0.404	-0.016	—				
	p	0.254	0.531	0.056	0.941	—				
PA Change T3T4	*r*	0.180	0.024	0.264	0.072	0.307	—			
	p	0.411	0.915	0.223	0.746	0.155	—			
NA Change T3T4	*r*	0.266	-0.407	-0.129	0.058	-0.320	-0.625	—		
	p	0.220	0.054	0.559	0.792	0.137	0.001	—		
Target Error S2	*r*	-0.335	0.195	0.529	0.253	0.680	0.065	-0.146	—	
	p	0.119	0.372	0.009	0.243	< .001	0.768	0.507	—	
Tune Outs S2	*r*	-0.310	0.427	0.408	0.031	0.174	0.066	-0.295	0.445	—
	p	0.150	0.042	0.053	0.889	0.427	0.765	0.171	0.034	—
Zone Outs S2	*r*	0.243	-0.100	0.019	0.709	-0.040	-0.041	-0.006	0.230	-0.079

	PA Change T2T3	NA Change T2T3	Tune-Outs S1	Zone-Outs S1	Target-Errors S1	PA Change T3T4	NA Change T3T4	Target-Error S2	Tune-Outs S2
p	0.264	0.650	0.933	< .001	0.857	0.854	0.978	0.292	0.719

Note: T2 = Post-induction; T3 = SART Block-1; T4 = SART Block-2

Table S8

Correlations Between the Change in PA and NA for Each Time Pair (Post-induction and SART Block-1; SARTBlock-1 and SART Block-2) with Mind-wandering Indices (tune-outs, zone-outs and target errors) for the Neutral Mood Induction Condition

		PA Chang T2T3	NA Change T2T3	Tune Outs S1	Zone Outs S1	Target Errors S1	PA Change T3T4	NA Change T3T4	Target Error S2	Tune Outs S2
NA Change T2T3	*r*	-0.548	—							
	p	0.007	—							
Tune Outs S1	*r*	-0.223	-0.226	—						
	p	0.307	0.301	—						
Zone Outs S1	*r*	0.017	-0.234	0.384	—					
	p	0.938	0.282	0.070	—					
Target Errors S1	*r*	0.037	0.115	-0.131	0.057	—				
	p	0.866	0.600	0.550	0.796	—				
PA Change T3T4	*r*	-0.022	-0.285	0.096	0.223	0.066	—			
	p	0.922	0.187	0.665	0.307	0.764	—			
NA Change T3T4	*r*	0.017	-0.057	0.289	-0.002	0.121	-0.299	—		
	p	0.939	0.795	0.180	0.994	0.581	0.165	—		
Target Error S2	*r*	-0.211	0.208	-0.082	0.145	0.837	-0.043	0.237	—	
	p	0.334	0.340	0.709	0.509	< .001	0.845	0.276	—	
Tune Outs S2	*r*	-0.256	0.407	0.247	-0.062	-0.037	-0.239	0.210	0.252	—
	p	0.238	0.054	0.257	0.780	0.868	0.273	0.337	0.246	—

		PA Chang T2T3	NA Change T2T3	Tune Outs S1	Zone Outs S1	Target Errors S1	PA Change T3T4	NA Change T3T4	Target Error S2	Tune Outs S2
Zone Outs S2	*r*	0.117	-0.211	0.486	0.209	-0.073	-0.265	0.120	-0.138	-0.193
	p	0.594	0.334	0.019	0.339	0.740	0.223	0.584	0.529	0.378

Note: T2 = Post-induction; T3 = SART Block-1; T4 = SART Block-2

Table S9

Repeated Measures ANOVA for Logarithm Transformed Data

Affect	*(df)*	Time			Condition			Time*Condition		
		F	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
PA	(3, 66)	16.47	<.001	0.20	0.13	.88	.004	10.09	<.001	0.23
NA	(3, 66)	0.38	.77	.006	14.13	<.001	0.30	7.32	.001	0.18

Table S10

Planned Comparisons for Logarithm Transformed Data

Time Pairs	Affect	Mood Induction Condition								
		Negative			Positive			Neutral		
		t	*p*	*d*	*t*	*p*	*d*	*t*	*p*	*d*
Pre-induction/Post-induction	PA	7.25	<.001	1.51	-5.62	<.001	1.15	2.70	.01	0.58
	NA	-6.72	<.001	1.40	3.02	.006	0.62	3.03	.006	0.65
Post-induction/SART-1	PA	-2.20	.04*	-046	6.19	<.001	1.26	-1.20	.24	0.25
	NA	5.20	<.001	1.08	-1.80	.09	0.37	2.33	.03*	0.49
SART-1/SART-2	PA	-0.35	.73	-0.07	4.37	<.001	0.89	5.33	<.001	1.11
	NA	0.93	.36	0.19	-1.45	.16	-0.30	0.24	.81	0.05

**Not significant at Bonferroni correction p = .0083*

Chapter 7: Can Listening to Valenced Music While Performing the SART Maintain an Induced Mood State?

Author contributions: I developed the study design with the guidance of MKTT. I collected the data, cleaned the data for analysis, and performed the data analysis and interpretation. I drafted the manuscript and MKTT provided critical revisions.

Abstract

Research investigating the relationship between mind-wandering and depression assume an induced mood remains stable during a mind-wandering task. But recent evidence challenges this assumption, suggesting that both induced mood, and baseline mood, weakens or becomes more negative during the SART—a go/no-go mind-wandering task. Here, we modified the protocol by extending mood induction music throughout the SART to sustain participants' induced mood. Participants completed a positive or negative mood induction procedure (self-referenced, valenced statements with matched music). Half of the participants in each condition continued listening to the music during two 5-minute SART blocks (SART-1, SART-2). Mood was measured at four time-points and mind-wandering was assessed through thought probes and behavioural indices (e.g. target-errors). We also asked participants about the content of their last probed thought. After a *positive* mood induction*,* participants' positive affect decreased (SART-1, SART-2) and negative affect increased (SART-2). Conversely, in the *negative mood induction condition,* participants' positive affect increased (SART-1) and negative affect decreased (SART-2). Listening to extended music did not affect mood shifts, but participants who listened to positive music made more errors than those who did not listen to music. Overall, participants' probed thought was SART-related and more negative, regardless of mood induction. These results suggest that mood-shifts during the SART are robust, and that extending valenced music does not prevent moods from weakening.

Introduction

Mind-wandering—when our attention drifts from what we are currently doing, to a different memory, thought or image (Smallwood & Schooler, 2006)—consumes a substantial amount of our waking hours (i.e., up to 50%; Killingsworth & Gilbert, 2010). Given its prevalence, understanding how mind-wandering influences wellbeing is crucial. Research suggests mind-wandering about negative content is associated with negative mood and depression (see Chaieb et al., 2022). In laboratory settings, this relationship is typically examined using a Mood Induction Procedure (MIP), followed by a low-demand cognitive task such as the SART (Robinson et al., 1997) during which mind-wandering frequency is measured (e.g., Smallwood et al., 2009). This protocol assumes that participants' induced mood remains constant during the mind-wandering task and that the mood manipulation is responsible for any mind-wandering outcomes. We know mood shifts negatively when participants rest and perform simple tasks like the SART (i.e., the *Mood Drift Over Time effect;* Jangraw et al., 2023). But participants induced into a mood state (positive, negative, neutral) who then perform the SART have reported falls in positive affect larger than what might be considered a natural mood drift (e.g. Nayda & Takarangi, 2024). These findings raise the question: how do we sustain an induced mood during the SART to ensure that only mood, and not the task, influences mind-wandering behaviour? Our primary aim was to test whether extending part of the mood induction through the task (i.e. the SART) might sustain the induced mood during that task. Our secondary aim was to explore if continuing the mood-induction affected mind-wandering frequency.

A challenge for mood and emotion researchers is designing a Mood Induction Procedure (MIP) that induces *and maintains* a mood state over an extended period, through a subsequent task that measures the construct of interest (e.g., eating behaviour, Cardi et al., 2015; decision-making, Lempert & Phelps, 2014; mind-wandering, Smallwood et al., 2009).

MIPs theoretically induce a mood state by activating schemas—clusters of stored knowledge, beliefs, and assumptions built from life experience—through exposing participants to schema-like events (e.g., film, music, memory), and/or through self-referential statements (termed Velten statements, e.g., in a negative mood induction: "I have too many bad things in my life"; Martin, 1990). Once these schemas are activated, the activation spreads to associated concepts (e.g., "I am no good"; Collins & Loftus, 1975), leading to mood change. It is important, then, that the subsequent task does not interfere with the mood induction (e.g., by disrupting the schema activation spread), which would confound measurement of the construct of interest.

Mind-wandering tasks in laboratory research need to resemble everyday mind-wandering tasks, like reading (i.e., low-cognitive demand, repetitive and well-known tasks; Franklin et al., 2011; Giambra, 1995). One such task is the SART (Robertson et al., 1997)—a go/no-go task that requires participants to respond to frequently presented non-target stimuli (digits 1-2; 4-9), while withholding a response to an infrequently presented target stimulus (digit 3; e.g., Smallwood et al., 2009). Mind-wandering is indexed throughout the SART with thought probes, for example asking participants if they are focused on the task ('yes' = on-task, 'no' = mind-wandering). If the participant indicates mind-wandering, they may then be asked if they were aware they were not focused on the task ('yes' = aware, termed *tune-out*; 'no' = not aware, termed *zone-out*) to index their thought awareness (e.g., Deng et al., 2014). Consistently, such studies show that people mind-wander more often when induced into a negative—rather than a positive—mood (e.g., Smallwood et al., 2009).

However, research suggests people's induced mood weakens while they perform the SART (Jonkman et al., 2017; Nayda & Takarangi, 2024 (Chapter 6); Stawarcyzk et al., 2013b). In one study, participants were induced into a negative, positive or neutral mood (i.e., Velten self-referential statements paired with valenced music; see Marcusson-Clavertz et al.,

2019) before completing two 5-minute SART blocks (Nayda & Takarangi, 2024; Chapter 6). Mood (operationalised as positive and negative affect) was measured at four time-points: pre- and post-induction, and at the end of each SART block (SART-1 and SART-2). Mood was initially successfully manipulated—higher positive (and lower negative) affect in the positive condition, higher negative (and lower positive) affect in the negative condition, and no change in the neutral condition from pre- to post-induction. However, mood shifted *during* the SART. First, participants induced into a negative mood experienced mood *improvement* after the first SART block (i.e., lower negative affect at SART-1 [*Cohen's d* = 1.00]) compared to post-induction; positive affect did not significantly change over the mind-wandering task). Second, participants induced into a positive mood felt increasingly *worse* (i.e., lower positive affect from post-induction to the end of SART-1 [*d* = 1.30], and again, after SART-2 [*d* = 0.79]; negative affect did not significantly change). Finally, participants in the neutral mood condition felt increasingly *worse* after SART-2 (lower positive affect at SART-2 [*d* = 1.11], but no change at SART-1). Importantly, these findings indicate that mood induction effects weaken when people perform the SART, but also mood deteriorates when they are in a neutral mood.

Nayda and Takarangi (2024) ran a second study, without a mood induction, to control for any unintended mood induction procedure effects on mood during the SART in the neutral condition. Participants reported positive and negative affect at baseline, and after each two 5-minute SART blocks. Participants reported lower positive affect between baseline and SART-1 (*d* = 0.66), and between SART-1 and SART-2 (*d* = 0.58), with no change in negative affect. Thus, as participants performed the SART, they felt less happy. Together, these studies highlight the possibility that if participants' positive mood is not maintained during the SART (i.e., if the induced mood effect weakens), they may mind-wander more often than if their mood remained stable. Similarly, if participants' induced negative mood is not maintained through the SART, they may be less likely to mind-wander than if their induced mood remained stable.

There are three possible explanations for the mood shift during the SART. First, mood may have shifted due to the *Mood Drift Over Time effect*—a naturally occurring negative mood shift during rest and simple tasks (Jangraw et al., 2023). This drift effect is a robust, medium effect (d = 0.57; N = 28,482) found across multiple in-lab and online studies and multiple tasks (i.e., gambling, visuomotor) and was only absent when participant freely chose their activities during rest (e.g., standing, reading the news, thinking). Although Jangraw et al., (2023) used a single item (i.e. *"How happy are you at this moment*?"; 1 = Very unhappy, 9 = Very happy), making effect size comparisons between studies with different measures difficult, this finding provides a guide to determine how much of an observed mood shift might be attributed to a natural mood drift, and to performing the SART. Given the effect sizes in Nayda and Takarangi (2025; Chapter 6) are mostly greater than those found for the Mood Drift Over Time effect, such mood changes may not be solely attributed to mood shifting naturally. Second, perhaps participants' mood became more negative because of the time spent on the task. That is, spending a considerable amount of time completing a cognitive task like the SART can cause cognitive disengagement and in turn, negatively impact participants' mood (Mrazek et al., 2014; Wang et al., 2014). However, mood inductions can last for up to 25 minutes (Sinclair et al.,1994) and given participants spent 10 minutes performing the SART, the induction was likely potent enough to sustain the induced mood. Finally, participants' mood may have been unintentionally affected by the characteristics of the task itself. For example, the SART's characteristics (e.g., repetitive, boring, monotonous) may inhibit schema activation spread or opposing schema activation. If this is the case, it is important to consider how we can sustain induced mood to overcome these potential negative aspects of the SART. This is the issue we focused on addressing here.

We modified the protocol to continue playing the valenced music from the mood induction through the SART to potentially sustain the schema activation and the induced mood. While mood induction effects (e.g., Velten statements) can last up to 25 minutes (e.g., Sinclair et al., 1994), their duration may depend on the subsequent task. Vastfjall (2002) suggested that mood fluctuates even during short experimental tasks. Playing valenced music through the SART may reinforce the initial mood induction and sustain the induced mood. Therefore, we investigated whether this method would (1) maintain the induced mood, and consequently, (2) increase mind-wandering in the negative condition (as mood stays negative) and reduce mind-wandering in the positive condition (as mood stays positive). Participants were randomly assigned to a positive mood induction or a negative mood induction condition. Within each mood induction, participants were allocated to one of two SART types: *SART with music* (participants continued to listen to the mood induction music during the SART); or *SART no music* (participants did not listen to music during the SART). We measured participants' positive and negative affect at four timepoints: pre- and post-induction, and at the end of two consecutive 5-minute SART blocks.

As evidence for an effective initial mood manipulation, we expected participants in the positive condition to report higher positive affect and lower negative affect at post-mood induction (vs. pre-mood induction) for both SART types (*SART with music* and *SART without music*). Similarly, for the negative condition, we expected participants to report higher negative affect and lower positive affect at post-mood induction (vs. pre-mood induction) for both SART types (*SART with music* and *SART without music*).

To assess our primary aim—whether listening to valenced music through the SART would maintain an induced mood—we compared the change in positive and negative affect between SART types for participants induced into a *positive mood*, and separately for participants induced into *negative mood*. As evidence for maintaining an induced mood, we expected that participants induced into a *positive mood* would report higher positive affect and lower negative affect at the completion of SART-1 and SART-2 in the *SART with music* (vs. *SART without music*) type. We also expected that participants induced into a *negative mood* would report higher negative affect and lower positive affect at the completion of SART-1 and SART-2 in the *SART with music* (vs. *SART without music*) type.

To examine our second aim—whether continuing music through the SART affected mind-wandering—we compared mind-wandering frequency between participants in the *SART with music* and the *SART without music* type, during SART-1 and SART-2 separately, for each mood induction condition. Given people mind-wander more in a negative mood (Smallwood et al., 2009), we expected participants induced into a *positive mood* would mind-wander more in the *SART without music* (vs. *SART with music*) type. Alternatively, we expected that participants induced into a *negative mood* would mind-wander more in the *SART with music* (vs. *SART without music*) type. We also expected that the difference in mind-wandering frequency between positive and negative mood induction conditions would be greater for the *SART with music (vs. SART without music*) type; an interaction.

Method

Participants

We were interested in at least a medium-sized difference between SART types in both the positive and negative mood induction conditions to demonstrate that extending the mood induction through the SART affects mind-wandering G*Power (Erdfelder et al., 1996) recommends a sample size of 128 usable participants to detect a medium effect size (f = 0.25, alpha = .05, power = .80) in a 2 (mood induction: positive; negative) x 2 (SART type: SART with music; SART without music) between subjects ANOVA. This sample size is adequate to detect a medium effect (*f* [U]= 0.25, alpha = .05, power = .80) in a 2 (SART type: SART with music; SART without music) x 4 (time: pre-induction; post-induction; SART-1; SART-2) mixed ANOVA, where the recommended sample size is 124 useable participants. This sample size is also adequate to detect a large effect (d = 0.80, alpha = .05, power = .80) in planned paired samples one-tailed *t*-tests comparing changes in mood (within each of the four SART type and mood induction combinations) across time points, where the recommended sample size is 108 useable participants.

We recruited 138 participants from the Flinders University participation pool (n = 130) and the community (n = 8). We excluded data from three participants for technical problems. Our final sample consisted of 135 participants (71.5% female, $M[SD]_{age}$ = 20.19 [4.13] years). Participants were randomly allocated to a mood induction condition (positive, negative) and a SART type (with music, without music), resulting in four groups: positive SART with music (n = 34), positive SART without music (n = 35), negative SART with music (n = 33), negative SART without music (n = 33).

Materials

Positive and Negative Affect Scale (PANAS; Watson et al., 1988; see Appendix O)

Participants rated 10 positive (e.g., *"interested"*) and 10 negative (e.g., *"distressed"*) items based on how they presently felt (1 = *Very slightly, or not at all*, 5 = *Extremely*). Positive affect (PA) is a state of feeling highly energetic and pleasurably engaged; higher scores indicate feeling active and alert—while lower scores indicate lethargy and sadness, predictive of depression (Díaz-García et al., 2020). Negative affect (NA) is a state of feeling distressed and unpleasurably engaged; higher scores indicate feelings of anger, contempt, and nervousness, indicative of anxiety, and lower scores indicate calmness and serenity (Watson et al., 1988). The PANAS has high internal consistency (present study: PA αs = .86 - .92; NA αs = .82 - .92), good test-retest reliability (present study: PA *r*s = .60 - .87; NA *r*s = .53 -

.70). The PANAS is frequently used in mood and mind-wandering research to measure mood (e.g., Smallwood et al., 2009).

