WHAT'S ON YOUR MIND? AN INVESTIGATION OF INDIVIDUAL DIFFERENCES IN MIND-WANDERING

An Undergraduate Research Scholars Thesis

by

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Submitted to the LAUNCH: Undergraduate Research office at
Texas A&M University
in partial fulfillment of requirements for the designation as an

UNDERGRADUATE RESEARCH SCHOLAR

Approved by
Faculty Research Advisor: Dr. Heather C. Lench

May 2023

Major: Psychology

RESEARCH COMPLIANCE CERTIFICATION

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This project did not require approval from the Texas A&M University Research Compliance & Biosafety office.

TABLE OF CONTENTS

ABSTRACT

What's On Your Mind? An Investigation of Individual Differences in Mind-Wandering

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Mind-wandering is a ubiquitous human experience characterized by task-unrelated thought, or thought that deviates from the present task. Past research has found that mind-wandering is a vital moderator of psychological well-being and is associated with important outcomes like academic attainment and psychopathology. However, the majority of research on mind-wandering examined task-unrelated thought when attending to an external task. Few studies have investigated mind-wandering in the absence of external stimulation (e.g., leaving participants alone with their thoughts). Additionally, research on individual differences in mind-wandering is limited. This secondary data analysis was done with a preliminary study examining the relationship between personality traits and mind-wandering while accounting for various dimensions of mind-wandering (e.g., emotions, temporal orientation, and valence of self-generated thought). Results found that personality traits are associated with positive and negative emotions experienced after mind-wandering. These findings expand our understanding of the relationship between personality and mind-wandering by showing that individual differences in personality may influence mind-wandering experiences.

ACKNOWLEDGEMENTS

Contributors

I would like to thank my faculty advisor, Dr. Heather C. Lench, for her guidance and support throughout this research. I would also like to thank Nazim Asani for his assistance, especially during the data analysis process. Additionally, I would like to thank Sophia North for the wonderful feedback she has provided me with. I would also like to thank the faculty and staff of the Texas A&M University LAUNCH Program for supporting and facilitating this amazing opportunity. Finally, I am grateful to the Emotion Science Lab for helping me grow exponentially as a researcher throughout the past three years.

Funding Sources

No external funding was received for conducting this study.

1. INTRODUCTION

It is sometimes difficult to stay in the here and now. In a world full of distractions, it's easy for the mind to wander and generate thoughts that are unrelated to the current situation or task. While various forms of attentional diversion, such as daydreaming, thought intrusion, and fantasy, can be used to describe this mental phenomenon, they have recently been integrated into a conceptual body of research under the term mind-wandering (Smallwood & Schooler, 2015). Mind-wandering is a shift away from the external environment to internal thoughts. The behavior is ubiquitous and omnipresent in everyday life (Smallwood & Schooler, 2006). For example, when faced with a tedious or repetitive task, we might become disengaged and begin to think about something more interesting than the task at hand. Or, when pulling into the driveway, we might notice that we haven't been fully present for the duration of the drive. Indeed, mind-wandering is a pervasive yet essential adaptation of the mind that comprises up to half of our daily thoughts (Killingsworth & Gilbert, 2010).

The concept of mind-wandering has received a great deal of attention in recent decades and continues to be a growing field in psychology. Existing research suggests that it can have both positive and negative effects (Mooneyham & Schooler, 2013). Mind wandering can promote adaptive emotion regulation, enhance creativity, and improve problem-solving skills (Yamaoka & Yukawa, 2020; Poerio et al., 2015; Salomons & Davis, 2013). Alternatively, mind-wandering is also associated with lower academic performance, negative mood, and poorer mental health (Yamaoka & Yukawa, 2020; Poerio et al., 2013; Hoffmann et al., 2016). However, most of existing research on mind-wandering has focused heavily on examining task-unrelated thought, especially in settings where participants are instructed to attend to an external task

(McMillan et al., 2013, Smallwood & Schooler, 2006). Fewer studies have explored mind-wandering without any external distractions vying for one's attention (Wilson et al., 2015). One study found that most people find being left alone with their own thoughts to be an aversive experience, even opting for negative stimulation in the form of electric shocks than to be alone with no stimulation at all (Wilson et al., 2014). To further expand on this understudied area of mind-wandering, the present study aims to investigate the role of individual differences in mind-wandering in an environment without any external distractions or stimulation.

While the influence of individual differences on mind-wandering is increasingly gaining attention in recent years, personality traits remain understudied compared to other predictors of mind-wandering processes, like working memory and cognitive capacity (Robinson et al., 2020; Smallwood and Schooler, 2015). This dearth in understanding is a vital omission because personality dispositions influence the content of our thoughts, the way we process external information, and how we regulate our attention toward stimuli. Thus, we draw from the Big Five Personality Inventory to examine self-generated thoughts in an environment devoid of external stimulation.

