

EFFECTS OF ANXIETY ON ATTENTION-BASED TASKS IN A COLLEGE
POPULATION

By

Jacob DeSoto

A Thesis Submitted in Partial Fulfillment of the Requirements for the
Degree of Master of Arts in Psychology

Middle Tennessee State University

December 2023

Thesis Committee:

Dr. Jessica Gaby, Chair

Dr. Paul Foster

Dr. Kimberly Ujcich Ward

ACKNOWLEDGEMENTS

I would like to acknowledge my thesis committee for not only their work on this study but also for all their guidance in various academic and professional areas. I would like to thank my lifelong friend Ethan, who assisted me in coding and creating the study. I would also like to thank my close friends in my cohort who have done countless peer reviews of my drafts. As well as my cat Thia, who has been there for me throughout my academic journey. Lastly, I would like to thank my family and girlfriend for all their support throughout the process.

ABSTRACT

We explored how anxiety may impact performance on two attention-based tasks, the Navon and Stroop tasks. Previous literature has illustrated that trait anxiety may lead to diminishing global processing and, therefore, a local processing bias (Basso et al., 1996). Which may contribute to narrowing the scope of one's attention, impairing cognitive flexibility (Derryberry & Reed, 1998; Najmi et al., 2012). Additionally, there is conflicting data on how anxiety interacts with performance on the Stroop task (Pacheco-Unguetti et al., 2010; Ursache & Cybele Raver, 2014). We conducted two t-tests analyzing high and low anxiety groups' performance on the Navon task. We also conducted an ANOVA analyzing three groups' performance on the Stroop task. We did not find any statistically significant differences in the performance on the Stroop and Navon task between groups of high anxiety and low anxiety.

Keywords: anxiety, Stroop task, Navon task

TABLE OF CONTENTS

CHAPTER I: INTRODUCTION.....	1
Anxiety in College Students.....	1
Anxiety and Academic Performance.....	2
Anxiety and Attention.....	3
Global and Local Processing.....	5
Anxiety and Global/Local Processing.....	8
Stroop Task and Executive Attention.....	9
Anxiety and Stroop Task.....	10
Purpose of the Current Study.....	12
CHAPTER II: METHOD.....	15
Participants.....	15
Measures.....	15
PsyToolkit.....	15
State-Trait Anxiety Inventory.....	16
Navon Task.....	17
Stroop Task.....	18
Demographics.....	20
Procedure.....	20
CHAPTER III: RESULTS.....	22
Analysis Summary.....	22
State-Trait Anxiety Inventory.....	22

Navon Task.....	23
Stroop Task.....	24
CHAPTER IV: DISCUSSION.....	25
Anxiety and Global/Local Processing.....	25
Anxiety and Stroop Task.....	27
Limitations of the Study.....	27
Future Directions.....	31
Conclusion.....	32
REFERENCES.....	34
TABLES.....	46
FIGURES.....	58
APPENDICES.....	62

LIST OF TABLES

Table 1. Percentage of the Reported Gender.....	47
Table 2. Percentage of the Reported Ethnicity.....	48
Table 3. Percentage of the Reported Diagnosis.....	49
Table 4. Percentage of the Reported Drug and Substance Usage of Participants.....	50
Table 5. Percentage Reported a History of Severe Head Injury of Participants.....	51
Table 6. Groups of Anxiety Measured for the Stroop Task.....	52
Table 7. STAI-T Scores and STAI-S Mean Scores.....	53
Table 8. Global Processing Reaction Times.....	54
Table 9. Local Processing Reaction Times.....	55
Table 10. Stroop Task Reaction Times.....	56
Table 11. Independent Sample Tests.....	57

LIST OF FIGURES

Figure 1. Example of a Navon figure from PsyToolkit.....	59
Figure 2. Example of Navon figures from PsyToolkit.....	60
Figure 3. Example of Stroop stimuli from PsyToolkit.....	61