Mood Induction Protocol (MIP)

We paired the Velten Mood Induction Procedure (VMIP; see Seibert & Ellis, 1991 and Appendix P) with valenced music to induce mood states (e.g., Marcusson-Clavertz et al., 2019). Participants in the positive and negative conditions read 25 self-referential statements (e.g., positive: *"I've got some good friends"*; negative: *"I'm tired of trying"*) written in black font against a white background for 12 seconds each, and 5 minutes total. Next, during an incubation phase, participants were instructed to feel the experience suggested by the statements, to recall a scene when they have had the intended feeling, and then expand on the intended feeling by "*.... concentrate on this feeling. Let it flow"* for a further 3 minutes (Sinclair et al., 1994). Research shows the mood induction protocol with incubation increases the mood effect's duration and potency by up to 35 minutes, while minimising the impact of non-responders (participants who do not report a mood change; Rottenberg et al., 2018; Sinclair et al., 1994). To enhance the intended mood, participants listened to matched valenced music (Positive: *Coppélia, tableau 1 No. 6 Thèm*; Negative: *Adagio in G Minor for Strings*) throughout the MIP and incubation phase (see Westermann et al., 1996). To maintain the mood induction during the SART, valenced music continued for half the participants in the negative and positive induction conditions.

Sustained Attention to Response Task (SART; Robertson et al., 1997)

Our SART was programmed using E-Prime 2.0. Each SART block—SART-1 and SART-2—contained 25 cycles with 9 digits, ranging from 1-9 in random order (non-target digits = '1-2'; '2-9'; target digit = '3'). Each digit appeared 25 times within each SART block, comprising 450 trials across both SART blocks. We instructed participants to press the spacebar for all non-target digits but withhold their response when the target digit appeared.

Each stimulus appeared for 750 ms, with an inter-stimulus interval (mask) of 1250 ms. Digit font sizes varied randomly between 48 and 120 to prevent the task becoming predictable or automatic, and to increase mind-wandering detection through errors (Robertson et al., 1997). Thought probes (e.g., *"Was your attention focused on the task just now?"*) were presented pseudo-randomly in each SART block after a minimum of seven, and a maximum of 43 stimuli. If the participant responded "no" to the first question, we then asked: *"Were you aware that your attention was not focused on the task just now?"* (Y/N), to index participants' mind-wandering meta-awareness. The probes were not time restricted and remained on screen until the participant responded (Christoff et al., 2009; Deng et al., 2014; Robertson et al., 1997). We indexed behavioural mind-wandering as commission error frequency (i.e., responding to the target stimulus '3') during the SART. We also computed the Response Time Coefficient of Variability (RTCV: standard deviation/mean) for non-target trials, a measure of trial-to-trial fluctuations in participants' responses that is also considered an indirect indicator of mind-wandering (Cheyne et al., 2009).

Thought Characteristic Questionnaire (TCQ; e.g. Johnson et al., 1988; Stawarczyk et al., 2011; see Appendix Q)

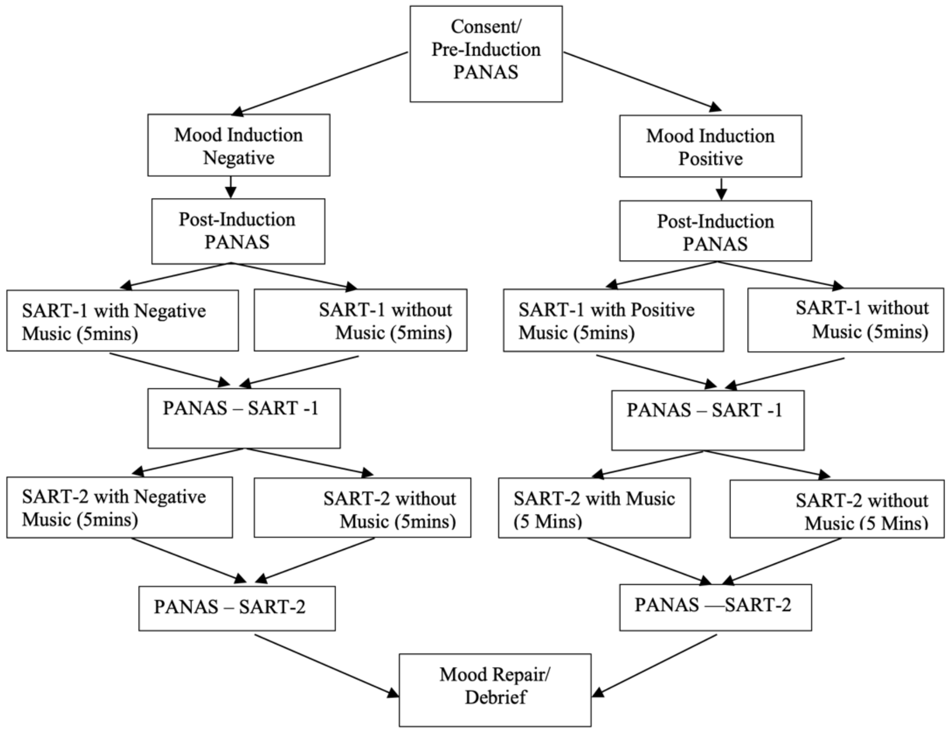
The TCQ is a self-report questionnaire used to assess phenomenological characteristics of thoughts sampled in daily life, derived from the Memory Characteristics Questionnaire. Participants were asked to recall and record (open text box) the thought they experienced immediately prior to the last thought probe. Participants responded to the following five questions: (a) *"How voluntary was the thought?"* (b) *"How related was this thought to a current goal?"* (c) *"How related was this thought to a current concern/worry"* (1 = *Not at all,* 7 = *Completely*); (d) *"How negative/positive was this thought?"* (-3 = *Extremely negative,* +3 = *Extremely positive*). Participants also specified their thought's main function (i.e., *decision/problem solving, planning, reappraisal, felt better, to keep aroused,* *other*). The text responses were coded as (1) on-task (i.e., fully focused on the task-related stimuli; i.e. the numbers); (2) off-task thoughts classified as: a) task-related thoughts (e.g., these about task duration or participants overall performance), and/or (b) off-task/environment related (e.g. noises, light, temperature) and/or (c) off-task/task-unrelated (e.g., thoughts about what they did last evening), where mind-wandering was indexed as task-related and off-task/task-unrelated thoughts. Two independent coders categorised the thoughts with any inconsistencies discussed to reach consensus. Inter-rater reliability for the coded thoughts showed almost perfect agreement (Cohen's k = .88, $p < .001$).

Procedure

We told participants that we were investigating how attention affects mental wellbeing. After providing consent, participants were randomly assigned to one of four types, comprising either a positive or negative mood induction and SART with or without music (see Figure 7.1). Participants completed a baseline PANAS (pre-induction), and the mood induction and incubation period procedure. They then completed the second PANAS (post-induction). Participants completed the first five-minute SART block (SART-1), either with or without valenced music, and the PANAS. Next, they recommenced the SART task for another 5 minutes (SART-2) and completed the final PANAS (see Figure 7.1). To repair mood, all participants completed the positive MIP, were fully debriefed, and compensated (i.e., course credit or $15AUD).

Figure 7.1

Study 1 Procedure



Results and Discussion

Recall our aims for the study were to investigate: (1) if continuing music through the SART maintains the mood induction effect, and (2) if continuing music through the SART affects mind-wandering. As evidence for maintaining an induced mood, we expected that (1) participants induced into a positive mood would report higher positive affect (PA) and lower negative affect (NA) at the completion of SART-1 and SART-2 in the SART with music (vs. SART without music) type and (2) participants induced into a negative mood would report higher NA and lower PA at the completion of SART-1 and SART-2 in the SART with music (vs. SART without music) type (see Table 7.1 for descriptive statistics).

We ran a two-way mixed ANOVA with SART type (SART with music, SART without music) as the between-subjects factor and time (pre-induction, post-induction, SART-1, SART-2) as the within-subjects factor for PA and NA, for each of the mood induction conditions separately. In the *positive mood induction* condition, we found a main effect of time for both PA ($F(3, 201) = 48.62$, $p < .001$, $\eta_p^2 = 0.42$) and NA ($F(3, 201) = 9.13$, $p < .001$, $\eta_p^2 = 0.12$), indicating that overall, PA decreased and NA increased. However, we did not find a main effect for SART type or an interaction for either PA ($\eta_p^2{}_{(type)} = .004$; $\eta_p^2{}_{(interaction)} = .001$) or NA ($\eta_p^2{}_{(type)} = .011$; $\eta_p^2{}_{(interaction)} = .006$). In the *negative mood induction* condition, we found a main effect of time for both PA ($F(3, 192) = 40.27$, $p < .001$, $\eta_p^2 = 0.39$) and NA ($F(3, 192) = 43.37$, $p < .001$, $\eta_p^2 = 0.40$), suggesting PA increased and NA decreased. We found no main effect for SART type or an interaction for either PA ($\eta_p^2{}_{(type)} = .002$; $\eta_p^2{}_{(interaction)} = .016$) or NA ($\eta_p^2{}_{(type)} = .002$; $\eta_p^2{}_{(interaction)} = .014$).

Table 7.1

Means and Standard Deviations of Positive and Negative Affect for Mood Induction Conditions: Positive and Negative; in Each of the SART Types: SART With Music and SART Without Music

Mood Induction Type	Time	Positive Affect				Negative Affect			
		SART without Music (*n* = 35)		SART with Music (*n* = 34)		SART without Music (*n* = 33)		SART with Music (*n* = 33)	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Negative	Pre-Induction	27.61	5.98	26.30	7.74	13.33	3.66	13.97	5.65
	Post-Induction	18.33	5.26	19.18	6.79	22.09	7.42	21.12	6.81
	SART-1	21.64	6.67	22.58	6.80	17.15	6.51	18.24	6.48
	SART-2	19.30	6.78	20.58	8.11	16.39	6.35	17.39	7.70
Positive	Pre-Induction	27.71	6.23	26.56	6.64	13.49	2.99	14.83	4.29
	Post-Induction	32.06	7.53	31.58	7.30	11.94	4.18	12.53	2.72
	SART-1	26.89	8.01	26.03	6.83	13.40	3.68	14.78	4.22
	SART-2	23.31	7.95	22.64	7.02	14.54	4.61	15.17	4.83

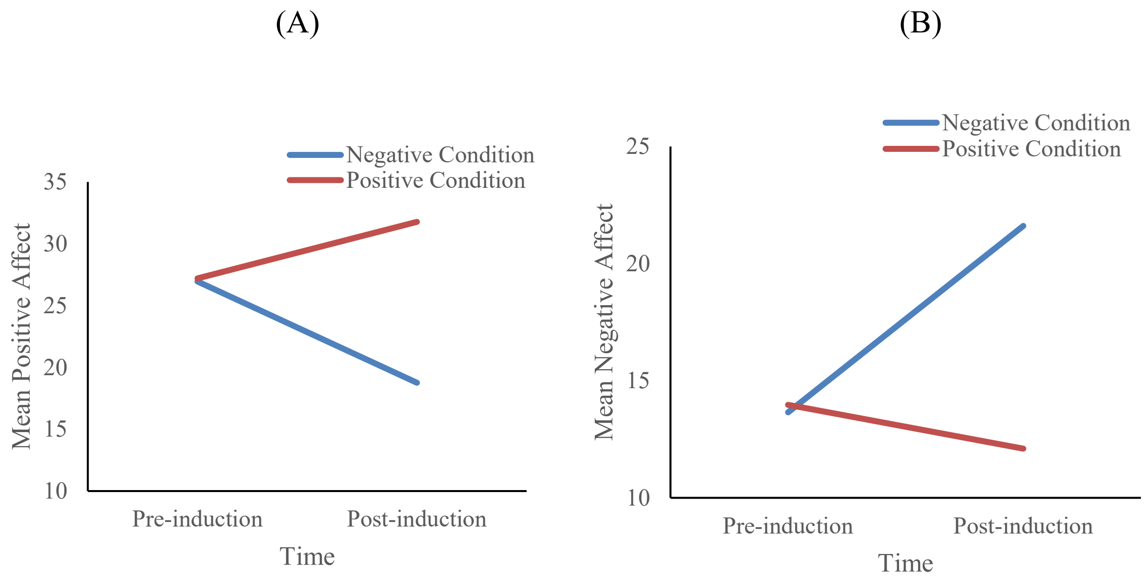
Mood Induction

To ensure mood shifted in the intended direction during the mood induction we ran planned comparisons between pre- and post-induction for PA and NA separately for each mood induction condition, collapsed across SART type (Figure 7.2). PA significantly increased between pre- and post-induction in the *positive mood induction* condition ($t(68) = 6.19$, $p < .001$, $d = 0.75$), and significantly decreased in the *negative mood induction* condition ($t(65) = 10.14$, $p < .001$, $d = 1.25$). NA significantly decreased between pre- and post-induction in the *positive mood induction* condition ($t(68) = 3.50$, $p < .001$, $d = 0.42$), and significantly increased in the *negative mood induction* condition ($t(65) = 9.57$, $p < .001$, $d = 1.18$; see Figure 7.2).

These data suggest mood shifted in the intended direction: participants induced into a positive mood showed increased positive—and decreased negative—affect, and participants inducted into a negative mood showed increased negative—and decreased positive—affect. This effect is consistent with previous mood induction studies using the Velten-Music MIP (e.g., Joseph et al 2020). The small change in NA in the positive condition may be explained by a floor effect given most participants' NA scores were near the lowest score at pre-induction (Cohen, 1988).

Figure 7.2

Positive and Negative Affect Pre- and Post-Induction



Extending Valenced Music Through the SART

To identify the direction of the changes in PA and NA throughout the SART, we ran planned comparison *t*-tests for each SART type in the mood induction conditions separately. First, we discuss the PA and NA changes between post-induction and SART-1, and between SART-1 and SART-2, for each SART type in the *positive mood* condition (see Figure 7.3), then for the *negative mood* condition (Figure 7.4). We used Bonferroni corrected (p = .0083) significance testing for the six tests in each mood condition.

Positive Mood Induction Condition

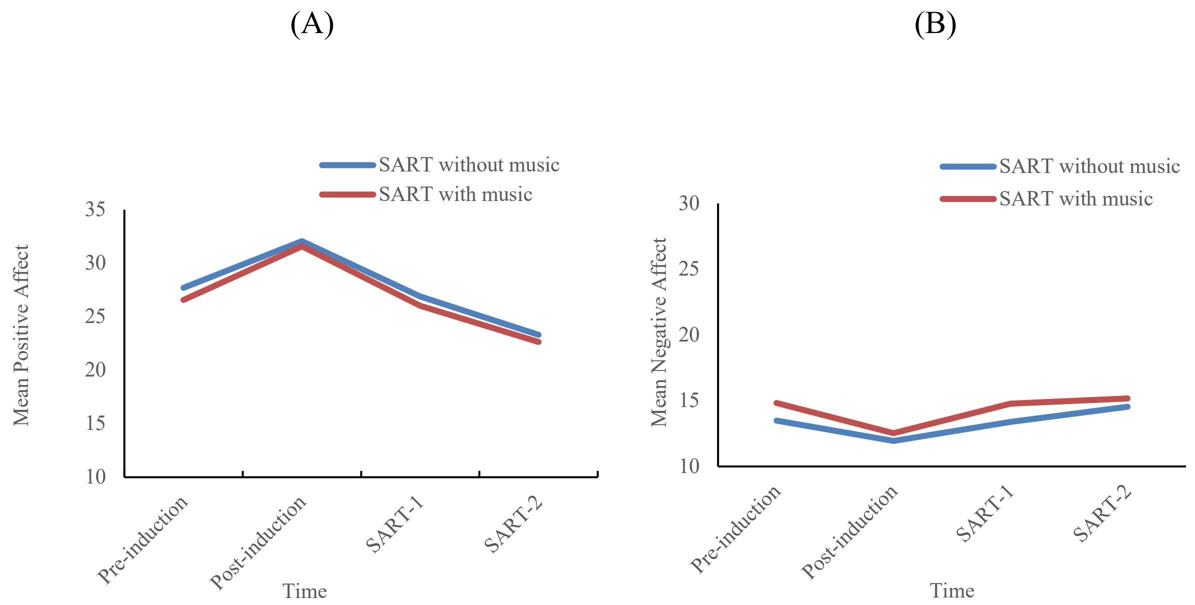
Participants' PA significantly decreased between post-induction and SART-1 for both SART types (*SART without music:* $t(34) = 4.86$, $p < .001$, $d = 0.82$; *SART with music:* $t(34) = 4.80$, $p < .001$, $d = 0.83$), and there was a further decrease between SART-1 and SART (*SART without music:* $t(34) = 4.60$, $p < .001$, $d = 0.79$; *SART with music:* ($t(34) = 4.12$, $p <$ .001, $d = 0.72$; see Figure 7.2A). Thus, across SART types, participants reported the same pattern of results with similarly large effect sizes, indicating that listening to positive music whilst completing the SART did not maintain participants' prior induced PA.

Participants' NA between post-induction and SART-1 did not significantly differ in the *SART without music* type, $t(34) = 1.59$, $p = .12$, $d = 0.27$, but significantly increased in the *SART with music* type, $t(32) = 2.83$ $p = .008$, $d = 0.49$. However, the reverse pattern occurred between SART-1 and SART-2; NA significantly increased in the *SART without music* type, $t(34) = 2.23$, $p = .03$, $d = 0.37$, but remained stable in the *SART with music* type, $t(32) = 0.58$, $p = .57$, $d = 0.10$ (see Figure 7.3B).

These results suggest that participants induced into a positive mood who did not continue listening to positive music during the SART (i.e., *SART without music*) generally maintained their NA. Conversely, participants who continued listening to the positive music showed an increase in NA. These results are contrary to our prediction that people who listened to music through the SART would maintain their induced mood. One explanation for this increase in NA is that the music became a distraction from performing the SART. Perhaps listening to music competed with attentional resources required maintaining SART accuracy, increasing participants' attention switching and leading to frustration (Hwang & Jeong, 2018).