Previous research has found neuroticism and openness to experience are most commonly associated with mind-wandering (Zhiyan and Singer, 1997). Neuroticism reflects one's tendency to experience negative affect, such as anger, anxiety, depression, and self-doubt (Widiger and Oltmanns, 2017). The trait involves emotional instability, limited coping with adverse situations, and cognitive rumination tendencies; thus, individuals high in neuroticism are more prone to ponder about negatively-valenced experiences, such as failures and worries (Robison et al., 2017). Several studies have found that neuroticism positively correlates with mind-wandering and ruminative thought cycles (Jackson et al., 2013; Kane et al., 2017; Robinson et al., 2017).

The trait disposes individuals to deep reflection, such as rumination, and decreases executive attention, which allows for intrusive cognition to emerge (Robinson et al., 2020). Rumination is a repetitive thought pattern characterized by an excessive focus on negative thoughts and feelings, and it is a common feature of many mental health disorders. Oftentimes, rumination is intrusive, unwanted, and difficult to control. Individuals high in neuroticism may be more prone to rumination, and mind wandering may serve as a trigger for this thought pattern. In addition to its relationship with neuroticism, mind wandering has also been linked to several mental health disorders, including anxiety, depression, and attention-deficit/hyperactivity disorder (ADHD), which also involve rumination as a key feature of its symptoms.

In turn, openness to experience, or open mindedness is a trait characterized by creative imagination with a receptivity toward novel experiences and ideas. Individuals that score higher in openness tend to be more imaginative, creative, curious, and willing to tolerate less certainty in situations. Compared to neuroticism, which is associated with negative affect, openness to experience has a positive connotation. The trait has been found to be positively associated with a type of mind-wandering called positive-constructive mind-wandering, which is characterized by an acceptance of internal thoughts and the ability to create creative mental pictures (Huba et al., 2017). Openness to experience has also been shown to be associated with deliberate mind-wandering (Marcusson-Clavertz and Kjell, 2019). For instance, self-reflection (an adaptive form of introspection) has shown associations with openness to experience, whereas self-rumination (a maladaptive and inflexible thinking pattern), was found to be associated with neuroticism (Vannucci and Chiorri, 2018). In other words, studies have found that openness to experience to be associated with a likelihood of one intentionally diverting their attention away from the

primary task to indulge in alternative thoughts, suggesting that thinking is more enjoyable for the individual, especially when the thoughts are deliberate.

Accordingly, the present study aims to investigate whether the above findings on personality traits are supported in an environment that stimulates mind-wandering without any external distractions. Based on previous research, we argue that neuroticism and openness to experience will reveal the greatest associations with various dimensions of mind-wandering, which will be discussed in the sections that follow.

The experience of mind-wandering is multi-faceted and can comprise various dimensions, such as content valence of self-generated thought, temporal orientation, and emotional valence, among many others (Andrews-Hanna et al., 2013; Klinger, 1999). In the present study, we aim to explore each of the aforementioned dimensions in relation to personality traits.

One aspect of thought that is essential to mind-wandering is content valence, or the positive and negative emotions associated with the thought content, or what the individual is thinking in the moment. Much of existing research on the content valence of mind-wandering relates to the capture of attention, in which case participants would be instructed to attend to a task (Banks and Boals, 2016; Banks, Tartar, & Welhaf, 2014). Other studies focus on thought valence within the context of other dimensions (Stawarczyk et al., 2013; Ruby et al., 2013). Research that examines the content valence of mind-wandering episodes in the absence of an external task or stimuli is extremely limited. By analyzing the content valence of the self-reported thoughts during the thinking period, we hope to gain a better understanding of content valence in the context of mind-wandering and determine whether a relationship exists between personality traits and content valence in the present study.

The temporal orientation of the thought content is another important dimension to consider. When mind-wandering, people may often think about either the past, present, or future. Research has found that mind-wandering tends to be more future-oriented than past-oriented, and more often directed toward the near past and future events than distant events (Stawarczyk et al., 2013). However, past-oriented thoughts have been found to be associated with subsequent negative mood (Ruby et al., 2013). In fact, a fixation of the past has been associated with symptoms of depression (Baird et al., 2011). While future-oriented thoughts have been found to result in improvements in mood, excessive thoughts about the future have been correlated with anxiety and other mental illnesses in later life (Miloyan, et al., 2017). From a cognitive perspective, rumination has been described as a negative past-oriented cognitive bias, whereas optimism has been described as a positive future-oriented bias (Beaty et la., 2020). Studies have found that individuals who engage in more rumination are more likely to report thinking about past experiences, whereas optimists are more likely to report more positive future-oriented thoughts (Beaty et la., 2020). Given these findings, we are curious to see whether there is a relationship between the temporal orientation of the self-reported thoughts and certain dispositions in our study. Specifically, we wonder whether neurotic individuals will be more likely to fixate on the past, whereas open individuals will be more likely to fixate their attention towards the future due to their optimistic and imaginative nature.