LIST OF APPENDICES

Appendix A: Informed Consent.....63

Appendix B: Demographics Questions.....65

Appendix C: IRB Approval Letter.....67

Appendix D: Debriefing Statement.....70

CHAPTER I: INTRODUCTION

Anxiety in College Students

College can be an emotional experience for students, with the potential for many first-time, unfamiliar experiences. While many of these experiences may be fun and eye-opening, some aspects of college, such as academic expectations or financial concerns, may lead individuals to experience high stress and anxiety levels (Beiter et al., 2015). In one study, out of a total of 19 possibilities, “academics” was, on average, the greatest source of concern for a college sample, indicating that academic achievement pressure can be a stressor in a college student’s life. In that same study, out of a total sample of 374 undergraduate students, 40% of the participants displayed anxiety symptoms, and 38% displayed symptoms related to stress (Beiter et al., 2015). Asher BlackDeer et al. (2021) collected a sample of 117,430 students in 2008 and 2009 from over 100 college institutions, and the results indicated that 9.2% percent of the overall sample displayed symptoms of anxiety. These studies demonstrate how prevalent anxiety may be in college students across the United States and suggest that academic performance may be a contributing factor (e.g., Asher BlackDeer et al., 2021; Beiter et al., 2015).

The current study examines the potential relationship between anxiety as measured by the State-Trait Anxiety Inventory (STAI) and performance on the Stroop and Navon tasks, reflecting different aspects of attention that are crucial for academic success. We measured two types of anxiety: trait anxiety and state anxiety. Trait anxiety can be defined as the general level of anxiety a person feels on an everyday basis, whereas state anxiety is the level of anxiety they feel in the current moment (Shilton et

al., 2019; Spielberger et al., 1983). Sometimes a college student may feel nervous on the day of a mid-term or final exam; this is an example of state anxiety – how an individual feels at a specific moment. On the other hand, trait anxiety is a more generalizable characteristic of the individual – how they feel most of the time (Shilton et al., 2019; Spielberger et al., 1983). The two cognitive tasks used here measure different aspects of attention: visual global and local processing and executive inhibition (Miyake et al., 2000; Navon, 1977; Stroop, 1935). The following literature will display evidence of how anxiety may impact a person's attention, executive functioning, and visual processing, and how these different aspects of cognitive performance may affect college students' academic performance.

Anxiety and Academic Performance

Research on state-level anxiety and academic performance frequently suggests an impact on performance in specific contexts, such as test anxiety or statistics anxiety (e.g., Cassady & Johnson, 2002; Chew & Dillon, 2014; Hoegler & Nelson, 2018). Statistics anxiety is a form of state-level anxiety experienced when performing tasks involving statistical/mathematical calculations (Chew & Dillon, 2014). Hoegler and Nelson (2018) found that statistics anxiety may contribute to poorer performance on examinations in undergraduate-level statistics. Another performance-based anxiety is cognitive test anxiety, involving the cognitive aspects that may be associated with anxiety. This anxiety can occur while studying for an exam or taking an exam and consists of symptoms of worry and fear (Cassady & Johnson, 2002). Test anxiety may negatively affect academic

performance (Cassady & Johnson, 2002; Chapell et al., 2005). This relationship appears to occur at the undergraduate and graduate levels (Chapell et al., 2005).

Fewer studies in the past decade have been dedicated to trait anxiety and academic performance on a collegiate level, but existing studies suggest an inconsistent impact on academic performance. Vitasari et al. (2010) found that in university engineering students, there was a small but significant correlation between high anxiety as measured by the STAI and low academic performance. Another study found a significant indirect correlation between low academic performance and trait anxiety in middle school students (Owens et al., 2012). However, on a sample of undergraduate sophomores Chaplin (1989) demonstrated that anxiety may not always be detrimental to academic performance. This study compared groups of high academic performance with high anxiety and low academic performance with high anxiety. In the high-performance group, anxiety appeared to be beneficial and appeared to be detrimental or had no effect on the low-performance group. The author suggests that it may not be the anxiety itself but rather how an individual reacts to anxiety that determines the impact on academic achievement. High-performing students may have found ways to properly manage their anxiety and maintain high academic achievement (Chaplin, 1989).

Anxiety and Attention

Attention may have an important impact on academic achievement. In addition to academic achievement, anxiety appears to have a relationship with attention (Najmi et al., 2012; Pacheco-Unguetti et al., 2010). Posner and Petersen (1990) proposed three neural networks of attention: alerting, executive control, and orienting. The alerting network

involves becoming alert and maintaining that state. The executive control network or executive attention, consists of problem-solving, working memory, and managing conflicts. Executive attention is a part of the larger facet of executive functioning and can be investigated using the Stroop task, which requires executive control when managing conflicting information. Lastly, the orienting network allows people to focus and shift their attention (Posner & Petersen, 1990; Posner et al., 2007; Rueda et al., 2016).