Figure 7.3

Mean Positive (A) and Negative (B) Affect for Each SART Type in the Positive Mood Induction Condition



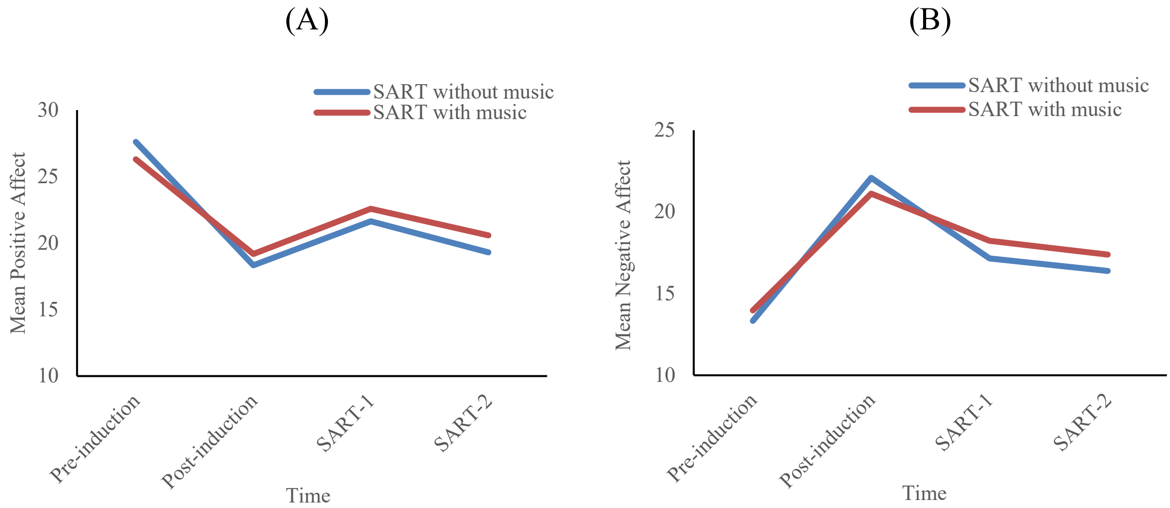
Negative Mood Induction Condition

Participants' PA significantly increased between post-induction and SART-1 for both SART types (*SART without music:* $t(32) = 2.91$, $p = .006$, $d = 0.51$; *SART with music:* $t(32) = 2.92$, $p = .006$, $d = 0.51$), but there was no significant difference between SART-1 and SART (*SART without music:* $t(32) = 2.15$, $p = .04$, $d = 0.54$; *SART with music:* $t(32) = 2.59$, $p = .014$, $d = 0.45$; Figure 7.4A). Thus, the pattern of PA changes were similar across SART types—the reduced PA post-induction weakened through the SART regardless of whether participants listened to valenced music during the SART.

Participants' NA significantly decreased between post-induction and SART-1 for both SART types (*SART without music:* $t(32) = 6.16$, $p < .001$, $d = 1.20$; *SART with music:* $t(32) = 3.29$, $p = .001$, $d = 0.57$), but there was no significant difference between SART-1 and SART-2 (*SART without music:* $t(32) = 2.02$, $p = .05$, $d = 0.21$; *SART with music:* $t(32) = 1.17$, *p* = .25, *d* = 0.20; Figure 7.4B). These NA changes suggest that, irrespective of SART type, the induced NA weakened as participants completed the SART.

Figure 7.4

Mean Positive (A) and Negative (B) Affect for Each SART Type in the Negative Mood Condition



Together these data suggest that while initial mood induction was successful, induced mood weakened when participants completed the first SART block, but not when they completed the second SART block. These results are consistent with previous research (Nayda & Takarangi, 2024; Smallwood et al., 2009). Consequently, the relationship of interest—how mood affects mind-wandering frequency—is perhaps not accurately measured using this protocol, because the unintended induced mood is not stable as mind-wandering is being captured.

There are several explanations for why the mood induction weakened during the SART. First, we know that continuously monitoring the stimuli requires cognitive effort and can cause fatigue, leading to poorer task performance (Randall et al., 2014). If the participant experiences fatigue and commits more errors during the SART (responding to the target stimulus ‘3’), recognising increased errors may activate negative schema (e.g., “I can’t do this”, “I’m a failure at this”). After a positive mood induction, negative schema activation may result in participants feeling less happy and engaged with the task (i.e., reduced PA). Conversely, after a negative mood induction, performing the SART may interrupt participant’s schema activation by providing a distraction, allowing participants to become more engaged with the task (i.e., increased PA).

Further, the monotonous and repetitive nature of the SART can create boredom, which is associated with irritability and increased NA (Head & Helton, 2014). The reduced NA in the positive mood condition may not be maintained through the SART because irritability may activate more negative schema and/or disrupt spreading of activated positive schema. Conversely, following the negative mood induction, participants’ negative affect is high; they likely feel more tense and irritable. Performing the SART may distract from their irritability, allowing NA to reduce.

While we expected that continuing the valenced music through the SART maintained the induced mood, it did not. Rather, participants’ PA and NA followed similar change patterns regardless of whether they listened to music during the SART. Perhaps participants’ induced mood naturally returns to baseline (i.e., pre-induction) over time, irrespective of the task or stimuli intended to maintain the induced mood. Alternatively, the valenced music may have been insufficient to maintain the schema spread to sustain the induced mood through the SART.

Effect of Music During the SART on Mind-Wandering

We also aimed to investigate whether extending the mood induction through the SART influenced mind-wandering frequency. Despite not finding evidence that mood remained stable during the SART, we proceeded with our preregistered aim and analyses. We ran mixed ANOVAs with SART Type (SART with music; SART without music) as the between-subjects factor and time (SART-1; SART-2) as the within-subjects factor for mind-wandering indices: tune-outs (mind-wandering with awareness), zone-outs (mind-wandering without awareness), target-errors, and RTCV for each mood condition separately (see Table 7.2 for descriptive statistics).

Table 7.2

Means and Standard Deviations of Tune-Outs, Zone-Outs, and Target-Errors for Mood Induction Conditions (Positive and Negative) and SART Types (SART With Music and SART Without Music

Mood Induction	SART Type	Time	Tune-outs		Zone-outs		Target-Errors		RTCV	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Negative	Without Music	SART-1	1.68	1.38	1.44	0.73	19.81	11.37	0.36	0.14
		SART-2	2.12	1.37	2.25	1.57	21.85	16.37	0.38	0.20
	With Music	SART-1	1.94	0.87	1.50	0.65	20.49	9.55	0.37	0.13
		SART-2	2.57	1.43	1.87	1.41	21.59	11.68	0.39	0.16
Positive	Without Music	SART-1	1.83	0.92	1.67	0.71	17.35	7.94	0.35	0.07
		SART-2	2.48	1.51	1.33	0.62	18.30	10.96	0.39	0.14
	With Music	SART-1	1.79	1.12	1.33	0.52	20.67	10.46	0.35	0.10
		SART-2	2.63	1.86	1.57	0.65	24.00	11.51	0.44	0.21

Positive Mood Induction Condition

We found no significant effect of time, SART type or interaction for *tune-outs* or *zone-outs* (see Table 7.3 for inferential statistics). However, for *target-errors* we found significant main effects of time and SART type for *target-errors* and a significant main effect of time for *RTCV*. Overall, participants made more errors with greater response time variability in the second 5-minute SART session compared to the first SART session. Further, participants made more errors in the *SART with music* type compared to the *SART without music* type.

Table 7.3

Main Effects and Interactions for Mind-Wandering Indexes: Tune-Outs, Zone-Outs, Target-Errors and RTCV

		Mood Induction Condition					
		Positive			Negative		
Mind-Wandering Index	Main Effects & Interactions	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Tune-Outs	Time: SART-1/SART-2	4.22	.05	.16	19.69	<.001	.39
	SART Type: With/Without Music	.17	.69	.01	1.32	.26	.04
	Interaction: Time x SART	.09	.76	.00	1.32	.26	.04
Zone-Outs	Time: SART-1/SART-2	.24	.64	.03	7.05	.02	.39
	SART Type: With/Without Music	1.21	.30	.12	0.44	.52	.04
	Interaction: Time x SART	3.19	.11	.26	1.98	.20	.15
Target-Errors	Time: SART-1/SART-2	4.54	.04	.06	2.65	.11	.04
	SART Type: With/Without Music	4.44	.04	.06	0.001	.97	.00
	Time x SART Type Interaction: Time x SART	1.43	.24	.02	0.12	.73	.002
RTCV	Time: SART-1/SART-2	16.28	<.001	.20	4.20	.05	.06
	SART Type: With/Without Music	.90	.35	.01	.15	.70	.00
	Interaction: Time x SART	2.05	.16	.03	.01	.93	.00

Negative Mood Induction Condition

We found significant main effects of time for *tune-outs* and *zone-outs,* but not for target-errors or RTCV. These findings suggest participants' mind-wandering increased, both with and without awareness in the second—compared to the first—5-minute SART session, but their target-error rate was similar. There was no main effect of SART type or interactions for tune-outs, zone-outs, target-errors, or RTCV suggesting mind-wandering and error rate was similar whether participants listened to music.

Taken together, these data do not support our hypothesis that listening to mood-inducing valence music during the SART maintains induced mood. Further, our prediction that participants in the negative mood induction condition would report more mind-wandering when listening to music compared to no music, and less mind-wandering in the positive condition (when listening to music compared to no music during the SART), was unsubstantiated. Instead, we only found an effect of SART type in the *positive mood induction* condition*;* participants in the *SART with music* type made more target-errors compared to participants in the *SART without music* type.

Our results reflect the mood weakening patterns that occur during the SART in both mood induction conditions observed in previous research. For participants in the positive mood induction condition, as PA decreased—potentially indicating fatigue and that participants were less task engaged—target-errors and RTCV increased over time. These results are consistent with research demonstrating that poorer task performance and greater RTCV is associated with increased time spent on less cognitively demanding tasks (e.g., the SART; Randall et al., 2014).

Contrary to our expectations, after a positive mood induction, participants made more target-errors when listening to the positive music (*SART with music*) than without music (*SART without music*). Possibly, the music distracted participants from the SART, impairing their performance. Indeed, research indicates that upbeat music—like the music used in this study—divert participants' attention away from tasks like study and work whereas calming music can be less disruptive (Goltz & Sadakata, 2021). The positive upbeat music may have competed more strongly for attentional resources, interfering with task performance compared to no music (Hwang & Jeong, 2018).

In the negative mood induction condition, the decrease in participants' PA between pre- and post-induction was large, suggesting they were less engaged and less happy after completing the task. Since people mind-wander more often in a negative mood (e.g., Poerio et al., 2013), this fall in PA likely explains participants' increased tune-outs (mind-wandering with awareness) and zone-outs (mind-wandering without awareness) over time. Although their PA increased during the first 5-minute SART block, the increase was moderate, suggesting the participants' affect remained low during the second 5-minute SART block.

One explanation for these findings is that positive and negative schema activated during the mood induction interacted with the SART to weaken the induced mood, and this interaction was stronger than the effect of listening to valenced music. Supporting this idea, a recent meta-analysis ($N = 1131$ across 6 studies) showed that negative task unrelated thoughts (TUTs; i.e., mind-wandering) were more strongly associated with poorer SART performance (e.g., increased RTCV and target-errors), compared to positive and neutral TUTs (Welhaf et al., 2025). Additionally, negative TUTs increased over time, during the SART, compared to positive and neutral TUTs. Perhaps the "Oh No" reaction to a target-error made during the SART moderated mood changes by differentially activating negative schema. For example, in the positive mood induction condition, making errors may have activated more negative schema (e.g. "I'm a failure"), increasing valenced mind-wandering and reducing positive affect. Alternatively, in the negative mood induction condition, negative schema were already active so making errors likely had a weaker effect on negatively valenced mind-wandering during the SART. Listening to valenced music was not sufficient to offset the negatively valenced mind-wandering through the SART.

Finally, we explored participants' thought content to determine if mood changes were associated with performing the SART, or due to something unrelated. Recall that participants described the thought they experienced when the last probe was presented—these thoughts were subsequently categorised as on-task or task-related or off-task/task-unrelated)[19]—and then rated that thought on involuntariness, goal-directedness, current-concern, valence and function. Overall, participants' most recent probed thought was more task-related (46.67%; on-task = 30.37%; task-unrelated = 22.96%) and typically negatively valenced (*M[SD]* = -0.33 [1.23])—supporting Welhaf and Banks (2024)—and goal related. Participants classified the function of their thoughts as predominantly problem solving (37.9%) and planning (22.7%), as well as to keeping themselves aroused (19.7%) to feel better (10.6%), with the least being reappraisal (1.5%; 7.6% did not classify). These results suggest that for most participants, thoughts about the SART (77.04%) were negative and thus that the SART itself negatively impacted participants' thoughts.

We compared thought characteristics between SART types using independent samples t-tests and chi-square tests for each mood induction condition (see Table 7.4. for descriptive statistics). We expected participants induced into a positive mood to be more on-task, and their thoughts less negative and more goal directed in the *SART with music* (vs. *SART without music*) type. Conversely, we expected that people induced into a negative mood would report more task-related, and off task thoughts (environment-related, and task-unrelated) that are more negative and more current concern related in the *SART with music* (vs. *SART without music*) type. In the positive mood condition, we found a significant difference in valence of the probed thought with participants in the *SART with music* type rating their thought as more positive than those in the *SART without music* type. Opposing

[19] Five thoughts were debated as either environment or task unrelated. It was agreed to classify thoughts as task unrelated thoughts due to the focus on the cause of the physiological symptoms work, medication, catching up with friends not the sensations of tiredness or hunger.

expectations, we found no significant difference in thought type (on-task, task-related, or off-task/task-unrelated) or thought characteristics between participants who listened to music and those who did not, in either the positive or the negative mood conditions using Bonferroni correction for eight tests (p = .006; Positive: p = .009 to .95; ds = 0.05 to 0.32; p = .47 to .68; Negative: p = .41 to .95; ds = 0.02 to 0.21; p = .87 to .96). We repeated the analyses to explore differences in thought characteristics between mood conditions collapsed across SART Type[20]. Again, we found no significant difference in thought types or characteristics (p = .05 to .97; ds = 0.06 to 0.35; p = .45 to .79)

[20] These analyses were not pre-registered but were exploratory.

Table 7.4

Means and Standard Deviations for Thought Characteristics in Each SART Type for the Content of the Final Probe Thought

			Mean (Standard Deviation)			
Thought Type	Type	*N*	Voluntary	Goal	Concern	Valence
	Range		1 - 7	1 - 7	1 - 7	(-3) – (+3)
On-task	Negative with Music	11	4.73 (1.68)	4.00 (2.33)	3.27 (2.20)	0.09 (0.83)
	Negative without Music	8	3.50 (2.00)	5.00 (2.33)	4.00 (1.51)	-0.13 (1.36)
	Positive with Music	9	3.89 (2.02)	4.44 (2.35)	4.44 (1.94)	0.33 (0.87)
	Positive without Music	13	4.62 (1.81)	5.69 (1.44)	4.69 (1.89)	-0.46 (1.39)
Task related	Negative with Music	12	3.17 (1.40)	4.25 (1.29)	3.92 (2.02)	-0.67 (1.07)
	Negative without Music	16	4.81 (1.38)	4.50 (2.45)	4.00 (2.00)	-0.62 (1.15)
	Positive with Music	16	4.72 (1.69)	4.19 (1.64)	4.13 (1.40)	0.44 (1.46)
	Positive without Music	19	3.89 (1.76)	5.26 (1.76)	4.05 (2.04)	-0.63 (1.26)
Off-task/Task unrelated	Negative with Music	10	5.10 (2.02)	4.50 (2.01)	3.90 (2.07)	-0.60 (1.35)
	Negative without Music	9	3.89 (1.69)	4.67 (2.39)	3.00 (1.32)	-0.67 (1.00)
	Positive with Music	9	4.22 (1.99)	3.89 (1.70)	3.11 (2.37)	-0.11 (1.45)
	Positive without Music	3	4.67 (2.08)	4.33 (2.08)	5.00 (1.00)	-1.33 (0.58)

Collectively, these findings extend our understanding of how mood is affected during the SART. Participants induced into a *positive mood* experienced a decrease in PA throughout the SART, regardless of whether they listened to valenced music. However, their mind-wandering behaviour differed based on music being present—those in the *SART with music* condition made more target-errors than those in the *SART without music,* indicating the music through the SART potentially distracted participants from the task, although we note that we did not ask participants directly if they found the music distracting. For participants in the *negative mood induction* condition, their induced NA weakened regardless of music.

Importantly, participants probed thought was mostly on-task or task-related and that thought tended to be negative, suggesting the SART affected people's thoughts negatively. Since negative thoughts are associated with more negative mood, it is likely that the SART itself influences participants' mood shift.

Our research has limitations. First, we did not include a mood control condition (i.e. a *no mood induction* condition), making it unclear whether the mood changes resulted from an interaction between mood and the SART, or participants' response to errors, regardless of a prior mood induction or music exposure. If there is no difference in mood shift between participants who listen to valenced music during the SART but without a mood induction, compared to those who receive a mood induction, then extending the music has no effect on sustaining the induced mood. Second, we did not include a control mind-wandering task to determine if the SART had a greater effect on mood deterioration than other tasks. Comparing different tasks (e.g. a line detection task) using this protocol could help clarify if the observed mood weakening while listening to music is specific to the SART or generalises to other low demand cognitive tasks. Third, we only captured one probed thought at the end of the SART. This one thought cannot generalise to participants' mood and mind-wandering experience throughout the SART. Capturing thought content at earlier and middle stages of the SART blocks would provide greater insight into how participants mood and mind-wandering behaviour interacts with the task.

Future research could address these limitations to better isolate the cause of the mood shift. Potentially, music is less effective at maintaining the activated schema than the Velten statements. Designing a method that incorporates valenced words from the Velten statements into the SART may help sustain schema activation from the mood induction, potentially enhancing mood maintenance. One approach could be to adapt a lexical decision task in which participants respond to valenced words extracted from the Velten statements (non-target) and withhold their response on a nonwords (target). This method may enhance schema activation by reinforcing the encoded information from the mood induction throughout the task. Since participants are instructed to “feel and experience each statement as if it was their own thought” when reading the Velten statements (Velten, 1968), being presented with the same self-referential words during the task might sustain the induced mood for a longer duration.