Emotions and affect have been found to be closely related to mind-wandering. There is a substantial amount of research on the relationship between mind-wandering and negative mood. Previous research suggests that mind-wandering leads to unhappiness, suggesting that the change in mood is a consequence of mind-wandering (Killingsworth & Gilbert, 2010). However, other studies have suggested negative mood to be a precursor to mind-wandering (Smallwood et al.,

2009). Mood also has associations with the affective content of mind-wandering, overlapping with the other dimensions of mind-wandering. For example, past-related wandering thoughts are associated with subsequent negative mood even if the current thought content was perceived as positive. Conversely, future- and self-related wandering thoughts generated improvements in mood even though the thought content was negative (Ruby et al., 2013). Other studies found that individuals tend to shift their temporal focus from the future to the present when induced with negative affect (Moberly and Watkins, 2008). We aim to investigate whether there is a relationship between emotional valence and certain personality traits.

In summary, mind-wandering plays a frequent role in everyday life, but the area of research remains relatively new. The majority of studies on mind-wandering focus on task-unrelated thoughts while attending to an external task. Few studies have investigated mind-wandering in the absence of external stimulation where participants are left alone with their thoughts. Therefore, the present study aims to investigate individual differences in mind-wandering in the absence of external stimulation and examine multiple dimensions of mind-wandering and their relations to dispositional traits. This study uses secondary data from a previous study to analyze the relationship between personality traits and the various dimensions of mind-wandering. Content valence, temporal orientation, and emotion will be examined to explore potential associations with dispositional traits. We hypothesize that 1) individuals will find just thinking to be a primarily negative experience 2) neuroticism will be associated with negative emotions 3) openness to experience will be associated with positive emotions 4) neuroticism will be associated with past-oriented thought 5) openness will be associated with future-oriented thought 5) neuroticism will be associated with negatively-valenced thought and 6) openness to experience will be associated with positively-valenced thought.

2. METHODS

2.1 Participants

Participants (n = 47) were university students (18 male, 29 female) from an undergraduate introductory psychology course at Texas A&M University. Participants' ages ranged from 18 years old to 25 years old (M = 18.74, SD = 1.22). Demographics consisted of African American (10.6%), Asian or Pacific Islander (12.8%), White (44.7%), Hispanic (29.8%), and Other (2.1%). All participants received course credit for their participation in the study.

2.2 Measures and Design

To test the relationship, data was examined from a preliminary study conducted in the Emotion Science Laboratory. In the preliminary study, participants were randomly assigned to one of two conditions: free-thinking or attention-capture. In the free-thinking condition, participants were directed to an empty room and seated at a table under the premise that the research assistant would be "preparing the study and be right back," but were intentionally left alone in the room for a period of 20 minutes. In the attention-capture condition, participants watched a video that induced boredom for a period of 20 minutes. This group was intentionally removed from analyses because we are focused on investigating the free-thinking condition in which participants were left alone in an environment without external stimulation or distractions.

In the study, participants were administered the Big Five Inventory (John et al., 1991) to assess for personality differences. The Big Inventory is a 60-item scale that assesses 5 personality traits (openness, conscientiousness, extroversion, agreeableness, and neuroticism) on a 5-point Likert scale from 1 (*Strongly disagree*) to 5 (*Strongly agree*). Sample items include, "I am someone who is original and comes up with new ideas," "I am someone who is reliable and

can always be counted on," and "I am someone who stays optimistic after experiencing a setback." Some items were reverse coded and the internal consistency of the measure was high ($\alpha = 0.89$).

Emotions were assessed using a 24-item measure, and the participants were asked to rate how intensely they felt the emotions following the mind-wandering period. The responses were measured on a 7-point Likert Scale from 1 (*Not at all*) to 7 (*Extremely*). Emotions assessed included positive emotions (e.g., admiration, aesthetic appreciation, amusement, awe, calmness, happiness, excitement, interest, joy, satisfaction, relief, surprise) and negative emotions (e.g., anxiety, anger, boredom, confusion, disgust, apathy, craving, nostalgia, dullness, fear, horror, sadness). Internal consistency of the measure was high ($\alpha = 0.90$).

In addition to emotions, participants were asked in a survey to report the thoughts they had during various points throughout the twenty minutes that they were left alone. Sample items include, "Please describe what you were thinking about during these past twenty minutes," "Please describe what you were thinking about for the first ten minutes," "Please describe what you were thinking about for the second ten minutes." The emotional valence of thought content from the self-generated thoughts was assessed using the Linguistic Inquiry and Word Count (LIWC-22), a linguistic analysis software and valid measure of emotional expression (Boyd et al., 2022; Kahn et al., 2007). The program compares text samples to over 100 dictionaries, each providing insight into a different aspect of one's physiological state (Pennebaker et al., 2007). The present study focused specifically on the category *Emotion*, which examined positive and negative emotion words.

Finally, the survey assessed temporal orientation of thought. Participants were asked to categorize the topic of their thoughts into past, present, or future using a sliding scale from 0-100% so that the total of all three categories added up to 100%.

2.3 Procedures

All participants consented to the preliminary study, which took place in a research lab. After signing the consent form, participants were directed to a separate room and completed a survey that assessed their personality. Those assigned to the free-thinking condition were left alone in the room for 20 minutes. After the mind-wandering period, they completed a questionnaire that measured their emotions, temporal orientation, categories of thought, cognition, and behavioral tics. The current study specifically examined data collected from the emotion, temporal orientation, and cognitive measures. Participants were not required to answer any questions they didn't wish to answer, and they were aware that their responses would be anonymous.