Pacheco-Unguetti et al. (2010) conducted two experiments suggesting that both state and trait anxiety may affect these neural networks. They found in a sample of college students that higher levels of trait anxiety are related to a deficit in the executive control network, suggesting that trait anxiety may lead to less activity in the prefrontal cortex. The data also indicated that state anxiety has a negative effect on the orienting and alerting networks. The authors suggest that trait anxiety affects top-down processing, and state anxiety affects bottom-up processing (Pacheco-Unguetti et al., 2010). Additionally, this study indicates that severity can contribute to the effect trait anxiety appears to have. Heller et al. (1997) found that individuals with high levels of trait anxiety (anxious apprehension) seem to have asymmetry in the frontal lobes. These findings could be seen in decreased activity in the right frontal lobe, which may lead to possible deficits in executive functioning tasks (Heller et al., 1997; Milham et al., 2003). Specifically, it appears that some of the primary responsibilities of the dorsolateral prefrontal cortex (DLPFC), located in the frontal lobe, include top-down processing and the control of one's attention, which could be impacted by anxiety (Banich et al., 2000; Milham et al., 2003).

Najmi et al. (2012) examined how the scope of one's attention interacted with the severity of their anxiety in an undergraduate sample. The scope of attention involves the ability to expand or narrow one's visual focus relative to the size of an individual's visual environment (Kosslyn et al., 1999; Najmi et al., 2012). Their data suggest that participants with high levels of trait anxiety had an impairment in expanding the scope of their attention compared to the participants with low levels of anxiety. This indicates that anxiety may inhibit one's cognitive flexibility through the inability to expand the scope of their visual attention. There is some evidence that the scope of visual attention may be related to global and local processing (Najmi et al., 2012).

Global and Local Processing

When someone looks at a painting, do they start by recognizing the entire picture or by focusing on the detail within the painting? This question concerns the global and local elements found within the painting. Regarding visual perception, local processing focuses on the individual elements that make up a scene (Nayar et al., 2015). Global processing involves seeing all the individual elements that create the scene and using this information to create a comprehensive global image (Navon, 1977; Nayar et al., 2015). A real-world example of global and local processing is the understanding and interpreting written language, where local processing involves understanding each word. In contrast, global processing allows one to comprehend the meaning of the entire sentence or passage.

The theory of global precedence states that visual perception tends to start from seeing the big picture (the forest) first and then noticing the finer details (the trees)

(Navon, 1977). Navon's research used visual stimuli where larger letters (global level) were composed of smaller letters (local). When the global level stimuli were not consistent with the local level stimuli (i.e., Big H formed by small X's - see figure 1), it inhibited local-level responses but not global-level comprehension. From this experiment, Navon (1977) deduced that people can selectively attend to the global level exclusively more easily than the local level. His experiments and previous literature concluded that visual perception tends to start from a global level and work its way down to a local level.

In a study by Woltin et al. (2012), the participants were primed on either the global level or local level before completing a Navon task, followed by a communicative intention task. In this study, priming involved having the target letters presented at either the global or local level prior to the tasks. Their data showed that participants from a college sample correctly understood the communicative intent of a written message (sincere or sarcastic) more frequently when they were globally primed than when they were locally primed. This study indicates that global processing may have a beneficial effect on written communication between individuals (Woltin et al., 2012). This can be incredibly impactful in the digital era, where there may be more written communication online than face-to-face or verbal communication.

Research indicates that children younger than seven may rely mainly on a local-level strategy (Nayar et al., 2015). Additionally, it appears that between the ages of seven and ten, the development of global-level processing starts reaching the level of an average adult (Nayar et al., 2015). This demonstrates that humans may naturally adapt

global processing strategies as their brains develop. This may be because a child's prefrontal cortex is still developing (Tsujimoto, 2008).

A study by Kimchi and Merhav (1991) found evidence of differences between the brain's hemispheres in global-local visual processing. Their data suggested that participants had more difficulty attending to the global element in the right field of view and ignoring the local element; the opposite was found for the left field of view. This suggests that the left hemisphere is more inclined to focus on local elements and the right hemisphere on global elements. This may indicate differences in the efficiency of performance on global-local tasks between the two hemispheres (Kimchi & Merhav, 1991). Robertson (1992) conducted a study with lesion patients in which his results suggest lateralization of global vs. local processing. A lesion in the right temporal-parietal region led to an advantage in processing at the local level. In contrast, a lesion in the left temporal-parietal region led to a global-level processing advantage (Robertson, 1992). Additional support for this lateralization is found in research using transcranial magnetic stimulation on all right-handed participants. Qin & Han (2007) found that inhibition of brain activity in the left posterior parietal lobe leads to a local processing deficit.