Conclusion

We investigated whether listening to valenced music while performing a mind-wandering task—the SART—maintains a prior mood induction. Our results suggest that after mood induction, the induced mood weakens as people complete two 5-minute SART blocks. This weakening was not reduced by extending the mood induction protocol through the SART. However, listening to music throughout the SART may have influenced participants’ mind-wandering behaviour, with participants who listened to positively valenced music—compared to no music—making more target-errors (a behavioural mind-wandering measure) and rating their most recent probed thought as more negative. Importantly, participants’ retrospective probed thought was mostly SART-related and negative, suggesting performing the SART has a negative effect on people’s thoughts. We suggest these differences result from the music being a distractor. Future research found consider using a modified language detection task throughout the SART to maintain mood induction manipulations.

Chapter 8: General Discussion

My thesis addressed two aims: (1) to investigate whether cognitive processes—including *negative thinking patterns, cognitive strategies* and *trauma intrusions*—influence mind-wandering and meta-awareness to maintain depression, and (2) to test the *assumption* that *mood remains stable* during a mind-wandering protocol that is used to examine the effect of mood on mind-wandering. This final chapter summarises the findings from my five empirical chapters, in the context of prior research. I also consider clinical and methodological implications, as well as the limitations, of my findings.

Negative Thinking Patterns: Rumination, Perseverative Thinking and Maladaptive Cognitive Beliefs

Studies 1, 2 and 3 explored various links between negative thinking patterns (i.e. rumination, perseverative thinking—repetitive, fixed, negative thinking), maladaptive meta-cognitive beliefs, mind-wandering and depression. These links provided part of the foundation for examining potential mechanisms, and the role of meta-awareness, in the mind-wandering and depression relationship. Prior research has identified that negative thinking patterns are associated with both mind-wandering and depression (Carciofo et al., 2017; Ottaviani et al., 2013; 2015; Xu et al., 2024). Specifically, research suggests that mind-wandering with negative content is associated with negative mood (Poerio et al., 2013), and mind-wandering with ruminative content is associated with depression, whereas other research shows people with depression engage more in rumination and perseverative thinking, but mind-wander less, compared to healthy controls.

Three major limitations emerge from these studies (Kandeger et al., 2023; Ottaviani et al., 2013; Rosenbaum et al., 2017). First, the definition of mind-wandering affects the measurement of negative thinking. Where some studies consider negative thinking *as* mind-wandering (i.e., mind-wandering thoughts are often negative, past-focused; Poerio et al., 2013), other research classifies negative thinking patterns, such as rumination and perseverative thinking, as distinct from general mind-wandering (e.g., Ottaviani et al., 2013; Rosenbaum et al., 2017). These differences in operationalisation may explain discrepancies in relationships between mind wandering, depression and negative thinking patterns. As a result, comparisons across studies become challenging and the precise role of negative thinking patterns within mind-wandering remains unclear.

Second, many of these studies have examined clinical populations, specifically people whose symptoms meet criteria for depressive disorders. While clinical samples are important, up to 17% of the community meet the *subthreshold* criteria for depression—characterised by one core and two to four major depressive disorder symptoms—a known precursor of major depressive disorder (Chen et al., 2021). Using non-clinical populations helps identify how negative thinking patterns and meta-cognitive beliefs interact before depression symptomology progresses to a clinical disorder. Understanding the impact of negative thinking patterns in the relationships between mind-wandering and depressive symptoms using large community samples may help identify early risk factors in preventing the progression to major depressive disorder.

Third, correlational studies that have assessed negative thinking patterns (i.e., rumination, perseverative thinking) have varied designs. Some studies have used neuroimaging, ambulatory data, and experience sampling with self-report measures, but have low power for these correlations (Ottaviani et al., 2013). Other studies have included mind-wandering and depression in relation to other predictor or outcome variables (e.g., ADHD; Kandeger, 2023; rumination; Rosenbaum, et al, 2017).

To address these limitations, I sought to examine the mind-wandering and depression relationship by combining trait and state mind-wandering measures with trait measures of the negative thinking patterns and depression in *large non-clinical* samples (*N*s = 200 to 570).

Recall that rumination in my thesis studies is considered a negative thinking pattern and a specific form of mind-wandering that is measured separately, based on the family resemblances theory (Seli et al., 2018). Using correlational analyses, I established key associations between negative thinking patterns, mind-wandering, and depression, which to my knowledge, had not yet collectively been investigated. Then, using mediation models, I examined the influence of each of these variables on the mind-wandering and depression relationship to identify and test potential mechanisms underpinning this relationship. Across several studies, I found that rumination, perseverative thinking and maladaptive cognitive beliefs positively correlated with mind-wandering and depression, suggesting that as mind-wandering and depression increase so do negative thinking patterns. However, contrary to predictions, only perseverative thinking and maladaptive cognitive beliefs mediated the relationship between mind-wandering and depression symptom severity in two of the three studies. In other words, participants prone to mind-wandering experienced greater depressive symptoms in part due to their tendency to hold maladaptive cognitive beliefs and engage in perseverative thinking. Yet, the mediation effects of rumination on the mind-wandering/depression relationship produced inconsistent results.

My findings contribute to the literature in several ways. Looking more closely at maladaptive cognitive beliefs, I found that beliefs about thought uncontrollability and danger (e.g., "*My negative thoughts are dangerous and could harm me if I don't control them*") mediated the relationship between mind-wandering and depression, supporting prior research showing a similar mediating effect between mind-wandering and negative affect (Carciofo et al, 2017). A novel finding in my thesis is that low cognitive confidence partly mediated the relationship between mind-wandering and depression, suggesting that people who are prone to mind-wandering and show doubt in their cognitive abilities (e.g., "*I have difficulty knowing if I've something or if I imagined it*") may experience more severe depression symptoms. One possibility arising from these results is that people who hold strong maladaptive beliefs may consider mind-wandering uncontrollable and may doubt their ability to control their thoughts, which in turn might exacerbate or maintain feelings of helplessness that are associated with greater depression (Nolen-Hoeksema et al., 2008).

Next, I found that *perseverative thinking*—characterised by difficulty disengaging from negative thoughts (Stade et al., 2023)—is associated with both mind-wandering and depression and partly mediates their relationship. This result aligns with prior research showing that people who mind-wandered with, but not without, perseverative content in daily life experienced greater depression (Ottaviani et al., 2013; 2015). Yet, my findings extend this research by showing that people prone to mind-wandering are more likely to feel depressed because of their tendency toward perseverative thinking. Whilst Ottaviani et al. distinguished *state* perseverative thinking from mind-wandering by coding thought probe responses captured in daily life, Study 3 focused on people's overall *trait* tendency to engage in both mind-wandering and perseverative thinking and how those *trait* tendencies related to depression severity. Critically, where *state* perseverative thinking is transitory and context-driven, *trait* tendencies refer to individual differences in the likelihood people will engage in perseverative thinking (e.g. Jouvent et al., 1999). Together my data from Study 3 and findings from Ottaviani et al. suggest that people with a trait tendency towards perseverative thinking, who engage in this negative thinking, are also prone to mind-wandering and are more likely to experience depressive symptoms.

The final negative thinking pattern I examined was *rumination and ruminative styles* (brooding, reflective and depressive). Rumination and ruminative styles correlated with mind-wandering and depression across the three studies, with Studies 2 and 3 highlighting the role of *brooding* rumination (e.g. "*why do things never go right for me*"), but not reflective (e.g. "*why do I feel this way, what can I do to change it*") or depressive (e.g., "*I can't stop* *thinking about how sad I feel*") rumination, as a maladaptive thinking process that contributes to depression vulnerability (Lindblom & Bosmans, 2021; NolenHoeksema, 2003). I found that people who frequently mind-wander experience greater depression severity partly due to their tendency to brood, supporting prior research showing that brooding predicts depression and mind-wandering predicts greater brooding (Fredrick et al., 2020; Raffaelli et al., 2021). These findings indicate the tendency to mind-wander could be a precursor/risk factor to brooding as a mechanism that influences depression severity (Nolen-Hoeksema et al., 2008). However, contrary to expectations and prior research (e.g. Kendeger et al, 2022), rumination did not mediate the relationship between mind-wandering and depression.

The finding that general rumination did not mediate the relationship between mind-wandering and depression in Study 1, but brooding rumination mediated the relationship in Study 3 was surprising, given that rumination is often operationalised as a form of mind-wandering (Seli et al., 2018). One explanation for this finding is the variability in rumination measurements I used across the studies. In Study 1, I used a global self-report rumination scale that showed low internal consistency (α = .49), suggesting high variability among items and inconsistencies in assessing rumination as a single construct. For example, two items taken from the rumination measure include "*I often think about what my life will look like in the future"* which may reflect goal setting or future planning whereas "*When I have a problem, I tend to think about it a lot of the time*" indicates fixed or ruminative thinking. This variability likely reduced the scale's sensitivity to depressive ruminative items more likely associated with mind-wandering and depression. In Studies 2 and 3, the Ruminative Response Style Questionnaire (Nolan Hoeksema et al., 2008), which distinguishes between brooding and reflective rumination, showed high internal consistency (Study 2 [α = .93]; Study 3 [α = .85]; Hoeksema et al., 2008), indicating a more reliable measure for assessing mediators of the relationship between mind-wandering and depression. A comparison of these two measures suggests that perhaps the global rumination scale includes more adaptive rumination items (i.e., future planning) whereas the rumination response style questionnaire, despite including reflective items (e.g., how events may be improved), focuses more on the maladaptive aspects of rumination such as depression symptoms and brooding.

A second explanation for why rumination did not mediate the relationship between mind-wandering and depression in Study 1 is the difference in mind-wandering measures used with the rumination measure. Study 1 included the Cognitive Failures Questionnaire (CFQ; Broadbent et al., 1982), which assesses the real-world consequences of participants' mind-wandering through attentional lapses that lead to cognitive errors (e.g. "*Do you fail to notice signposts on the road?*"). CFQ scores positively correlate with several other mind-wandering measures (e.g. self-reported mind-wandering, default mode network activity; Christoff et al. 2009). Indeed, when I correlated the CFQ with another mind-wandering measure—the Daydreaming Frequency Scale (Singer & Antrobus, 1972)—as part of a larger study associated with Study 1, I found a medium positive association (r = .47). However, a limitation of the CFQ is it does not directly assess task unrelated thoughts.

I addressed the possibility that the CFQ might not align with the definition of mind-wandering for task unrelated thoughts by using different trait measure—the Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003), and the Mind Wandering Questionnaire (MWQ; Mrazek et al., 2013)— in Studies 2 and 3. The MAAS assesses trait present-moment thinking and sustained attention (e.g. "*I find myself doing things without paying attention")* and negatively correlates with probe-caught and behavioural measures of mind-wandering (e.g. Hasenkamp et al., 2012; Mrazek et al., 2012). Unlike the CFQ, the MAAS aligns with the executive failures hypothesis—by assessing meta-awareness of attention lapses (e.g. "*I snack without being aware that I'm eating"*), and with the decoupling hypothesis—by indicating a decoupling from external environment (e.g. "*I drive places on* *'automatic pilot' and then wonder why I went there*"). While the MAAS measures present moment awareness it is considered the opposing construct of mind-wandering but lies on the same dimension (Belardi et al., 2022). The MWQ, like the MAAS and the CFQ, aligns with the executive failures hypothesis—by assessing attention on low-demand tasks (e.g. "I *have difficulty maintaining focus on simple or repetitive work*") and with the decoupling hypothesis—indicating decoupling from encoding information (e.g. "W*hile reading, I find I haven't been thinking about the text and must therefore read it again*"). Each of these measures (CFQ, MAAS and MWQ) are consistent with the family resemblance view of mind-wandering, capturing trait tendencies toward spontaneous, unintentional thoughts but differ in how these thoughts are operationalised (e.g., attention lapse, task unrelated thoughts; Seli et al., 2018). However, these measures are not well aligned with the dynamic framework of spontaneous thoughts, which classifies thoughts based on constraints such as emotional salience, intentionality and their temporal shifts—typically assessed through state-based thought content methods rather than trait scales or dichotomous self-report measures (Christoff et al., 2016). To address potential reliability issues, I used a different mind-wandering measure in each of Studies 1, 2, and 3 to determine the strength of the relationships between mind-wandering, depression and each of the tested cognitive processes. If different scales are measuring the same construct we would expect relatively consistent findings.

In Study 2 I triangulated the MAAS with state mind-wandering measures (probe-responses and behavioural mind-wandering measures; Lin et al., 2020). I found negative associations between both rumination depression and self-reported probe-caught mind-wandering, supporting the association found in Study 1. However, contrary to Study 1, I found that rumination mediated the relationship between mind-wandering and depression when using the RRS, the MAAS and the BDI[21].

Looking more closely at the rumination subscales, specifically at whether brooding supported the rumination and mind-wandering relationship; brooding positively correlated with zone-outs (mind-wandering without meta-awareness) and target errors (behavioural index of mind-wandering). In Study 3 I found mind-wandering and depression were associated partly through brooding. These differences depend on mind-wandering measure across the three studies and highlight the challenge of accurately and comprehensively measuring mind-wandering, given its covert and spontaneous nature, and varying definitions. Depending on the measure used, mind-wandering can be assessed behaviourally, cognitively and meta-cognitively (meta-awareness), each aligning with the main mind-wandering theories but potentially producing different findings, as demonstrated with Studies 1, 2 and 3.

Overall, the pattern of findings suggest that brooding is a key mechanism linking mind-wandering to depression. People prone to frequently mind-wander are more likely to experience depressive symptoms, particularly when they are also prone to brooding rumination. Maladaptive meta-cognitive beliefs—like low confidence in cognitive ability and the belief that thoughts are uncontrollable—contribute to the mind-wandering and depression relationship potentially by reinforcing brooding rumination thinking patterns. Over time, persistent brooding may become perseverative, making it more difficult for people to disengage from the negative thoughts and thus putting them at risk for increased depression symptoms. Importantly, while valid questionnaires measuring the same underlying construct should converge, the three measures used across these studies have reasonable convergence (i.e., intercorrelation). While I did not find that rumination partly mediated the relationship between mind-wandering and depression in Study 1, I did find this effect in Study 2 when I

[21] These results were not reported in published manuscript, they have been analysed post hoc.

used different measures. It seems likely that each measure captures distinct facets of mind-wandering (e.g., cognitive failures, task unrelated thoughts, meta-awareness in mind-wandering). These findings show the importance of using a variety of measures to capture as many aspects of mind-wandering as possible for a more comprehensive understanding of the relationship between mind-wandering and its potential correlates.

Maladaptive Cognitive Strategies

In Studies 1, 2 and 3, I also examined the influence of *maladaptive* cognitive strategies (i.e. avoidant strategies of dissociation, thought suppression and thought control) on mind-wandering and depression symptom severity and the relationship between these variables. Avoidant cognitive strategies are associated with depression and anxiety symptoms (Purdon & Clark, 2001; Petkus et al., 2014). But their specific impact on mind-wandering and depression remains unclear. Research methods vary widely; studies use different measures to assess thought control, suppression, dissociation, and rumination and in relation to mind-wandering and/or depression in clinical, community and student samples. Some studies are underpowered for detecting stable correlational and moderation analyses (e.g. *N*s = 98, 99; Vannikov-Lugussi et al., 2018; 2021; Schonbrodt & Perugini, 2013) and they also differ in their primary outcome measures (e.g. dissociation, negative affect; Hattori & Ikeda, 2016; He et al., 2018; Poerio et al, 2016; Vannikov-Lugussi et al., 2018; 2021). Moreover, some studies examine how mind-wandering is associated with other variables, such as suppression, but separately to depression (e.g. Baird et al., 2013; Halvorsen et al., 2014).

Like my analyses on negative thinking patterns, using correlation and mediation models, I sought to clarify how avoidant cognitive strategies (e.g., thought suppression) influence the mind-wandering and depression relationship using questionnaires assessing state and trait mind-wandering, maladaptive avoidant-cognitive strategies and depression symptoms in large non-clinical samples. I found that as people’s tendencies to use avoidant-cognitive strategies of thought suppression, thought control process of worry and punishment and dissociation (subcategories of depersonalisation/derealisation, absorption and amnestic), increased, mind-wander and depression symptoms also increased. These data suggest that people prone to mind-wandering also engage in avoidant-cognitive strategies and have greater depression symptoms. Study 1 showed people prone to mind-wandering experience depression partly due to their attempt to suppress thoughts and/or use thought control strategies of worry and self-punishment to regulate negative emotions. Additionally, people who mind-wander and brood have an increased tendency to dissociate (Study 3). These findings align with prior research showing that people are less able to suppress mind-wandering when they are in a more negative mood (Hattori & Kenji, 2016), and that a perceived lack of ability to thought control is associated with depressive symptoms (Feliu-Soler et al., 2019; He et al., 2018; Luciano & Algarabel, 2006). Further, these results extend prior research indicating that rumination (brooding) predicts depersonalisation/derealisation dissociation (Vannikov-Lugassi & Soffer-Dudek, 2021) by demonstrating that mind-wandering is associated with dissociation partly through a tendency to brood.

However, the role of dissociation in the relationship between mind-wandering and depression is unclear, with Studies 1 and Study 3 showing discrepant results for whether dissociation (depersonalisation/derealisation, amnestic and absorption) mediates the mind-wandering and depression relationship. Specifically, in Study 1, participants' who were prone to mind-wandering experienced greater depression, partly due to their tendency towards depersonalisation/derealisation but not their absorption or amnestic dissociation. Alternatively, in Study 3, absorption and amnestic tendencies also mediated the relationship between mind-wandering and depression. One explanation for why dissociation subtypes mediated the relationship in one study but not the other—in addition to the different mind-wandering measures discussed previously—relates to the statistical analyses I used. In Study

1, I explored the individual contributions of dissociation subcategories in mediating the mind-wandering depression relationship using parallel mediation models. However, a mediator-to-mediator interaction may have occurred (i.e., the effect of one mediator on the outcome variable changes depending on the level of another mediator variable; Vanderweele & Vansteelandt, 2014). Specifically, absorption and amnestic dissociation may have co-varied with depersonalisation, reducing the unique variance they each explained in the mind-wandering and depression relationship and resulting in the non-significant contributions. Indeed, when amnestic and absorption dissociation are entered as individual mediators in separate mediation models, they significantly contributed 14.66% and 25.49% of the total variance to the relationship (β= .030, 95% CI [.016, .054]; β= .052, 95% CI [.032, .073]) respectively.