The Statistical Package for the Social Sciences (SPSS) was used to conduct all statistical procedures. Pearson correlation was applied to examine the relationship between personality traits and various aspects of mind-wandering. Specifically, Pearson correlation was used when analyzing personality and emotion. A non-parametric correlation, or Spearman's correlation, was run to examine personality and temporal orientation. A Spearman's correlation was also run to examine personality and thought valence. The valence of self-generated thought was gleaned using the Linguistic Inquiry and Word Count program. LIWC-22 calculates percentages in a text sample that reflect the selected categories. Since the category *Emotion* was the focus of the investigation, the composite scores of the percentages for the positive and negative emotion subcategories were calculated and correlated with personality traits. To be specific, rather than

the sums of positive and negative emotion words, the composite scores of the proportions were used in the correlations.

3. RESULTS

3.1 Personality and Emotions

To test the relationship between personality traits and mind-wandering, correlations were run and analyzed using SPSS. Results found that there was a significant relationship between personality and emotional experiences. Neuroticism was positively associated with negative emotions (i.e., anger: r (45) = .29, p < .05; anxiety: r (45) = .58, p < .001; awkwardness: r (45) = .29, p < .05; boredom: r (45) = .29, p < .05; confusion: r (45) = .47, p < .001; sadness: r (45) = .39, p = .01). Additionally, neuroticism was negatively associated with satisfaction, r (45) = -.32, p = .03. This suggests that neurotic individuals experience greater negativity during periods of mind-wandering.

Openness was positively associated with calmness, r (45) = .30, p = .04, and negatively associated with joy, r (45) = -.33, p = .03, and satisfaction, r (45) = -.30, p = .04. The positive correlation with calmness suggests that open individuals may be more receptive of free-thinking periods; however, the negative correlations with joy and satisfaction suggest that the overall experience of mind-wandering itself is less positive. In other words, more open individuals tended to experience fewer positive emotions when mind-wandering.

Conscientiousness and extroversion were only associated with one emotion, respectively. Conscientiousness was negatively correlated with sadness, r (45) = -.34, p = .02, and extroversion was negatively correlated with craving, r (45) = -.31, p = .04. There were no significant correlations between agreeableness and emotions.

Table 1. Correlations between Big Five Personality Traits and Negative Emotion Experiences

Traits	Anger	Anxiety	Awkwardness	Boredom	Confusion	Sadness
Neuroticism	0.29*	0.58**	0.29*	0.29*	0.47**	0.39**
Openness	-0.16	-0.14	-0.25	-0.08	-0.17	-0.05
Conscientiousness	-0.12	-0.27	0.07	-0.20	-0.06	-0.34*
Extroversion	-0.03	-0.23	-0.24	-0.22	-0.12	-0.14
Agreeableness	-0.15	-0.21	0.04	-0.15	-0.08	-0.23

Note: *. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 2. Correlations between Big Five Personality Traits and Positive Emotion Experiences

Traits	Calmness	Craving	Joy	Satisfaction
Neuroticism	-0.26	0.06	-0.20	-0.32*
Openness	0.30*	-0.20	-0.33*	-0.30*
Conscientiousness	0.15	-0.50	-0.08	0.06
Extroversion	0.19	-0.31*	0.27	0.12
Agreeableness	0.11	0.06	0.09	0.10

Note: *. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

3.2 Personality and Thought Valence

Spearman correlations were conducted for personality and valence of thought. Personality traits did not seem to be significantly correlated with valence of thought content. However, there was a significant negative correlation between openness and positive-valence thoughts, r (45) = -.32, p = .03.

Table 3. Correlations between Big Five Personality Traits and Thought Valence

Traits	Positive Valence	Negative Valence
Neuroticism	-0.07	0.24
Openness	-0.32*	0.05
Conscientiousness	-0.07	-0.15
Extroversion	0.12	0.07
Agreeableness	-0.10	-0.27

Note: *. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

3.3 Personality and Temporal Orientation

Correlational analyses revealed no significant correlations between personality traits and temporal orientation (i.e., thinking in the past, present, or future). Potential explanations for these findings are discussed.

Table 4. Correlations between Big Five Personality Traits and Temporal Orientation

Traits	Past	Present	Future
Neuroticism	0.16	-0.09	0.03
Openness	-0.01	0.16	-0.21
Conscientiousness	0.02	-0.17	0.25
Extroversion	-0.08	-0.13	0.12
Agreeableness	-0.04	-0.08	0.14

4. CONCLUSION

4.1 Discussion

The current study explored the relationship between personality differences and dimensions of mind-wandering experienced during a period without external stimulation. Specifically, this study examined content valence of self-generated thoughts, temporal orientation, and emotions following a mind-wandering period, and their relationships with personality traits. According to the findings, personality traits were associated with the participants' emotional experiences.