According to Tyler and Tucker (1982), individuals with trait anxiety may rely more on their left hemisphere in visual perception, such as performing the Navon task. If this is true, it could explain how the local processing bias observed in multiple studies interacts with the observed asymmetry in global and local processing (e.g., Basso et al., 1996; Becker et al., 2017; Derryberry & Reed, 1998; Kimchi & Merhav, 1991;

Robertson, 1992; Shilton et al., 2019), potentially leading to a local processing bias and diminishing global processing.

Anxiety and Global/Local Processing

The following studies will demonstrate how anxiety may interact with the global precedence theory. High trait anxiety may impact an individual's scope of attention on global/local tasks leading to a local-level processing bias (Basso et al., 1996; Becker et al., 2017; Najmi et al., 2012; Shilton et al., 2019). Shilton et al. (2019) investigated global-local visual processing in anxious adults using the Navon task. Participants with high trait anxiety were biased toward processing local-level visual stimuli, with less of a preference towards global-level processing. High state anxiety participants' data showed more global interference (as opposed to local interference) than participants who reported low state anxiety levels (Shilton et al., 2019). This indicates that, unlike trait anxiety, no local processing preference appears to result from state anxiety.

Basso et al. (1996) found that male participants exhibiting symptoms of depression or anxiety displayed a bias towards local processing, suggesting that these pathologies diminish global processing. Derryberry and Reed (1998) examined how trait anxiety interacted with attention in a global/local visual processing task that manipulated the participants' motivational state. The results of this study found that the participants with high trait anxiety displayed quicker local-level processing in the negative motivation task than participants with low trait anxiety. Interestingly, these results did not indicate any impairment to their attention on the global level. However, it suggests a relationship

between the narrowing focus of attention and high trait anxiety observed in the global/local task (Derryberry & Reed, 1998; Najmi et al., 2012).

Becker et al. (2017) conducted a study exploring the relationship between trait anxiety, global processing, and eating disorders. Using a Navon figures task, they found a local-level processing bias in participants who met the qualifications for a binge-eating disorder. In addition, a correlation was found between binge-eating and anxiety levels. This led the researchers to conclude that trait-level anxiety may lead to a local processing bias. This detail-focused (local-level) perceptual bias may indirectly lead to maladaptive behaviors, such as an eating disorder (Becker et al., 2017).

The previously mentioned research suggests a local-level processing preference is found in individuals with high trait anxiety (Basso et al., 1996; Becker et al., 2017; Derryberry & Reed, 1998; Shilton et al., 2019). As previously mentioned, there is some indication that global processing may diminish with the presence of high trait anxiety (Basso et al., 1996). Therefore, this could indicate that high trait anxiety negatively affects a person's ability to broaden their visual scope of attention, leading to more narrowing of their scope of attention (Basso et al., 1996; Najmi et al., 2012).

Stroop Task and Executive Attention

During a lecture, the professor may ask a question to the class. If a student were to shout out an answer without raising their hand this would be an example of failing to inhibit a response. The ability to restrain one's unwanted responses is known as response inhibition (Albert et al., 2013). In this study, the other task we used to measure attention was the Stroop task. In this task, participants were shown multiple trials of the color

names in various colors of ink (e.g., the word blue in the ink color red) (Stroop, 1935).

The primary component measured in the Stroop task is managing the conflict of incongruency through inhibition; this is done by directing participants to inhibit the word's meaning and respond only to its color (Miyake et al., 2000; Stroop, 1935).

Viewing the task from this perspective, it is a measure of executive functioning/attention (Miyake et al., 2000; Posner et al., 2007). One of the two main areas in the brain that appear to be involved in the Stroop task is the DLPFC, which seems to have a role in executive functioning (Milham et al., 2003). The other area that seems to play a lesser role is the anterior cingulate cortex (ACC) (Egner & Hirsch, 2005; Milham et al., 2003; Taylor et al., 1997). Both regions perform some role in attention within the brain (Banich et al., 2000). The ACC may be responsible for allocating attention between task-relevant and irrelevant information (Milham et al., 2003). According to some, the ACC is the main area of activation in the executive attention network (Bush et al., 2000; Rueda et al., 2016). However, there is debate on its function and role because the ACC appears to have inconsistent activation during the Stroop task (Banich et al., 2000; Egner & Hirsch, 2005; Milham et al., 2003; Taylor et al., 1997). Lastly, both the ACC and DLPFC appear to have roles in the executive attention network due to their activation in magnetic resonance imaging (MRI) while performing the Stroop task (Marek et al., 2010; Pacheco-Unguetti et al., 2010; Posner & Petersen, 1990; Posner et al., 2007).