In Study 3, I used serial mediation analyses to test each dissociation subcategory as a mediator variable in separate mediation models. This approach accounted for co-variances between the dissociation sub-categories, ensuring I could identify their specific contributions to the mind-wandering and depression relationship, which in this case resulted in significant indirect effects. Taken together, these conflicting results for dissociation in Studies 1 and 3 suggest that amnestic and absorption dissociation potentially co-vary and are weaker mediators than depersonalisation/derealisation dissociation in the relationship.

The role of dissociation in the mind-wandering and depression relationship extends prior research by showing that a tendency to mind-wander also predicts dissociation, and that absorption dissociation is associated with mind-wandering (Vannikov-Lugassi & Soffer-Dudek, 2018). The present studies provide novel evidence that people prone to mind-wandering tend to engage the three dissociation subtypes; they may do so to disconnect from thoughts related to regulating depression symptoms (e.g., detaching emotionally from "*why am I always so sad*"). This disconnection can be experienced as a lack of awareness (amnestic dissociation), a sense of detachment (depersonalisation/derealisation), or a blurring (absorption dissociation) between themselves and the environment (e.g., Cavicchioli, et al. 2021) to avoid the associated negative thoughts and emotions.

Adaptive Cognitive Strategies

In Studies 1 and 2, I investigated the influence of *adaptive cognitive strategies* of thought control: distraction, reappraisal) and mindfulness (i.e. present-moment awareness) on mind-wandering and depression symptom severity. Mechanisms underpinning the mind-wandering and depression relationship can also be understood by examining how adaptive cognitive strategies weaken this relationship. But current research on mind-wandering, mindfulness and depression has significant gaps; many studies focus on mindfulness interventions (e.g., Feruglio, 2021; Takahashi et al., 2019), or are underpowered (Deng et al., 2014), use different predictor or outcome (e.g., ADHD; Kandeger et al., 2024) and/or varied samples (incl. clinical and non-clinical participants; (Cash & Whittingham, 2010; Kendeger et al., 2024). Studies investigating associations between mind-wandering, reappraisal and distraction have been limited to specific topics. For example, reappraising shame when mind-wandering about disclosing secrets improves well-being, and distraction about romantic relationships during mind-wandering can improve mood (Langeslag & Philippi, 2024; Liu et al., 2022). Overall, however, there is limited evidence for how people's tendencies towards adaptive cognitive strategies influences the relationship between mind-wandering and depression.

As with maladaptive strategies, using correlation and mediation models, I sought to investigate the associations between mindfulness (i.e., present-moment awareness; Study 2) and adaptive thought control processes and both mind-wandering and depression, plus their contribution to this relationship. Using questionnaires and experience sampling, I measured trait mindfulness, reappraisal and distraction, and state mind-wandering and depression with large non-clinical samples.

First, I explored reappraisal and distraction (Study 1). I found people prone to mind-wandering also have increased depression and tend to reappraise unwanted thoughts ($r = .24$, $p < .001$ and $r = .18$, $p < .001$, respectively), but distraction was not associated with mind-wandering or depression. This pattern aligns with previous research showing that distraction does not correlate with depression and anxiety (Reynolds & Wells, 1999). Neither reappraisal nor distraction mediated the relationship between mind-wandering and depression. Thus, the findings suggest that people who mind-wander and feel depressed also reappraise thoughts, possibly in an attempt to improve well-being. Moreover, neither reappraisal nor distraction influence the mind-wandering and depression relationship.

Next, I explored mindfulness (Study 2). Mindfulness correlated with less probe-caught mind-wandering (both with and without awareness; *r*s = -.27 to -. 21 respectively; Study 2), and lower depression symptoms. Mindfulness mediated the relationship between depression and probe caught mind-wandering (with awareness), suggesting that as depression symptoms increase, people become less present moment focused, which in turn leads to greater mind-wandering (with awareness). Similarly, mindfulness mediated the relationship between brooding (negative thinking pattern) and depression, suggesting that as brooding reduces mindfulness, people become less present moment focused (i.e. less aware), which in turn contributes to greater depression. This mediation of mindfulness with brooding and depression partly aligns with previous research (Jimenez, 2009; Vancappel et al., 2023) and extends those findings by suggesting a potential feedback system. Taken together, these studies suggest people’s brooding is potentially modified by mindfulness and mindfulness is modified by brooding, which ultimately influences people's depression symptoms.

Trauma Intrusions

Given the robust relationships between depression and dissociation, dissociation with posttraumatic stress disorder (PTSD), and the frequent co-occurrence of depression and PTSD, surprisingly few studies have investigated the role of trauma intrusions in mind-wandering and depression (Iyadurai et al., 2019; Kubota et al., 2015; Sun et al., 2023). Trauma intrusions—a hallmark PTSD symptom—are associated with spontaneous mind-wandering, and people can experience trauma intrusions without meta-awareness, indicating an association with mind-wandering (Brosowski et al., 2022; Takarangi et al., 2014). Despite this research, it remains unclear whether a relationship exists between trauma intrusions, mind-wandering and depression.

In my thesis, I explored how trauma intrusions influenced the relationship between mind-wandering and depression. I combined questionnaires assessing state and trait symptoms of trauma intrusions, mind-wandering and depression, in non-clinical samples. I found trauma intrusions positively correlated with both trait mind-wandering ($r_{\text{study 1}} = ..41$; $r_{\text{study 2}} = .28$) and depression symptoms ($r_{\text{study 1}} = .54$; $r_{\text{study 2}} = .47$); trauma intrusions also mediated the relationship between these variables, but were not associated with state self-report or behavioural measures of mind-wandering ($r = .09$ to .12). Study 2 replicated Study 1's finding that trauma intrusions are positively correlated with depression.

Thus, trauma intrusions are associated with dispositional mind-wandering (as seen in Study 1) rather than momentary fluctuations in mind-wandering measured using experience sampling (Study 2). Perhaps people who experience more frequent traumas also experience more attention lapses over time in daily life, but these lapses are not always detected in momentary measurements using thought probes (Schmitt & Blum, 2020). Alternatively, the self-report data may be influenced by a reporting bias when participants retrospectively recalled their trauma, or by social desirability bias, potentially affecting their responses.

Another possible explanation is the method used to bring awareness to people's trauma symptoms. In Study 1, participants completed a trauma history questionnaire that assessed their exposure to several significant traumas (e.g., crime-related events, general disasters). Participants indicated the frequency of each trauma and their approximate age when the trauma(s) occurred. Study 2 asked participants to think about their worst trauma then write it in a text box. In both studies, participants then completed the posttraumatic stress checklist for DSM 5 (PCL-5; Weathers et al., 2013) to assess symptom severity. Perhaps recalling the extent of trauma exposure, compared to the worst trauma the participant experienced, affected participants' subsequent assessment of their symptom severity. For example, recalling a trauma history (i.e. cumulative trauma) requires retrieving many distressing events, potentially amplifying emotional distress and acute awareness of PTSD symptoms. Conversely, when recalling a single worst trauma, a person may focus on its specific effects, potentially leading to lower symptom ratings by comparison (e.g. Priebe et al., 2018). Supporting this possibility, I compared participants' reported trauma intrusion symptom severity across studies and found participants in Study 1 reported more frequent trauma intrusions than participants in Study 2 ($t(768) = 8.48$, $p <. 001$, $d = 0.61$). Additionally, Study 1 recruited online participants from the United States via Mechanical Turk, while Study 2 sampled Flinders University students and local community members. Differences in culture, age at the time of trauma exposure, experience, and coping mechanisms used between these two sample types may have influenced the relationship between mind-wandering and depression, potentially contributing to the variations in findings between the two studies (see Schnyder et al., 2016).

Interim Summary

Findings across Studies 1, 2 and 3 indicate that people prone to mind-wandering are more likely to engage in rumination and negative thinking patterns associated with maladaptive meta-cognitive beliefs—specifically, the belief that their thoughts are uncontrollable, and a lack of confidence in their cognitive abilities. People prone to mind-wandering also engage maladaptive cognitive strategies, potentially to manage negative thinking patterns. Specifically, people who tend to brood and engage in perseverative thinking (two forms of rumination) may also tend to use dissociation as a strategy to decouple from thoughts to avoid the associated distress. An important finding is that as people's depression increases, they tend to be less mindful and consequently mind-wander more both with, and without, awareness (Study 2). If people are meta-aware of their thoughts, they may become more likely to recognise and disconnect from those thoughts to regulate negative emotion. It would appear then that mindfulness is linked to meta-awareness. Indeed, dispositional meta-awareness partially mediates the relationship between mind-wandering and depression, suggesting that people prone to mind-wandering tend to have decreased dispositional meta-awareness, which in turn increases depression severity (Study 3). This novel finding aligns with my results in Study 2 showing dispositional mindfulness predicted less self-reported probe-caught mind-wandering both with and without meta-awareness; and probe-caught mind-wandering both with and without awareness predicted depression[22].

Given that dissociation is related to both mind-wandering and depression, and that it dissociation has been referred to as "the state of missing mindfulness"—where the body disconnects from the brain to manage distressing events and emotions (Forner, 2019, p. 8)—perhaps dissociation is a mechanism that regulates meta-awareness of mind-wandering.

[22] These results were not reported in the published manuscript.

Pulling it Together: Mechanisms Explaining Mind-Wandering and Depression—The Influence of Negative Thinking Patterns, Dissociation, Meta-Awareness in a Mediation Model

The relationships I found in Studies 1, 2 and 3 formed the foundation for testing a 5-chain serial mediation model that might explain the mechanism underpinning people's proneness to mind-wandering and depression severity. I proposed that people's tendency to mind-wander increases negative thinking patterns—brooding and perseverative thinking—which are known risk factors for depression (Studies 1 and 3). These negative thinking patterns may activate dissociation tendencies so that people can potentially avoid depressive symptoms associated with these thoughts (Studies 1 and 3). Dissociation reduces mindfulness, consequently increasing mind-wandering with and without meta-awareness (Study 2). This reduced meta-awareness presumably limits people's ability to recognise and address their negative thinking patterns, ultimately increasing and/or maintaining depression symptoms (Study 3).

While this proposal—as a five-chain serial mediation model—was not supported, a four-chain serial model predicting that people with mind-wandering tendencies and negative thinking patterns tend to dissociate more, which influences depression, was supported. This novel serial mediation contributes to the depression and mind-wandering literature in several important ways. First, dispositional meta-awareness did not contribute to the serial mediation, indicating that dissociation did not influence people's tendency to be more, or less, meta-aware of thoughts, and thus did not influence depression. This finding contradicted my hypothesis that people might attempt to dissociate when brooding, which might reduce meta-awareness and increase depression, given that increased brooding was associated with increased probe-caught mind-wandering without meta-awareness *and* increased depression (Study 2). On the one hand, perhaps meta-awareness no longer contributes to the relationship when dissociation is introduced because the items measuring dissociation and meta-awareness share similar characteristics (e.g. the tendency to drive without awareness of the route taken) and led to multicollinearity, weakening the contribution of meta-awareness in the mediation model. But divergence analysis showed that of the 28 dissociation items and seven meta-awareness items, only dissociation item one (i.e., "*Some people have the experience of driving or riding in a car or bus or subway and suddenly realizing that they don't remember what has happened during all or part of the trip*") correlated with four meta-awareness items (r = .307 to .364; $p < .001$) and item two (i.e., "*Some people find that sometimes they are listening to someone talk and they suddenly realize that they did not hear part or all of what was said"*) correlated with two meta-awareness items (rs = .314 and .326; $p < .001$). Therefore, it is unlikely the dissociation is, in fact, measuring aspects of meta-awareness. On the other hand, then, perhaps dissociation disrupts cognitive processing—which may include meta-awareness of the negative thinking patterns that can occur with mind-wandering. This disruption to meta-awareness may prevent people from addressing their maladaptive thinking patterns, thereby reinforcing the mind-wandering and depression relationship.

Recall that meta-awareness is an intermittent cognitive process that monitors and evaluates our basic consciousness (thoughts, emotions, etc) to ensure it remains aligned with our primary goals (Schooler, 2002). In Study 2, when participants were randomly probed during a cognitive task, they reported being on task but also sometimes mind-wandering both with and without meta-awareness. This pattern suggests that meta-awareness fluctuated throughout the task. But during dissociation, basic cognitive processes become disconnected (Cavicchioli et al., 2021). Ordinarily, meta-awareness would detect an attention shift from external information to mind-wandering. But if cognitive processes are disconnected, meta-awareness cannot engage these processes, rendering it redundant. As a result, dissociation may limit people's access to negative thinking patterns, potentially to avoid emotional distress and depression. However, while this short-term avoidance may provide temporary relief, it can ultimately contribute to greater depression symptoms, because unresolved negative thoughts continue to influence mood outside of conscious awareness (Welhaf et al., 2025).

The second important finding is that people prone to mind-wandering and engaging in negative thinking patterns can experience any of the three dissociation subcategory patterns. These findings align with previous research that shows absorption dissociation is moderately associated with trait mind-wandering ($r = .51$, $p < .001$; Soffer-Dudek, 2019) and mind-wandering (daydreaming) predicts depersonalisation/derealisation (Poerio, et al., 2016). Additionally, amnestic and depersonalisation/derealisation dissociation are positively associated with depression, and depression mediates the relationship between depersonalisation/derealisation dissociation and sleep quality (Hozoori & Barahmand, 2013; Maaranen et al., 2005; Soffer-Dudek, 2014). However, to my knowledge, my research is the first to establish that amnestic dissociation is associated with trait mind-wandering. Dissociation subcategories each may contribute to the mind-wandering and depression relationship in different ways. For example, people who experience depersonalisation dissociation tend to disconnect from their sense of self, often leaving them feeling emotionally numb and detached from their own lives (Sierra & David, 2011). This detachment might make negative thoughts feel more overwhelming as people struggle to access them while remaining emotionally disconnected. This disconnection could contribute to feelings of hopelessness and increased depression. With amnestic dissociation, people may forget distressing thoughts by disconnecting from them and consequently feel depressed without a clear understanding of the cause (Staniloiu & Markowitsch, 2014). An inability to recognise or process negative thoughts and emotions potentially reduces emotional regulation opportunities, contributing to a chronic cycle of depression. Finally, people who experience absorption dissociation may become so immersed in their thoughts or an external stimulus (e.g. listening to sad music and lyrics), they become oblivious to their surroundings (Soffer-Dudek, 2019). When their thoughts involve negative thinking patterns, this heightened focus on distressing content may increase brooding and perseverative thinking, further increasing depression severity.

Mood Shifts and the SART

Although the above findings highlight a possible mechanism explaining how mind-wandering is related to depression, testing such mechanisms beyond the mediation analysis method I used in my previous studies—i.e., in laboratory settings—relies on our ability to successfully manipulate mood and then attribute changes in mind-wandering behaviour to that mood shift. This brings me to my second thesis aim: to test the *assumption that mood remains stable* during a commonly used mind-wandering protocol when examining the effect of mood on mind-wandering.

A key assumption when investigating the influence of mood on mind-wandering is that *mood remains stable* throughout the task used in experimental protocols to ensure differences in mind-wandering behaviour are attributed to mood and not to aspects of the task. However, preliminary evidence indicates mood can incidentally shift as participants perform tasks (Jonkman et al., 2017; Stawarczyk et al., 2013). I conducted a series of studies (Studies 4, 5 and 6) to systematically test this assumption, and explore an alternative paradigm to manage these mood shifts.

In Studies 4 and 6, participants received a mood induction, while in Study 5 no mood induction was included. Across all studies participants completed two 5-minute SART blocks with random probes to assess self-reported mind-wandering and meta-awareness. Mood was operationalised as positive (energetic, pleasantly engaged) and negative (anger, nervousness) affect. For studies with a mood induction, mood was measured as positive and negative affect at 4-timepoints (pre- and post-induction, and at the end of each SART-1, SART-2), and without a mood induction, 3-timepoints (Pre-SART, SART-1, SART-2). Mood changes were measured as the difference in positive and negative affect between each time point.

Mood Effect During the SART

Overall, I found that participants' mood fluctuated during the two SART blocks regardless of mood induction, but these fluctuations differed across studies. Both Studies 4 and 6 showed similar mood patterns for positive affect in the positive condition (i.e. positive affect decreased in both SART blocks) and negative affect in the negative condition (i.e., decreased in SART-1, no change in SART-2). However, these studies differed for negative affect in the positive condition (i.e., Study 4: stable in both SART blocks; Study 6: increased in SART-1 and stable in SART-2) and positive affect in the negative condition (Study 4: stable in both SART blocks; Study 6: increase in SART-1, decrease in SART-2). Regardless of mood condition, positive affect was lower at the end of the second SART than pre-induction levels, indicating that positive affect had not returned to baseline at the end of the SART.

Importantly, while I expected the neutral induction to have no mood effect during the SART, mood response patterns differed between participants who received a neutral mood (control; Study 4), and those with no mood induction (Study 5). Both the neutral and no mood studies showed similar mood patterns for positive and negative affect in SART2 (i.e., decrease positive affect; stable negative affect). However, these studies differed on positive affect in SART- 1 (Study 4; stable; Study 5: decrease) and negative affect in SART- 1 (Study 4: stable; Study 5; increase). These findings suggest that overall, participants' negative affect was consistently stable across all studies in SART block 2, regardless of a mood induction, and positive affect consistently decreased after a positive mood induction and without a mood induction. Negative affect varied in the first SART block and positive affect varied in the negative mood induction condition. These mood shifts are problematic for assessing mind-wandering because mind-wandering behaviour may fluctuate alongside mood shifts, confounding our understanding of mood and mind-wandering.