Neuroticism was significantly correlated with multiple negative emotions following a mind-wandering period, supporting the hypothesis that neuroticism will be associated with negative emotions. Namely, neuroticism was found to be positively associated with anger, anxiety, awkwardness, boredom, confusion, and sadness. These findings suggest that neurotic individuals are more susceptible to ruminative thought processes when left alone with one's thoughts, which are consistent with past research. In addition, neuroticism was also negatively associated with satisfaction, which further illustrates that neurotic individuals tend to experience mind-wandering periods negatively and potentially even more negatively than other individuals. Furthermore, this relationship suggests that the higher an individual scores in neuroticism, the more negatively they may find the free-thinking experience to be because they have nothing to distract themselves from their negative thoughts. Because neuroticism disposes individuals to experiencing the world as distressing and threatening, being left alone with one's thoughts may exacerbate the negative thinking patterns and therefore the experience of mind-wandering to a greater degree. Neurotic individuals are naturally more anxious, more prone to worry

excessively, and struggle with emotion regulation, so mind-wandering may be a form of cognitive avoidance and coping mechanism to redirect their attention to other thoughts (Robison et al., 2017). Mind-wandering may also exacerbate already existing negative emotions and lead to rumination, which locks individuals into negative thinking patterns (Nolan et al., 1998; Pont, et al., 2019). However, the type of mind-wandering (e.g., maladaptive rumination, positive-constructive daydreaming, intentional, spontaneous) that the participants engaged in during the free-thinking period was not assessed; therefore, we were unable to conclude that rumination directly occurred for neurotic individuals nor differentiate between the specific types. Nonetheless, because neurotic individuals are naturally more prone to rumination, the results suggest that negative thinking patterns may have occurred that caused the prominence of negative emotions reflected in our findings. Further research is needed in order to clearly link neuroticism to rumination in these mind-wandering contexts. Additionally, further studies could explore the different types of mind-wandering and potentially identify their links to specific personality traits.

Openness was found to be negatively associated with positive emotions, which support our hypothesis that openness would be associated with positive emotions. While an association was expected, we found it interesting that the correlation was not positive. The negative association suggests that trait openness played a role in the experience of mind-wandering, but that the influence may not be strong enough to elicit a positive response following the mind-wandering period. Specifically, these results suggest that being left alone with one's thoughts is still generally a negative experience for most people, despite the presence of more curious, open-minded, and optimistic dispositions. Research on openness suggests that open individuals are more inclined to engage in introspection and imaginative thinking, hence they may be more

receptive and well-adjusted to free thinking periods (Schretlen et al., 2010). Such an inclination may also lead to more frequent mind-wandering during the time that they are left alone, although the form of mind-wandering may not necessarily be negative. Open-minded individuals also tend to seek more variety and novel experiences; thus, the lack of stimulation and excitement during a mind-wandering period may decrease the experience of positive emotions. The relationship between openness and positive emotions was negative, indicating that open-minded individuals may find mind-wandering without external stimulation to be a less positive experience. These findings suggest that open individuals may still find the experience of just thinking to be unpleasant, but not as strongly as neurotic individuals.

Conscientiousness was found to be negatively associated with sadness, which was an unexpected result. A potential explanation could be that more conscientious individuals may be quicker to perceive the research assistant's prolonged disappearance as part of the study, resolving some of their confusion, and therefore experience less sadness and negative emotions as a result. Because conscientious individuals are naturally more goal-oriented, attentive to details, and adherent to rules, they may be more prone to ponder about the intentions of the study, so they might also more easily accept the situation as an intended part of the study. In fact, research has found conscientious individuals to engage in fewer mind-wandering episodes because of an inclination to fixate on task completion and goal achievement, leaving less mental space for the mind to wander (Robinson et al., 2020). Because of this, highly conscientious individuals may be less affected by the affective aspects of mind-wandering overall. However, further research is necessary to explore the relationship between conscientiousness and mind-wandering.

Extroversion was found to be negatively associated with craving, which was a particularly unexpected finding. According to research, extroverted individuals tend to seek out stimulation in their external environment, suggesting that they are less likely to engage in internal thought processes compared to introverted individuals (Philipp and Wilde, 1970). However, our findings did not reflect this pattern even though the participants in our study were left alone without any stimulation. This result seems to suggest that another factor may be at play in influencing the relationship between extroversion and sensation seeking. Because the relationship found in our research was negative, contrasting previous findings, further research is needed to better understand the complex relationship between mind-wandering and extroversion.

While no significant correlations were found for agreeableness, potential explanations could relate to the other-oriented nature of the trait. Agreeableness describes one's ability to cooperate with others, show empathy, and altruism, hence being left alone in a room without the presence of others may have masked any potential for the trait to have an influence. Future directions on agreeableness could investigate mind-wandering in a social environment.

Regarding the valence of thought content, there was a negative association between openness and positive valence, which partially supports our hypothesis. While we hypothesized that there would be an association between openness and positive valence, the negative association was somewhat unexpected. The findings suggest that trait openness does not directly lead to more positively-valenced thoughts during mind-wandering periods, and reinforces the idea that open individuals find mind-wandering to be a less positive experience. Furthermore, our hypothesis that neuroticism would be associated with negatively-valenced thoughts was not supported. A potential explanation could be that there were limitations to our measure and analysis of self-generated thought that may have influenced our assessment of thought valence. It

is worth seeing in future research whether these findings hold true if alternative measures were implemented to assess thought valence.

Finally, there were no significant findings between personality and temporal orientation. Therefore, our hypotheses that there would be an association between neuroticism and past-oriented thoughts as well as openness and future-oriented thoughts could not be supported. A potential explanation could be that personality may not play a major role in influencing the temporal orientation of individuals' thoughts during mind-wandering periods. In the case of openness, it is possible that the trait is less associated with the orientation of thoughts, but the attitude towards such thoughts. Rather than thinking about the future more, their positive and curious inclinations may have a greater influence on their mindset rather than the direction of the topic itself. However, the insignificant findings on neuroticism were unexpected because past research has found neuroticism to be associated with an excessive focus on both past and future-oriented thoughts. An alternative explanation for the lack of significance could lie in the specific method to which temporal orientation was measured. Utilizing an alternative and comprehensive method of capturing temporal orientation could reveal more about the relationship between personality and temporal orientation.

Overall, the results of the study partially supported our hypotheses. The hypothesis that neuroticism will be associated with negative emotions and openness will be associated with positive emotions was strongly supported. The hypothesis that neuroticism will be associated with negatively-valenced thought and openness will be associated with positively-valenced thought was partially supported as neuroticism showed no correlations with valence of thought content. Lastly, the hypothesis that neuroticism will be associated with past-oriented thought and openness will be associated with future-oriented thought were not supported.

4.2 Limitations

Some limitations should be considered when interpreting the findings of our study. The study may have been limited by the study sample. Our sample consisted solely of students from undergraduate introductory psychology classes at a large Texas university. All participants ranged from 18-25 years of age with an average of about 19 years. The location which the sample was drawn from restricted the age and education level, meaning it was not fully representative of the general population. Age-related differences may lie in mind-wandering tendencies, so it should be noted that these findings primarily reflect emerging adult populations. Additionally, the racial demographics of the sample (44.7% White, 29.8% Hispanic) and relatively small sample size (n = 47) further limit the generalizability of the findings. Therefore, the findings should be examined with heed. The study could be repeated with a larger, more representative, and diverse sample to determine whether these results translate over for individuals of various ages, education levels, and backgrounds.

Limitations also reside in the nature of the research design. The current study was a secondary data analysis that examined data from a preliminary study and was intended to be exploratory in nature. Therefore, mind-wandering was not experimentally manipulated, so a causal relationship could not be drawn between personality and mind-wandering. Instead, we focused on personality and its relation to the aspects of the mind-wandering experience rather than explore the various types of mind-wandering (e.g., rumination, positive constructive daydreaming) or mind-wandering tendencies (i.e., the extent to which one engaged in mind-wandering during a period of time).

The language used in the study may have also influenced our results. At the start of the study, participants were directed to a room and instructed to wait while the research assistant

would be “right back.” The language used by the research assistants suggested that they would only be gone for a short period of time. In reality, the participants were intentionally left alone for twenty minutes. The wording of the phrase may have induced further confusion in the situation, which may have prompted negative feelings when the participants were left in a state of waiting and realized that the research assistant still had not returned after a period of time. In the context of individual differences, neurotic individuals may feel more anxious and concerned, among other negative emotions, than others due to the specific language that was used. We believe the wording could have possibly influenced the emotions the participants felt as well as the thoughts they had during the time that they were left alone to a certain extent. Therefore, it is important to note that the wording used during the study may have affected the emotions felt during the mind-wandering period. Future studies could incorporate more neutral wording in the instructions that intentionally prompts individuals to engage in mind-wandering in order to assess a more unbiased and thorough experience of the cognitive process. In addition, directly instructing participants to engage in a period of mind-wandering may allow for participants to more freely think about topics of their own choosing without outside influence.

External factors may have also influenced our results, such as outside stressors or situations that the participant may have been in prior to participating in our study. Additionally, their mood state may have also influenced the thoughts they had during the mind-wandering period. Because emotions were not assessed prior to the study, we are unable to discern whether there was a drastic change in mood before and after the mind-wandering period. Future studies could incorporate an additional emotional measure at the start of the study in order to identify potential fluctuations in mood.

There were also limitations in the measure assessing temporal orientation, or the direction and focus of participants' thoughts. A potential reason for the lack of significance found for temporal orientation is that the preliminary study utilized a slider method. Participants were asked to rate the percentage to which they thought about the past, present, and future from a scale of 0 to 100, but the three percentages had to add up to 100. This method of assessment partially limited our ability to fully assess the extent to which participants thought about the past, present, or future. Alternative forms of assessing temporal orientation, such as identification with statements in the form of self-report questionnaires, may reveal more about the relationship between temporal orientation and mind-wandering.