To counter these mood shifts, I modified the protocol in Study 6 by continuing the valenced music from the mood induction throughout the SART for half the participants in each mood condition (Study 6). Based on evaluative conditioning, research shows that pairing valenced images (the unconditioned stimulus) with music (conditioned stimulus) at encoding can evoke an emotional response aligned with the valence of the image, even when subsequently presented with neutral stimuli (see Houwer & Thomas, 2001). I reasoned that when participants read schema activating statements (unconditioned stimuli) paired with music (conditioned stimuli), those schemas would remain activated when listening to the music while attending to the SART. However, contrary to expectations, participants who listened to music showed mood shifts that did not differ to those who did not listen to music, regardless of the mood induction. These findings suggest that continuing the music through the SART did not sustain the mood induction.

Overall, my findings suggest that mood weakens (mood induction), or mood deteriorates (no mood induction) when participants perform the SART. Despite variations between studies the pattern of results remains robust (i.e., the direction of the mood shift is constant). Together these studies challenge the assumption that mood remains stable during the SART. Perhaps the mood induction procedure is not sufficiently potent to sustain the mood during the SART but in each study the mood induction effects were large, indicating the mood induction was at least initially successful. Alternatively, perhaps participants are reacting to the characteristics of the SART. Specifically, being a monotonous and repetitive task, the participant may become disengaged and bored, or their success rate over the task is low and they may feel frustrated with their performance. But overall, the findings suggest that using the SART to assess the mood and mind-wandering relationship is problematic because if mood is shifting through the SART, then mind-wandering behaviour measured during the SART may also be affected. Measuring mood as participants perform the SART may be important to allow the researcher to control for mood shift effects.

Mood Effect on Mind-Wandering

I also examined the influence of mood induction on mind-wandering in Studies 4, 5 and 6. Participants who received a *positive* or *negative* mood induction did not differ in self-reported and behavioural mind-wandering over time. Specifically, participants in both mood induction conditions mind-wandered *with* awareness more frequently but did not show increases in mind-wandering *without* meta-awareness, commit more target errors or show greater reaction time variability over time (η_p^2 = .03 - .11[23]; Study 4). These results largely replicated in Study 6 (η_p^2 =.02 - .07), with one exception: participants committed more target errors over time, again regardless of the mood induction. However, in Study 5 (no mood induction) participants mind-wandered with, but not without, meta-awareness, and showed greater reaction time variability over time, yet did not commit more target errors.

These findings suggest that changes in mind-wandering patterns *may* occur alongside mood shifts during the SART. While I expected that participants in a positive mood would mind-wander less, the reduction in positive affect during the SART (Studies 4, 5 and 6) suggests that participants' mind-wandering behaviour might begin to resemble that of participants induced into a negative mood. Further, behavioural indicators of mind-wandering between participants with and without a mood induction remained stable for participant in all studies except for an increase in target errors over time in Study 6. Participants mind-wandered more with, but not without, meta-awareness regardless of a mood induction

[23] Target errors approached significance p = .06, reflected in the large effect size η_p^2 = .11.

(Studies 5 and 6). Further, only one study (Study 4) showed mind-wandering without meta-awareness increased over time.

In Study 6, I included a thought sampling questionnaire that showed interesting results. At the end of the second SART block participants wrote the thought they had just prior to the last thought probe, then rated that thought according to characteristics of valence, function, voluntariness, goal directedness and current concern. Overall, participants focused on the task or focused on task-related thoughts like their performance (e.g., "*annoyed at myself for not getting it right*"). But their thoughts tended to be negative regardless of whether they were induced into a positive or negative mood, suggesting that the SART influenced participants' thoughts negatively.

Taken together, Studies 4, 5 and 6 provide evidence that mood is not stable during the SART and that mood shifts may occur alongside changes in mind-wandering patterns. Instead, mood becomes more negative over time, and participants' thoughts in the later stages of the SART tend to be negative, regardless of a prior mood induction. This negative shift in thought and mood may lead participants induced into a positive mood to mind-wander in a similar pattern to participants in a negative mood. Furthermore, extending the induction procedure by continuing valenced music during the SART was not sufficient to sustain an induced mood.

My research is the first to my knowledge to systematically test mood stability, and unintended mood shifts, during the SART. Prior studies that have measured mood pre- and post-SART as an incidental part of a larger research focus show have shown mixed findings. For example, after a negative mood induction, negative affect remained stable in Jonkman et al. (2017)—consistent with my Studies 4 and 6—but declined in Stawarczyk et al. (2013). Positive affect remained stable in Jonkman et al. and Study 4, declined in Stawarczyk et al. and increased in Study 6. These findings demonstrate the difficulty in sustaining an induced mood that withstands the natural negative mood shift during rest and low-cognitive tasks—making it difficult to isolate the mood effect on mind-wandering without confounding influences of the SART.

Several factors may have influenced fluctuations in positive and negative affect across the SART in Studies 4, 5, and 6. First, different mood induction procedures (e.g., valenced music, autobiographical memories/events) vary in effectiveness (Gerrads-Hesse et al., 1994; Van der Does, 2005). The Velten Mood Induction Procedure is widely used and one of the most effective laboratory methods for inducing depressive mood states (e.g., d = 0.76; Larsen & Sinnet, 1991), but individual responses vary. For example, people with higher baseline depression, frequent negative thoughts, neuroticism, and recent negative life events experience greater mood deterioration following a Velten mood induction (Blackburn, et al., 1990). Additionally, neutral statements alleviate dysphoric mood as effectively as positive statements, suggesting that the neutral conditions may carry a positive mood bias (Styles et al., 1993). This finding may explain the similar mood pattern between positive and neutral mood shifts in Study 4, and the differences in positive affect shifts between Studies 4 and 5. If neutral statements carry a positive bias (Study 4), this bias may have sustained participants' positive affect during the first SART block, differentiating them from those who did not receive a mood induction (Study 5). However, as time on task progressed, this positive bias may have diminished, leading to a fall in positive affect during the second SART block, aligning with participants' affect shift in both the positive mood induction (Study 4) and the no induction study (Study 5).

Second, the task performed is important in sustaining mood. Negative mood induction procedures are based in cognitive theories of depression. Mood is proposed to shift when events align with existing negative schema (e.g., "I am no good"); these schemas are then activated, influencing perceptions, reinforcing maladaptive thought patterns, and increasing depression vulnerability (see Gibb & Coles, 2005). Mood induction procedures are thought to activate schemas, which then bias people's attention toward stimuli that align with those activated schemas. Although the SART is a neutral task, it may weaken the positive and negative induction by interacting with the activated schemas in different ways. This may also explain the higher variability in positive affect, and the more stable negative affect, observed across the three studies. For example, as people make SART errors, the "Oh no!" negative thought people likely experience in response to the high error rate of the SART may activate schemas of "I am a failure". This schema likely produces associated negative thoughts ("I'm so bad at this") and leads to task disengagement aligned with depression symptoms and lower positive affect. In contrast, if, participants are induced in a negative mood, the schemas activated during the SART align with those in the mood induction and the schemas remain activated. Additionally negative affect, typically linked to anxiety and stress, showed less fluctuation during the SART possibly because performing the task did not elicit fear-based responses. Supporting this explanation, Welhaf et al. (2025) found that participants' negative task unrelated thoughts consistently increased over time during the SART, compared to positive or neutral task unrelated thoughts, suggesting that participants thought content became more negative while performing the SART. Additionally, in Study 6, when participants recalled the thought they had immediately before the final thought probe of the SART, most of these thoughts were on task or task-related, and negatively valenced. Together, these findings suggest that performing the SART elicits negative thoughts that are more depressive in nature—characterized by a reduction in positive affect—rather than anxious or stressful in nature, which would typically involve an increase in negative affect. These depressive thoughts appear to be related to the task itself.

Finally, task context such as time on task and task demands influences both mood and mind-wandering. We know that the longer participants perform the task, the more likely they are to become less motivated to perform well (e.g. Randall et al., 2014). Across Studies 4, 5 and 6, each participant spent equivalent time performing the SART (10 minutes) and consistently showed a decline in positive affect. Additionally, they showed increased response time variability, indicating vigilance decrement—a gradual decline in sustained attention and focus on task performance (Matthews et al., 2002). However, target errors increased for participants in Study 6 only; for participants in Studies 4 and 5 target errors were stable over time. If time on task was a primary factor in mood deterioration, I would expect all behavioural indices of mind-wandering to be affected. An alternative explanation is that the additional time spent inducing the mood state may have affected participants' motivation, leading to boredom and decreased task engagement, which in turn contributed to higher task error rates in Study 6.

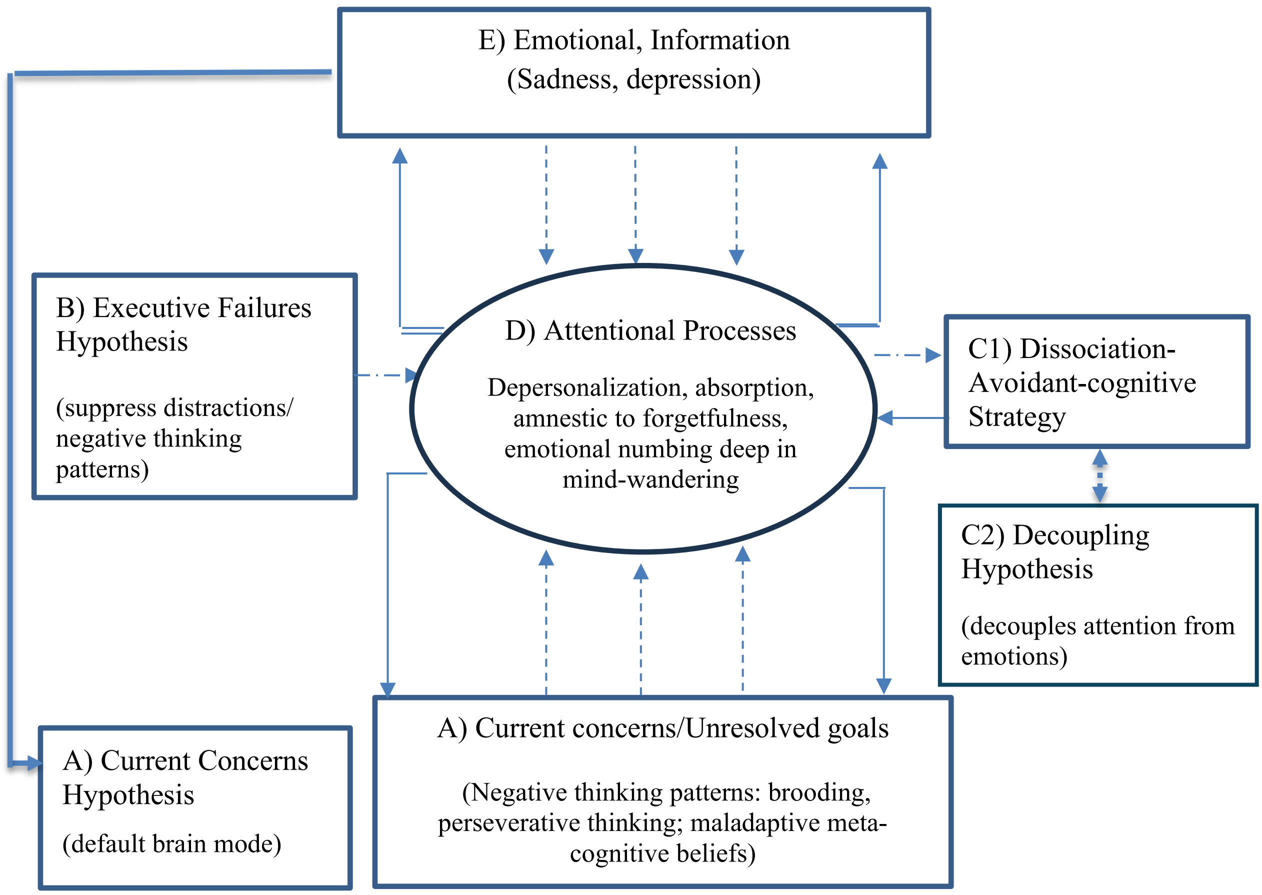
Furthermore, mind-wandering varies depending on both the task-demand and the type of task the participant is performing, with low-demand tasks more likely to facilitate mind-wandering. The SART, while a low-demand task, requires sustained attention to maintain accuracy. This sustained attention can lead to a fatigue effect often associated with vigilance tasks (Matthews et al., 2002). Any fatigue or disengagement effect produced by the SART could have interacted with current mood, regardless of mood induction, to lower positive affect. In addition, task type can influence the effects of a prior mood induction. Jonkman et al. (2017) found that after a positive or negative mood induction, participants reported a decrease in negative affect in both mood conditions during a reading task. However, during the SART, those in the positive mood indication condition showed a decrease in positive affect. This difference may be explained as an interaction between participants' thoughts and the task itself. For example, the SART can produce more negative thoughts related to the task such as "I'm bad at this" (Study 6), whereas perhaps the reading task produced different, less negative thoughts. These findings suggests that participants' mood shifts differentially depending on the task being performed.

Theoretical Implications

My thesis contributes to our theoretical understanding of mind-wandering in several ways. First, to explain the mechanisms underpinning the mind-wandering and depression relationship, I developed a framework based on the process-occurrence theory of mind-wandering (see Figure 1). The model suggests that people have consistent current concerns that that are part of basic consciousness (current concerns hypothesis). When those current concerns are more salient than the task (A), and they become more difficult to suppress (executive failure hypothesis—onset of mind-wandering), people mind-wander (B). When negative thinking patterns—i.e., brooding and perseverative thinking—are produced from the current concerns, people use avoidant-cognitive processes (thought suppression, worry and self-punishment) to avoid or regulate the distress associated with those negative thinking patterns. Dissociation (C1) plays a critical role in this process by decoupling cognitive processing (C2; Soffer-Dudek, 2019), like the decoupling of attention in mind-wandering (Smallwood & Schooler, 2006). This disconnection/decoupling, rather than sustaining mind-wandering, likely reinforces dissociation by decoupling attentional resources from the negative emotions associated with the negative thinking patterns. Indeed, research indicates that many regions of the brain responsible for mind-wandering are also responsible for meta-awareness (see Schooler et la., 2011). Consequently, the disruption of attention may be experienced as emotional numbing, forgetfulness or deep absorption in mind-wandering and negative thought, resulting in various levels of meta-awareness (D; Ozdemir et al, 2015). Consequently, the detachment from emotions reduces people's ability to recognise and address the source of the distress—namely the mind-wandering and negative thought patterns—ultimately contributing to increased depression severity (E). Depression is maintained by the belief that thoughts are uncontrollable, together with reduced cognitive capacity to regulate or disengage from negative thinking patterns. These beliefs reinforce negative thinking patterns, potentially leading to a rebound effect, further increasing mind-wandering and negative thinking patterns (A), thereby perpetuating a self-sustaining mind-wandering depression loop.

Figure 8.1

A Mind-wandering and Depression Model Adapted from Smallwood (2013 p. 524): Mind-Wandering Theories (A, B, C2); Avoidant Cognitive Strategies (C1) and Cognitive/Executive Control (D), Depression (E)



One approach to test this model in a laboratory-based paradigm might be to compare people with low versus high levels of dissociative experiences on outcome measures of mind-wandering, negative thinking, and depression. Participants would complete baseline measures of depression, trait rumination, perseverative thinking tendencies, and dissociation. Participants who score in the first (low) and fourth (high) quartile of dissociative scores would then complete a concerns-based mood induction. For example, the concerns group might be told they are to give a talk on their worst experience as a guest speaker during a lecture, while the control group might be told they will watch people give a speech (e.g., Stawarczyk et al., 2013). This concerns-based induction is intended to increase rumination and worry. The participants would then complete a vigilance task with thought probes to measure mind-wandering. The probes could include measures of current perseverative and ruminative thinking, meta-awareness and mood. At the end of the session, participants would be asked to return the following week to perform or view the speech. During the week, participants would be probed for mind-wandering, mood and thought content at random intervals. I would hypothesise that people who report high, compared to low, dissociation tendencies would show increased mind-wandering, rumination and depression scores during the lab session, and those scores would increase over time in the concerns condition, compared to the control condition.

The second theoretical contribution from my findings is that while dissociation plays a key role in the mind-wandering and depression relationship within the mediation model, meta-awareness does not appear to be involved for people prone to dissociate. Instead, the findings suggest dissociation and meta-awareness may operate as parallel but distinct mechanisms serving different functions in the mind-wandering and depression relationship. Meta-awareness functions intermittently, monitoring thoughts and engaging higher order processes to direct attention, enabling people to recognise and redirect their thoughts when needed. In contrast, dissociation appears to function as a more automatic, involuntary response to distressing or overwhelming thoughts and experiences. Empirical evidence supports the idea that dissociation is a protective mechanism, particularly in response to extreme stress or perceived threat that cannot be escaped or controlled. Based on a meta-analysis (*N* = 11,596 over 57 studies), Cavicchioli et al. (2021) concluded that dissociation is an emotion regulation mechanism that automatically contributes to emotional states through avoidance of internal (e.g. thoughts) and external (e.g. cues) information. Consequently, dissociation provides a temporary escape from the psychological distress of negative thinking patterns, allowing people to detach from, rather than actively process, their negative experiences.

The automatic nature of dissociation during traumatic events (Krausef-Utz, et al., 2017) means that dissociation likely functions independently of meta-awareness. While meta-awareness enables people to monitor and potentially modify their cognitive and emotional responses, dissociation is a reflexive and subconscious reaction aimed at avoiding distress. Possibly when people dissociate, they have limited insight into their cognitive states, making it difficult to accurately report whether they are meta-aware or not. Consequently, some people who mind-wander and are prone to negative thought and dissociation might automatically dissociate from the negative thoughts rather than addressing them, even if meta-awareness is active.

These findings raise important questions about the interaction of dissociation and meta-awareness. If dissociation is predominantly an automatic and protective mechanism, does meta-awareness override or modify dissociation tendencies? Alternatively, are people with heightened meta-awareness more susceptible to noticing distressing thoughts, thus increasing dissociation responses? Future research might address these questions to better understand how we become meta-aware of our negative thinking patterns to reduce the risk of developing depression.

Methodological Implications

My thesis informs current methods of investigating mind-wandering and depression. Across the six studies I demonstrated the difficulties in consistently measuring mind-wandering based on (1) different aspects of mind-wandering definitions (e.g., cognitive failures vs task unrelated thoughts; Studies 1, 2 and 3), and (2) the task performed when measuring mind-wandering (Studies 4, 5 and 6).

Mind-Wandering Measures

Studies 1, 2 and 3, highlight the challenges researchers face in assessing mind-wandering and its correlates (e.g., rumination), particularly when examining the link between mind-wandering and depression. Several methodological implications can be drawn from these studies and warrant addressing in this area of research. First, due to the inherently subjective and fluctuating nature of mind-wandering, researchers should consider a multi-method approach within the same study to cross-validate mind-wandering data. For example, combining probe-caught and self-caught methods, behavioural measures, thought diaries and physiological measures would provide more comprehensive mind-wandering data to reduce the risk of varying result patterns depending on measurement type. *Second*, capturing real-time thought content during participants' mind-wandering is essential to identifying the maladaptive cognitive beliefs and/or negative thinking patterns people might be experiencing when mind-wandering. While multi-categorical and dichotomous response options provide useful information on the frequency and characteristics of mind-wandering, they may interrupt thought flow. Alternatively, aligned with the dynamic framework of spontaneous thought (Christoff et al., 2016), researchers might consider using think-out-loud protocols paired with low-demand tasks to capture real time mind-wandering. This method offers a richer, more ecologically valid insight into spontaneous thoughts, which may help differentiate mind-wandering (e.g., task unrelated thoughts, stimulus independent thoughts) from related phenomena such as rumination, daydreaming and creative thinking. It also accounts for the dynamic shifts in thoughts that occur depending on the level of deliberate and automatic constraints. *Third,* researchers might consider cross-cultural comparisons to understand cultural differences in negative thinking, trauma experience, mind-wandering and coping strategies. Comparing online participants with student samples may produce different findings due to demographic and cultural differences between the cohorts. *Fourth,* to address the variability in mind-wandering definitions, researchers should always provide a definition of mind-wandering applicable to their study, including what is included in that definition (e.g., rumination) and the rationale for the specific mind-wandering measurement used (e.g., CFQ vs MWQ). Being transparent about definitions, although currently implied, may make comparisons of findings across different studies easier and give a more consistent understanding of the mind-wandering and depression relationship.

The SART in Mood and Mind-Wandering

Throughout Studies 4, 5 and 6, I showed that mood fluctuates when performing the SART after a mood induction. This finding challenges the assumption that mood is stable as state mind-wandering is measured, questioning if mind-wandering behaviour during this task can be attributed solely to mood state. I also showed that participants' negative thoughts are SART-related, suggesting that participants think negatively about the task itself. These findings have several implications for the use of the SART in mood and mind-wandering research, and perhaps the use of the SART in sustained attention research. *First,* researchers might reassess the assumption that pre-task mood induction controls for mood throughout a subsequent task. It may be necessary to monitor mood continuously or at multiple times points during the task to control for mood shifts when assessing mind-wandering. *Second,* negative task thoughts may occur during the SART. Therefore, attributing mind-wandering patterns solely to mood states prior to a task should be considered with caution. *Third,* while listening to music did not extend the mood induction, research could consider other methods to achieve this goal. One idea might be to use a lexical decision task with valenced words. Including key words that reflect the events described during the mood induction (the go-stimuli), and neutral or non-words (no-go stimuli) might extend the duration of the activated schema to sustain the induced mood as mind-wandering is measured. Beyond mind-wandering research, the SART in sustained attention research may also be influenced by unintended mood shifts, potentially impacting performance outcomes. For example, if assessing a participant for the ability to sustain attention on a task, using the SART may introduce a mood shift confound to the results. Researchers using the SART might measure mood alongside attention measures to control for any mood fluctuations that might affect sustained attention.

Clinical Implications

My thesis offers valuable insights that can inform and enhance current clinical practice in the treatment of depression. Across three studies, I demonstrate that people with greater tendencies to engage in mind-wandering often experience more severe depressive symptoms. These symptoms are closely linked with negative thinking patterns, maladaptive beliefs about thoughts (such as uncontrollability and dangerousness), and dissociative tendencies. These findings suggest that, for people presenting with depressive symptoms, it may be clinically useful to assess not only traditional symptoms of depression, but also people's propensity for mind-wandering, their meta-awareness of their thoughts and any dissociative coping strategies they might use. Incorporating these potential risk factors into treatment planning might help tailor interventions. For example, if a person has limited access to their negative thoughts—potentially due to avoidant cognitive strategies like thought suppression, worry and/or emotional numbing—therapies could focus on increasing emotional awareness and reducing dissociation. Techniques such as grounding exercises and emotion focused interventions may help people stay connected with their emotions and improve emotional regulation while decreasing dissociative symptoms (Greenberg, 2002).

Additionally, if a person tends to rely on avoidant-cognitive strategies to manage negative thoughts and depressive symptoms, incorporating interventions like acceptance and commitment therapy (ACT; Hayes et al, 2011) or mindfulness based cognitive therapy (MBCT; Segal et al., 2018) might help the person manage the symptoms without engaging in the thoughts. Enhancing meta-awareness—particularly people's ability to notice when they are mind-wandering or ruminating—may help interrupt the cycle of negative thinking. Incorporating metacognitive training, such as detached mindfulness (a component of Metacognitive Therapy; Capobianco & Nordahl, 2023), can enhance people's capacity to observe rather than engage in their negative thinking patterns. To support this process, experience sampling methods (e.g., using thought diaries or real-time mood and thought tracking apps) could be used therapeutically to help people become more aware of when and how their thoughts shift, particularly during episodes of mind-wandering or rumination. Overall, integrating assessments of mind-wandering, dissociation, and negative thinking patterns into clinical practice can provide a more comprehensive understanding of a person's depressive experience, enabling clinicians to tailor interventions that address core depressive symptoms and the cognitive and attentional processes that sustain them.

Limitations and Future Directions

My thesis has several important limitations. *First*, I did not collect real-time thought content data across all studies, which limits my ability to confirm whether participants' mind-wandering episodes were specifically related to negative thinking patterns (e.g., brooding and perseverative thinking, maladaptive cognitive beliefs; Studies 1, 2, and 3) and were a pathway to depression. Similarly, I am not able to confirm whether negative schemas were activated during the SART (Studies 4, 5 and 6). In Study 6, however, I did capture a retrospective thought sample, which provided more fine-grained information about participants' thoughts as they performed the SART (the thought valence, focus and function) and provided insight into the interaction between participants' thoughts and the SART. Future research might include techniques to capture thought contents such as the type of thought (e.g. ruminative), its valence (positive, negative or neutral) and mind-wandering type (deliberate or spontaneous) as part of the intermittent thought probes. One approach might involve approximately four probes spaced across the task that asks participants to write their thoughts in five words or less then rate these thoughts according to characteristics such as valence, temporal orientation to gather more detailed data about what is contributing the participants' mood.

Second, in Studies 1, 2 and 3, I relied on self-report questionnaires to measure trait rumination, meta-cognitive beliefs, thought suppression, thought control, dissociation and mind-wandering, as well as people's depression symptoms. Self-report measures are inherently vulnerable to biases, particularly social desirability bias and variability in participants' ability to respond consistently, and a reliance on retrospective recall, which is subject to memory distortion (Rosenman et al, 2011). I used experience sampling during laboratory studies (Studies 2, 4, 5 and 6) to measure participants' state mind-wandering and meta-awareness, providing a degree of data triangulation; indeed, I generally found alignment between trait tendencies and state measures of mind-wandering (as seen in Study 2). Future research could strengthen the validity of self-report data by triangulating several self-report questionnaires for within-subject. Including objective measures such as neuroimaging and physiological data might improve the validity of the self-report data.

Third, in Studies 2, 4, 5 and 6 I used random thought probes with dichotomous response options (i.e., yes/no) during the SART to assess state meta-awareness and mind-wandering. A limitation of this protocol is the difficulty in classifying goal-directed and stimulus independent thoughts dichotomously. For example, a task-related thought might be reported as on-task for one participant and mind-wandering for another depending on how they judge their thoughts. This subjectivity can lead to inconsistent responding both within and between participants. Another criticism of thought probes is the inability to capture the onset, duration and termination of one mind-wandering episode. Successive probes may reflect the same continuous train of thought but be recorded as separate episodes, resulting in an overreporting of mind-wandering frequency.

In addition, some people may clearly recognise when they have mind-wandered, while others may not confidently detect if and when their mind has wandered. Indeed, in Study 2, participants were significantly more confident in rating being on-task than when reporting being off-task, suggesting they are less clear about whether they mind-wandered. Future research addressing the probe limitations might integrate a continuous slider, or a multi-categorical scale ranging from "not aware at all", to "completely aware" into the probe-caught/self-caught paradigm (e.g., Vannucci et al., 2019). Additionally, including a self-caught aspect to the probe-caught paradigm where participants select a category of thought (e.g. the task, my performance, work, or a memory; Zanesco et al., 2024) with brief description, might provide more detailed information to compare thought content across mind-wandering episodes. This comparison could help determine whether the self-caught and probe-caught episodes reflect a continuous or a distinct mind-wandering occurrence. Combining the estimation protocol outlined in Voss et al. (2018) could provide additional evidence for determining a discrete mind-wandering episode.

Fourth, for my conceptual aim, I recruited non-clinical samples to examine a model that explains potential risk factors in the onset and/or maintenance of depression. While this approach allowed me to explore underlying mechanisms, it limits generalisability of findings to a clinical population. However, as I outlined in Chapter 1, I operationalised depression broadly, including depressive symptoms, negative affect, negative mood and dysphoria. This broader definition allowed me to examine people experiencing subthreshold depression, including students—a group with subthreshold depression rates of 14-39% (Ge et al. 2024). The depression measures used (BDI and the DASS) have reasonable to good convergent validity with the structured clinical interview for the DSM (SCID: e.g. Hayden et al., 2012; Moya et al., 2022; Veerman et al., 2009). But future research might directly compare clinical samples with community and subthreshold depression samples to identify whether the relationships I found generali*s*e to clinical populations or are specific to those with mild depression.

Fifth, I did not investigate the effect of working memory capacity (WMC) on the mind-wandering and depression relationship. Several findings support the potential role of WMC in my proposed model. Research shows people with lower WMC, compared to higher WMC, mind-wander more often *and* report moderate to high depression severity, potentially due to their reduced ability to inhibit negative thinking patterns and prevent dissociation (Koster & De Raedt, 2012; Marchetti et al., 2016). Thus, mind-wandering is linked to both depression and WMC. Future research could test this proposed pathway. For example, one possible study might measure participants' WMC, trait mind-wandering, dissociation, brooding and perseverative thinking patterns. Participants could be induced into a particular mood state, followed by a reading task with content matched to the valence of the mood induction. During the task, intermittent thought probes could assess state mind-wandering, meta-awareness and current mood. To capture real-world patterns, this lab-based protocol could be followed by a 7-day experiencing sampling method where participants receive prompts throughout the day to report on their mind-wandering, mood and dissociative experiences.

Additionally, the in-lab protocol could be repeated at 6-month follow-up to assess changes over time for stronger causal conclusions.

Sixth, for my methodological aim I did not include a task control condition or vary mood induction procedures. Although I established that mood did shift during the SART, and this robust mood shift occurred regardless of a prior mood induction, I cannot generalise these findings to other tasks during which mind-wandering is measured, such as reading or line-detection tasks. Given that the size of the mood shifts (particularly the size of the decline in positive affect) are primarily larger than that identified as the estimated Mood Drift over Time effect, without a control task, or indeed no task at all, I cannot claim that the shift in mood during the SART is caused solely by the SART itself. Comparing the mood shifts following a mood induction between the SART, a matched low-demand alternative task, and a no task condition, would help determine whether mood changes occurred naturally (no task), result from general task engagement, or are specifically associated with the SART.

Furthermore, I used one mood induction procedure (MIP) across the three studies. Although the Velten mood induction procedure succeeded in inducing the intended mood state, showing large changes in positive and negative affect in the expected directions, people's responses to MIPs can vary. For example, participants with higher baseline depression, frequent negative thoughts, neuroticism and recent negative life events experience greater mood deterioration following a Velten mood induction (Blackburn et al., 1990). Indeed, greater mood deterioration due to individual differences may have occurred among participants induced into a negative mood in Studies 4 and 6. The unintended fall in positive affect through the SART may be in part due to individual differences in response to the Velten MIP. Future research could measure baseline levels of individual differences—neuroticism, depression, rumination and negative life events—to control for unintended mood shifts during the SART when using the Velten MIP. Another approach would be to compare the Velten MIP with an alternative mood induction protocol (e.g. valenced film) to determine if the Velten MIP, even after controlling for individual difference, impacts mood during the SART

Seventh, participants' mood was regularly assessed throughout studies 4, 5, and 6—20 affective items at four timepoints throughout the studies—which may have resulted in a regression to the mean effect where extreme scores move closer to the mean with repeated measurements (Ostermann et al., 2008). Participants' fall in positive affect through the SART may have been in part due to a regression to the mean effect, but the stable negative affect observed through the SART for most of the SART blocks suggests regression to the mean may not have affected participants' mood overall. Future research might include categorical response option formats with probes to assess whether fluctuations in positive and negative affect are attributable to the SART itself or to activated schema from the mood induction. This approach may provide more detailed information about thought content and help clarify whether the Velten MIP affected mood during the SART.

Finally, I used cross sectional designs to test the relationships between mind-wandering, depression, negative thinking patterns and cognitive strategies. I demonstrated through serial mediation analysis that people prone to mind-wandering and negative thinking patterns tend to dissociate more and experience greater depression. This particular pathway was based on a strong theoretical argument, but the alternative pathway was not tested as a way to confirm my hypothesis about directionality. Mediation analysis is often used with longitudinal studies because data collection at different time points establishes a temporal order; here I would hypothesise that mind wandering with negative thinking patterns and a tendency to dissociate at time 1 leads to increased depression at time 2. To confirm this pathway, future research could conduct a longitudinal design study examining mind-wandering, negative thinking patterns, dissociation and depression at prescribed timepoints to assess changes in variables over time. Alternatively, a cross-sectional design could test alternative pathways, such as people with greater depression tend to dissociate more which in turn leads to greater negative thinking patterns and increased mind-wandering to either support or refute the serial pathway and potentially provide evidence for the proposed cognitive loop model.

Conclusion

My findings develop our understanding of the relationship between mind-wandering and depression by demonstrating how mind-wandering, negative thinking, avoidant-cognitive strategies and depression are associated. Several mechanisms emerged from these associations. Specifically, people prone to mind-wander experience greater depression partly through their tendency to ruminate (specifically brood), experience more trauma intrusions and hold unhelpful beliefs about the uncontrollability of their thoughts, and doubt their cognitive capacity. This relationship between mind-wandering and depression relationship can also be explained by people’s tendencies to engage in maladaptive cognitive strategies of thought suppression, thought control (punishment and worry) and dissociation, which are potentially used to manage negative thinking patterns and depression symptoms. Additionally, mind-wandering is experienced both with and without meta-awareness, which may reduce people's ability to recognise and address their negative thinking patterns, potentially contributing to the maintenance of their depression. Dissociation—the temporary detachment of cognitive processes—was highlighted as important contributor to the mind-wandering and depression relationship. Specifically, a serial mediation showed that people prone to mind-wandering and negative thinking patterns tend to dissociate more often which ultimately exacerbates and/or maintains depression. This depression may lead to increased mind-wandering, creating a cognitive loop maintaining the mind-wandering and depression relationship. My findings also inform research investigating the mood and mind-wandering relationship. These findings show that, rather than people's mood remaining stable as they perform the SART as assumed, their mood shifts. Additionally, changes in mind-wandering behaviour measures when people perform the SART tend to occur alongside these mood shifts, questioning the use of the SART as a task when measuring mind-wandering.

P. S. I hope you enjoyed those sandy beaches and turquoise water breaks, if not perhaps you could reward yourself now.

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Appendix A – Cognitive Failures Questionnaire (CFQ; Broadbent et al., 1982)

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The following questions are about minor mistakes which everyone makes from time to time, but some of which happen more often than others. We want to know how often these things have happened to you in the last six months. Please circle the appropriate number.

	Very often	Quite often	Occasionally	Very rarely	Never
1. Do you read something and find you haven't been thinking about it and must read it again?	4	3	2	1	0
2. Do you find you forget why you went from one part of the house to the other?	4	3	2	1	0
3. Do you fail to notice signposts on the road?	4	3	2	1	0
4. Do you find you confuse right and left when giving directions?	4	3	2	1	0
5. Do you bump into people?	4	3	2	1	0
6. Do you find you forget whether you've turned off a light or a fire or locked the door?	4	3	2	1	0
7. Do you fail to listen to people's names when you are meeting them?	4	3	2	1	0
8. Do you say something and realize afterwards that it might be taken as insulting?	4	3	2	1	0
9. Do you fail to hear people speaking to you when you are doing something else?	4	3	2	1	0
10. Do you lose your temper and regret it?	4	3	2	1	0
11. Do you leave important letters unanswered for days?	4	3	2	1	0
12. Do you find you forget which way to turn on a road you know well but rarely use?	4	3	2	1	0
13. Do you fail to see what you want in a supermarket (although it's there)?	4	3	2	1	0
14. Do you find yourself suddenly wondering whether you've used a word correctly?	4	3	2	1	0
15. Do you have trouble making up your mind?	4	3	2	1	0
16. Do you find you forget appointments?	4	3	2	1	0
17. Do you forget where you put something like a newspaper or a book?	4	3	2	1	0
18. Do you find you accidentally throw away the thing you want and keep what you meant to throw away – as in the example of throwing away the matchbox and putting the used match in your pocket?	4	3	2	1	0
19. Do you daydream when you ought to be listening to something?	4	3	2	1	0
20. Do you find you forget people's names?	4	3	2	1	0
21. Do you start doing one thing at home and get distracted into doing something else (unintentionally)?	4	3	2	1	0
22. Do you find you can't quite remember something although it's 'on the tip of your tongue'?	4	3	2	1	0
23. Do you find you forget what you came to the shops to buy?	4	3	2	1	0
24. Do you drop things?	4	3	2	1	0
25. Do you find you can't think of anything to say?	4	3	2	1	0

Appendix B – Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995)

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Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you **over the past week**. There are no right or wrong answers. Do not spend too much time on any statement.