Lastly, participants were asked about the thoughts they had during the time they were left alone. Because this section in the survey was entirely free-response, participants were allowed to respond at varying lengths. The survey did not specify whether a certain word count should be reached, hence we received a wide range of response lengths. Our method of analysis for approaching the free-response section was to utilize LIWC-22 to assess the emotional valence of the thoughts expressed. The software provided percentages for the extent to which the text reflected positive or negative emotions, among other variables. Because participants in the study provided varying lengths of responses, the reliability of the linguistic analysis may have been affected, especially because reliability increases with larger lengths of text. Future studies could incorporate instructions for participants to reach a certain word count in their responses and emphasize the importance of thoroughly reflecting on their thoughts. Additionally, an alternative method of conducting analyses could also be implemented, such as having human raters score responses.

Another factor that may have influenced the participants' responses is a lack of interest or motivation to reflect on their thoughts. Because the measures were administered through two surveys—one before the mind-wandering period and one after—participants may feel less motivated to thoroughly complete the second survey, especially during the free response section, because they had just experienced a mind-wandering period with zero stimulation and experienced boredom as a result. Hence, some participants may feel inclined to provide shorter responses than others, which may possibly explain the varying lengths of responses that was received.

4.3 Future Directions

Future directions could focus on exploring other individual differences in mind-wandering, such as gender differences, racial differences, and age-related differences, within the context of larger and more diverse samples. Because there are various types of mind-wandering (e.g., rumination, positive constructive, intentional, spontaneous), future studies could also work towards differentiating between these types and exploring the situations in which they occur. Alternative approaches could focus on investigating the direct, causal relationship between personality traits and mind-wandering tendencies in order to better understand the extent to which personality traits influence mind-wandering and the direction of these thought processes. The current study focused on investigating individual differences in mind-wandering experiences, specifically the emotions people experience following a mind-wandering period without any external stimulation. Further studies could incorporate measures that directly assess mind-wandering to better understand the mechanisms of the phenomenon in a similar environment. Implementing an experimental design in future studies could reveal more about the

relationship between personality and mind-wandering and help establish causality on this important yet understudied area of psychology.

Overall, the relationship between personality and mind-wandering periods remains complex. Personality can influence various facets of mind-wandering, especially emotion. However, the impact of personality on the frequency of mind-wandering in addition to other facets of the cognitive process remains understudied. Further research is needed to explore the causal relationship between personality and mind-wandering. Such findings can have implications on addressing the negative aspects of mind-wandering, like rumination, and potentially even contribute to findings on how maladaptive thought cycles manifest.

4.4 Conclusion

In conclusion, our study contributes to the growing body of research regarding the relationship between personality and mind-wandering and offers various implications for the risk of maladaptive thinking when left alone. Our research has shown that mind-wandering is associated with positive and negative emotions, and that free thinking is generally a negative experience for people. These findings expand our understanding of the phenomenon of mind-wandering as it remains a vital aspect of emotional and cognitive functioning.

REFERENCES

Andrews-Hanna, J. R., Smallwood, J., & Spreng, R. N. (2014). The default network and self-generated thought: component processes, dynamic control, and clinical relevance. In Annals of the New York Academy of Sciences (Vol. 1316, Issue 1, pp. 29–52). Wiley.

Banks, J. B., & Boals, A. (2016). Understanding the role of mind wandering in stress-related working memory impairments. In Cognition and Emotion (Vol. 31, Issue 5, pp. 1023–1030). Informa UK Limited.

Banks, J. B., Tartar, J. L., & Welhaf, M. S. (2014). Where's the impairment: an examination of factors that impact sustained attention following a stressor. *Cognition & emotion*, *28*(5), 856–866.

Beaty, R. E., Seli, P., & Schacter, D. L. (2019). Thinking about the past and future in daily life: an experience sampling study of individual differences in mental time travel. *Psychological research*, *83*(4), 805–816.

Boyd, R. L., Ashokkumar, A., Seraj, S., & Pennebaker, J. W. (2022). The development and psychometric properties of LIWC-22. Austin, TX: University of Texas at Austin. https://www.liwc.app

Hoffmann, F., Banzhaf, C., Kanske, P., Bermpohl, F., & Singer, T. (2016). Where the depressed mind wanders: Self-generated thought patterns as assessed through experience sampling as a state marker of depression. In Journal of Affective Disorders (Vol. 198, pp. 127–134). Elsevier BV

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *Big Five Inventory (BFI)* [Database record]. APA PsycTests.

Kahn, J. H., Tobin, R. M., Massey, A. E., & Anderson, J. A. (2007). Measuring emotional expression with the Linguistic Inquiry and Word Count. The American Journal of Psychology, 120, 263–286.

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science (New York, N.Y.)*, *330*(6006), 932.

Klinger, E. (1999). Thought flow: Properties and mechanisms underlying shifts in content. In J. A. Singer & P. Salovey (Eds.), *At play in the fields of consciousness: Essays in honor of Jerome L. Singer* (pp. 29–50). Lawrence Erlbaum Associates Publishers.