		Never	**Sometimes**	**Often**	**Almost always**
1.	I found it hard to wind down	0	1	2	3
2.	I was aware of dryness of my mouth	0	1	2	3
3.	I couldn't seem to experience any positive feeling at all	0	1	2	3
4.	I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5.	I found it difficult to work up the initiative to do things	0	1	2	3
6.	I tended to over-react to situations	0	1	2	3
7.	I experienced trembling (e.g., in the hands)	0	1	2	3
8.	I felt that I was using a lot of nervous energy	0	1	2	3
9.	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10.	I felt that I had nothing to look forward to	0	1	2	3
11.	I found myself getting agitated	0	1	2	3
12.	I found it difficult to relax	0	1	2	3
13.	I felt down-hearted and blue	0	1	2	3
14.	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15.	I felt I was close to panic	0	1	2	3
16.	I was unable to become enthusiastic about anything	0	1	2	3
17.	I felt I wasn't worth much as a person	0	1	2	3
18.	I felt that I was rather touchy	0	1	2	3
19.	I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)	0	1	2	3
20.	I felt scared without any good reason	0	1	2	3
21.	I felt that life was meaningless	0	1	2	3

Appendix C – Metacognitions Questionnaire (MCQ-30; Cartwright-Hatton & Wells, 1997)

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Items		Do not agree 1	Agree slightly 2	Agree moderately 3	Agree very much 4
1	Worrying helps me to avoid problems in the future				
2	My worrying is dangerous for me				
3	think a lot about my thoughts				
4	I could make myself sick with worrying				
5	I am aware of the way my mind works when I am thinking through a problem				
6	If I did not control a worrying thought, and then it happened, it would be my fault				
7	need to worry in order to remain organized				
8	I have little confidence in my memory for words and names				
9	My worrying thoughts persist, no matter how I try to stop them				
10	Worrying helps me to get things sorted out in my mind				
11	I cannot ignore my worrying thoughts				
12	I monitor my thoughts				
13	I should be in control of my thoughts all of the time				
14	My memory can mislead me at times				
15	My worrying could make me go mad				
16	I am constantly aware of my thinking				
17	I have a poor memory				
18	pay close attention to the way my mind works				

19 Worrying helps me cope
20 Not being able to control my thoughts is a sign of weakness
21 When I start worrying, I cannot stop
22 I will be punished for not controlling certain thoughts
23 Worrying help me to solve problems
24 I have little confidence in my memory for places
25 It is bad to think certain thoughts
26 I do not trust my memory
27 If I could not control my thoughts, I would not be able to function
28 I need to worry, in order to work well
29 I have little confidence in my memory for actions
30 I constantly examine my thoughts

Appendix D – Global Rumination Scale (GRS; McIntosh & Martin, 1992)

Text removed for copyright restrictions.

Please refer to article:
McIntosh, W. D., & Martin, L. L. (1992). The cybernetics of happiness: The relation of goal attainment, rumination, and affect. In M. S. Clark (Ed.), Emotion and social behavior (pp. 222–246). Sage Publications, Inc

Appendix E – White Bear Suppression Inventory (WBSI; Muris et al., 1996; Wegner & Zanakos, 1994)

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Please select the number for each item below that best describes how you generally deal with your thoughts, where: 1 = 'strongly disagree' and 5 = 'strongly agree'.

	1 Strongly disagree	2	3	4	5 Strongly agree
There are things I prefer not to think about.					
Sometimes I wonder why I have the thoughts I do.					
I have thoughts that I cannot stop.					
There are images that come to mind that I cannot erase.					
My thoughts frequently return to one idea. I wish I could stop thinking of certain things.					
Sometimes my mind races so fast I wish I could stop it.					
I always try to put problems out of my mind.					
There are thoughts that keep jumping into my head.					
Sometimes I stay busy just to keep thoughts from intruding on my mind.					
There are things I try not to think about.					
Sometimes I really wish I could stop thinking.					
I often do things to distract myself from my thoughts.					
There are many thoughts that I have that I don't tell anyone.					
My thoughts frequently return to one idea.					

Appendix F – Dissociative Experience Scale-II (Bernstein & Putman, 1986*;*

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Please refer to the article DOI: 10.1097/00005053-198612000-00004

Appendix G – Thought Control Questionnaire (TCQ; Wells & Davies, 1994)

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Most people experience unpleasant and/or unwanted thoughts (in verbal and/or picture form). Which can be difficult to control. We are interested in the techniques that you generally use to control such thoughts.

Below are a number of things that people do to control these thoughts. Please read each statement carefully, and indicate how often you use each technique by circling the appropriate number. There are no right or wrong answers. Do not spend too much time thinking about each one.

When I experience an unpleasant / unwanted thought:

		Never	Sometimes	Often	Almost always
1	I call to mind positive images instead	1	2	3	4
2	I tell myself not to be so stupid	1	2	3	4
3	I focus on the thought	1	2	3	4
4	I replace the thought with a more trivial bad thought	1	2	3	4
5	I don’t talk about the thought to anyone	1	2	3	4
6	I punish myself for thinking the thought	1	2	3	4
7	I dwell on other worries	1	2	3	4
8	I keep the thought to myself	1	2	3	4
9	I occupy myself with work instead	1	2	3	4
10	I challenge the thought’s validity	1	2	3	4
11	I get angry at myself for having the thought	1	2	3	4
12	I avoid discussing the thought	1	2	3	4
13	I shout at myself for having the thought	1	2	3	4
14	I analyse the thought rationally	1	2	3	4
15	I slap or pinch myself to stop the thought	1	2	3	4
16	I think pleasant thoughts instead	1	2	3	4
17	I find out how my friends deal with these thoughts	1	2	3	4
18	I worry about more minor things instead	1	2	3	4
19	I do something that I enjoy	1	2	3	4
20	I try to reinterpret the thought	1	2	3	4
21	I think about something else	1	2	3	4
22	I think more about the more minor problems I have	1	2	3	4
23	I try a different way of thinking about it	1	2	3	4
24	I think about past worries instead	1	2	3	4
25	I ask my friends if they have similar thoughts	1	2	3	4
26	I focus on different negative thoughts	1	2	3	4
27	I question the reasons for having the thought	1	2	3	4

28	I tell myself that something bad will happen if I think the thought	1	2	3	4
29	I talk to a friend about the thought	1	2	3	4
30	I keep myself busy	1	2	3	4

Appendix H – PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013)

Scale made freely available from the National Center for PTSD at www.ptsd.va.gov.

:

Instructions: Below is a list of problems that people sometimes have in response to a very stressful experience. Keeping your worst event in mind, please read each problem carefully and then select one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

In the past month, how much have you been bothered by:	Not at all (0)	A little bit (1)	Moderately (2)	Quite a bit (3)	Extremely (4)
1. Repeated, disturbing, and unwanted memories of the stressful experience?					
2. Repeated, disturbing dreams of the stressful experience?					
3. Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?					
4. Feeling very upset when something reminded you of the stressful experience?					
5. Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?					
6. Avoiding memories, thoughts, or feelings related to the stressful experience?					
7. Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects or situations)?					
8. Trouble remembering important parts of the stressful experience?					
9. Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?					

10. Blaming yourself or someone else for the stressful experience or what happened after it?	
11. Having strong negative feelings such as fear, horror, anger, guilt, or shame?	
12. Loss of interest in activities that you used to enjoy?	
13. Feeling distant or cut off from other people?	
14. Trouble experiencing positive feelings (for example, being unable to feel happiness or having loving feelings for people close to you?)	
15. Irritable behaviour, angry outburst, or acting aggressively?	
16. Taking too many risks or doing things that could cause you harm?	
17 Being "superalert" or watchful or on guard?	
18. Feeling jumpy or easily startled?	
19. Having difficulty concentrating?	
20. Trouble falling or staying asleep?	

Appendix I – Beck Depression Inventory (BDI-II; Beck et al., 1996).

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Please refer to the article DOI: 10.1037/t00742-000

Appendix J – Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003)

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Below is a collection of statements about your everyday experience. Using the 1–6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be.

1. I could be experiencing some emotion and not be conscious of it until some time later.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

2. I break or spill things because of carelessness, not paying attention, or thinking of something else.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

3. I find it difficult to stay focused on what's happening in the present.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

6. I forget a person's name almost as soon as I've been told it for the first time.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

7. It seems I am ‘‘running on automatic,” without much awareness of what I'm doing.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

8. I rush through activities without being really attentive to them.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

10. I do jobs or tasks automatically, without being aware of what I'm doing.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

11. I find myself listening to someone with one ear, doing something else at the same time.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

12. I drive places on 'automatic pilot' and then wonder why I went there.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

13. I find myself preoccupied with the future or the past.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

14. I find myself doing things without paying attention.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

15. I snack without being aware that I'm eating.

1.	2.	3.	4.	5.	6.
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost never

Appendix K – Ruminative Responses Scale (RSS; Nolan-Hoeksema et al., 1999)

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People think and do many different things when they are depressed. Please read each of the items below and indicate whether you almost never, sometimes, often, or almost always think or do each one when you feel down, sad or depressed. Please indicate what you generally do, not what you think you should do.

	Almost never	Sometimes	Often	Almost always
Think about how alone you feel	1	2	3	4
Think “I won’t be able to do my job if I don’t snap out of this.”	1	2	3	4
Think about your feelings of fatigue and achiness	1	2	3	4
Think about how hard it is to concentrate	1	2	3	4
Think “What am I doing to deserve this?”	1	2	3	4
Think about how passive and unmotivated you feel	1	2	3	4
Analyze recent events to try to understand why you are depressed	1	2	3	4
Think about how you don’t seem to feel anything anymore	1	2	3	4
Think “Why can’t I get going?”	1	2	3	4
Think “Why do I always react this way?”	1	2	3	4
Go away by yourself and think about why you feel this way	1	2	3	4
Write down what you are thinking and analyze it	1	2	3	4
Think about a recent situation, wishing it had gone better	1	2	3	4
Think “I won’t be able to concentrate if I keep feeling this way.”	1	2	3	4
Think “Why do I have problems other people don’t have?”	1	2	3	4

Think “Why can’t I handle things better?”	1	2	3	4
Think about how sad you feel	1	2	3	4
Think about all your shortcomings, failings, faults, mistakes	1	2	3	4
Think about how you don’t feel up to doing anything	1	2	3	4
Analyze your personality to try to understand why you are depressed	1	2	3	4
Go someplace alone to think about your feelings	1	2	3	4
Think about how angry you are with yourself	1	2	3	4

Appendix L – Mind Wandering Questionnaire (Mrazek et al., 201)

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Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

Almost never (1)	*Very infrequently* (2)	*Somewhat infrequently* (3)	*Somewhat frequently* (4)	*Very frequently* (5)	*Almost always* (6)

I have difficulty maintaining focus on simple or repetitive work.	1	2	3	4	5	6
While reading, I find I haven't been thinking about the text and must therefore read it again.	1	2	3	4	5	6
I do things without paying full attention.	1	2	3	4	5	6
I find myself listening with one ear, thinking about something else at the same time.	1	2	3	4	5	6
I mind-wander during lectures or presentations.	1	2	3	4	5	6

Appendix M – Multidimensional Awareness Scale (MAS-MA; DeMarree & Naragon-Gainey, 2022;

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Strongly disagree	*Disagree*	*Somewhat disagree*	*Neither agree nor disagree*	*Somewhat agree*	*Agree*	*Strongly agree*
(1)	(2)	(3)	(4)	(5)	(6)	(7)

I don't know when I should listen to my thoughts and when I shouldn't.	1	2	3	4	5	6	7
I notice how my thoughts and feelings come and go.	1	2	3	4	5	6	7
When I'm walking outside, I notice the people and scenery I pass by.	1	2	3	4	5	6	7
I often get lost in my thoughts.	1	2	3	4	5	6	7
I am aware of my thoughts and feelings as I experience them.	1	2	3	4	5	6	7
I am usually aware of what is going on around me.	1	2	3	4	5	6	7
I struggle with my thoughts and feelings a lot.	1	2	3	4	5	6	7
I often get "caught up" in my thoughts and can't look at them objectively.	1	2	3	4	5	6	7
I keep thinking about things that bother me.	1	2	3	4	5	6	7
I notice it when I am having a feeling.	1	2	3	4	5	6	7
I can think about something without getting worked up about it.	1	2	3	4	5	6	7
I don't pay attention to my surroundings.	1	2	3	4	5	6	7
I can observe my feelings as they unfold.	1	2	3	4	5	6	7
My friends say I'm oblivious to what happens around me.	1	2	3	4	5	6	7
I don't let my current feelings overwhelm me.	1	2	3	4	5	6	7
I pay attention to the sights and sounds around me.	1	2	3	4	5	6	7
I experience my thoughts and feelings without being carried away by them.	1	2	3	4	5	6	7
When a thought or feeling is not helpful for me, I am able to let it go.	1	2	3	4	5	6	7
I observe my thoughts without getting caught up in them.	1	2	3	4	5	6	7
I pay attention to sensations in my body to understand how I am feeling.	1	2	3	4	5	6	7
When my emotions change, I notice.	1	2	3	4	5	6	7
I tend to ignore my surroundings.	1	2	3	4	5	6	7
I usually know what thoughts are going through my mind at any given time.	1	2	3	4	5	6	7
My internal experiences really bother me.	1	2	3	4	5	6	7
Viewing my feelings objectively is difficult.	1	2	3	4	5	6	7

Appendix N – Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011;

		Never	Rarely	Sometimes	Often	Almost always
1.	The same thoughts keep going through my mind again and again.	0	1	2	3	4
2.	Thoughts intrude into my mind.	0	1	2	3	4
3.	I can't stop dwelling on them.	0	1	2	3	4
4.	I think about many problems without solving any of them.	0	1	2	3	4
5.	I can't do anything else while thinking about my problems.	0	1	2	3	4
6.	My thoughts repeat themselves.	0	1	2	3	4
7.	Thoughts come to my mind without me wanting them to.	0	1	2	3	4
8.	I get stuck on certain issues and can't move on.	0	1	2	3	4
9.	I keep asking myself questions without finding an answer.	0	1	2	3	4
10.	My thoughts prevent me from focusing on other things.	0	1	2	3	4
11.	I keep thinking about the same issue all the time.	0	1	2	3	4
12.	Thoughts just pop into my mind.	0	1	2	3	4
13.	I feel driven to continue dwelling on the same issue.	0	1	2	3	4
14.	My thoughts are not much help to me.	0	1	2	3	4
15.	My thoughts take up all my attention.	0	1	2	3	4

Appendix O – Positive and Negative Affect Schedule (PANAS; Watson et al., 1988;

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This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to the word. **Indicate to what extent you feel this way *right now*, that is, at the present moment.**

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Interested	____________	Irritable	____________
Distressed	____________	Alert	____________
Excited	____________	Ashamed	____________
Upset	____________	Inspired	____________
Strong	____________	Nervous	____________
Guilty	____________	Determines	____________
Scared	____________	Attentive	____________
Hostile	____________	Jittery	____________
Enthusiastic	____________	Active	____________
Proud	____________	Afraid	____________

Appendix P – Velten Mood Induction Procedure (VMIP: see Seibert & Ellis, 1991).

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Positive and Negative Condition Script

During this part of the experiment, you will be required to listen to music wearing headphones. Please listen carefully to the following instructions. You can read the instructions on screen at the same time. *enter*

In this part of the experiment, you will be reading a series statements that will appear on the screen. These statements represent a mood state. *Enter`*

In order to participate fully and successfully, you will need to be willing to feel and experience each statement as it would apply to you personally. *enter*

In other words, when you read each statement, you will allow yourself to respond as though the statement had been your own original thought. You will go with the feeling and not try to stop it.
enter

At first, you might feel like resisting the mood. *enter*

However, you will see that it is the case that you have the opportunity to learn to talk yourself into a mood, and obviously, you will also learn how to talk yourself out of one. *enter*

When this happens, you will find that you have learned something valuable about yourself; you can learn to control your moods. *enter*

Thus, you will try to experience the mood suggested. *enter*

You will feel each item, making the statement your own. You will experience the mood suggested and will not attempt to stop it. You will visualize a scene in which you have had such a feeling or thought. *enter*

Then you will begin to let whatever comes to your mind that relates to the feeling. This is a type of free association - letting thoughts that pertain to the feeling flow freely. *enter*

You are now ready to experience the statements that follow. *enter*

From this point forward, you will spend the time reading the statements and experiencing the feelings they suggest to you. *enter*

Negative Velten Statements (Sample)

1. I feel a little down today.
2. My classes are harder than I expected.
3. Everyone else seems to be having more fun.
4. Sometimes I feel so guilty that I can't sleep.
5. I wish I could be myself, but nobody likes me when I am.

Positive Velten Statements (Sample)

1. Being in college makes my dreams more possible.

2. The world is full of opportunity and I'm taking advantage of it.
3. I know if I try I can make things turn out fine.
4. I bet things will go well for the rest of the day.
5. When I have the right attitude nothing can depress me.

Neutral Velten Statements (Sample)

1. There are sixty minutes in one hour.
2. A neuron fires rapidly.
3. New Mexico is in the United States.
4. Apples are harvested in the Fall.
5. Basket weaving was invented before pottery making.

Appendix Q – Thought Characteristic Questionnaire (TCQ; Johnson et al., 1988; Stawarczyk et al., 2011)

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Please recall the thought you had immediately before the last time you were asked *"Were you focused on the task ask" (y/n)*. Describe that thought in 10 words or less in the text box below. For example:

- If you responded yes: were you thinking about the task or your performance on the task?
- If you responded no: were you thinking about something unrelated to the task – a memory or something you need to do?

1. How voluntary was this thought?

1	2	3	4	5	6	7
Not at all						Completely

2. How related was this thought to a current goal?

1	2	3	4	5	6	7
Not at all						Completely

3. How related was this thought to a current concern/worry?

1	2	3	4	5	6	7
Not at all						Completely

4. How negative/positive was this thought?

-3	-2	-1	0	1	2	3
Extremely Negative						Extremely Positive

(5) Please specify the main function of the thought
(1) decision/problem solve
(2) Planning
(3) Re-appraisal
(4) Feel better
(5) to keep aroused), and
(6) other