Marcusson-Clavertz, D., Kjell, O. N. E., Persson, S. D., & Cardeña, E. (2019). Online validation of combined mood induction procedures. *PLoS ONE, 14*(6), Article e0217848.

McMillan, R. L., Kaufman, S. B., & Singer, J. L. (2013). Ode to positive constructive daydreaming. In Frontiers in Psychology (Vol. 4). Frontiers Media SA.

Miloyan, B., Bulley, A., Brilot, B., & Suddendorf, T. (2017). The association of Social Anxiety Disorder, Alcohol Use Disorder and reproduction: Results from four nationally representative samples of adults in the USA. In A. Kavushansky (Ed.), PLOS ONE (Vol. 12, Issue 11, p. e0188436). Public Library of Science (PLoS).

Moberly, N. J., & Watkins, E. R. (2008). Ruminative self-focus and negative affect: An experience sampling study. *Journal of Abnormal Psychology, 117*(2), 314–323.

Mooneyham, B. W., & Schooler, J. W. (2013). The costs and benefits of mind-wandering: A review. *Canadian Journal of Experimental Psychology / Revue canadienne de psychologie expérimentale, 67*(1), 11–18.

Poerio, G. L., Totterdell, P., & Miles, E. (2013). Mind-wandering and negative mood: Does one thing really lead to another? In Consciousness and Cognition (Vol. 22, Issue 4, pp. 1412–1421). Elsevier BV.

Poerio, G. L., Totterdell, P., Emerson, L. M., & Miles, E. (2015). Love is the triumph of the imagination: Daydreams about significant others are associated with increased happiness, love and connection. *Consciousness and cognition, 33*, 135–144.

Robison, M. K., Miller, A. L., & Unsworth, N. (2020). A multi-faceted approach to understanding individual differences in mind-wandering. *Cognition, 198*, 104078. https://doi.org/10.1016/j.cognition.2019.104078

Ruby, F. J. M., Smallwood, J., Engen, H., & Singer, T. (2013). How Self-Generated Thought Shapes Mood—The Relation between Mind-Wandering and Mood Depends on the Socio-Temporal Content of Thoughts. In L. M. Martinez (Ed.), PLoS ONE (Vol. 8, Issue 10, p. e77554). Public Library of Science (PLoS).

Salomon, J. A., Haagsma, J. A., Davis, A., de Noordhout, C. M., Polinder, S., Havelaar, A. H., Cassini, A., Devleesschauwer, B., Kretzschmar, M., Speybroeck, N., Murray, C. J., & Vos, T. (2015). Disability weights for the Global Burden of Disease 2013 study. *The Lancet. Global health, 3*(11), e712–e723.

Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin, 132*(6), 946–958.

Smallwood, J., & Schooler, J. W. (2015). The Science of Mind Wandering: Empirically Navigating the Stream of Consciousness. In Annual Review of Psychology (Vol. 66, Issue 1, pp. 487–518). Annual Reviews.

Smallwood, J., & Schooler, J. W. (2015). The Science of Mind Wandering: Empirically Navigating the Stream of Consciousness. In Annual Review of Psychology (Vol. 66, Issue 1, pp. 487–518). Annual Reviews.

Smallwood, J., Fitzgerald, A., Miles, L. K., & Phillips, L. H. (2009). Shifting moods, wandering minds: negative moods lead the mind to wander. *Emotion (Washington, D.C.)*, *9*(2), 271–276.

Stawarczyk, D., Cassol, H., & D'Argembeau, A. (2013). Phenomenology of future-oriented mind-wandering episodes. In Frontiers in Psychology (Vol. 4). Frontiers Media SA.

Vannucci, M., & Chiorri, C. (2018). Individual differences in self-consciousness and mind wandering: Further evidence for a dissociation between spontaneous and deliberate mind wandering. *Personality and Individual Differences, 121,* 57–61.

Widiger, T. A., & Oltmanns, J. R. (2017). Neuroticism is a fundamental domain of personality with enormous public health implications. In World Psychiatry (Vol. 16, Issue 2, pp. 144–145). Wiley.

Wilson, B. M., Mickes, L., Stolarz-Fantino, S., Evrard, M., & Fantino, E. (2015). Increased False-Memory Susceptibility After Mindfulness Meditation. *Psychological science*, *26*(10), 1567–1573.

Wilson, T. D., Reinhard, D. A., Westgate, E. C., Gilbert, D. T., Ellerbeck, N., Hahn, C., Brown, C. L., & Shaked, A. (2014). Just think: The challenges of the disengaged mind. In Science (Vol. 345, Issue 6192, pp. 75–77). American Association for the Advancement of Science (AAAS).

Yamaoka, A., & Yukawa, S. (2020). Mind wandering in creative problem-solving: Relationships with divergent thinking and mental health. *PLoS ONE, 15*(4), Article e0231946.

Zhiyan, T., & Singer, J. L. (1997). Daydreaming styles, emotionality and the Big Five personality dimensions. *Imagination, Cognition and Personality, 16*(4), 399–414.