Anxiety and Stroop task

In a study using MRI, Saviola et al. (2020) observed that both state and trait anxiety had a relationship with the activation of the ACC in their sample. During a

decision-making task, Paulus et al. (2004) found in a sample of undergraduate students, that the high trait anxiety group had significantly greater activation in the ACC than their average trait anxiety group. This interaction between anxiety and the ACC may lead to a difference in top-down processing and allocation of attention in the Stroop task (Paulus et al., 2004). Bishop's (2009) data suggests that trait anxiety may impair the DLPFC's role in attentional control while processing conflicting information. This finding did not appear to also occur with state anxiety (Bishop, 2009). Together, these findings suggest a relationship between anxiety and the activation of the two main areas of the brain involved in performing the Stroop task.

This relationship could contribute to poorer performance in the Stroop task displayed by individuals high in trait anxiety (Hallion et al., 2017; Rosa-Alcázar et al., 2021; Saviola et al., 2020; Ursache & Cybele Raver, 2014). There is also evidence that elevated scores in either state or trait anxiety led to poorer performance in executive control in an undergraduate sample (Warren et al., 2021). Some evidence suggests state anxiety does not negatively affect but may improve performance on the Stroop task (see Ursache & Cybele Raver, 2014). However, there is mixed evidence with theories, such as attentional control theory proposing that state anxiety may lead to deficits in executive functioning (Eysenck et al., 2007). This study does not provide a definitive answer but further extends the research on this interaction.

Rosa-Alcázar et al. (2021) examined the interaction between three disorders found in the *DSM-5* and executive functioning. This was measured by interference in the Stroop task by participants with obsessive-compulsive disorder, generalized anxiety

disorder (GAD), and social anxiety disorder. The researchers found a correlation between the severity of the scores on the GAD screening survey and interference on the Stroop. It appears to be due to high severity because overall, there were no significant differences found in performance between the three groups. Additionally, for both obsessive-compulsive disorder and GAD, when there was comorbidity present, a significant difference was found in Stroop interference leading to worse performance analyzed (Rosa-Alcázar et al., 2021). This would indicate that the severity of GAD (a trait anxiety) and the presence of comorbid anxiety disorders may influence Stroop task performance.

Another study found that participants who met the criteria for GAD performed worse than the “healthy” control group (Hallion et al., 2017). The authors suggested that the presence of GAD predicted deficits in performance on the Stroop task. These interpretations could also suggest that GAD can negatively affect executive control and impair cognitive efficiency (Hallion et al., 2017; Miyake et al., 2000). This study’s results could indicate how participants with score high trait anxiety may perform on the Stroop task. Additionally, these studies display how there may be a connection between clinical diagnoses of anxiety and executive functioning/attention.

Purpose of the Current Study

This study furthered the research on how anxiety may influence attention through performance in the Stroop and Navon tasks. We hypothesize that the results would reflect previous research, indicating that individuals with high levels of trait anxiety would have more local interference in the Navon task (Basso et al., 1996; Becker et al., 2017). Specifically, we hypothesized that participants with high trait anxiety would have slower

reaction times on global processing than participants with low trait anxiety for the Navon task. Additionally, we hypothesized that participants with high trait anxiety would have faster reaction times on local processing than participants with low trait anxiety.

For the Stroop task, we hypothesized that individuals high in trait anxiety, those high in state anxiety, and those who score high in both types of anxiety (LH-HL, HH) would have slower reaction times on the incongruent trials of the Stroop task when compared to the reference group (LL) (see Table 6 for details). We expected to see more interference in the Stroop task for individuals high in trait anxiety, those high in state anxiety, and those who score high in both types of anxiety.

Previous literature has shown that global-level processing may be beneficial in situations, such as interpreting a written message or in memory tasks (Gasper & Clore, 2002; Woltin et al., 2012). Also, it appears that trait anxiety inhibits one's ability to expand the scope of their attention which may contribute to the predicted outcome of the Navon task (Najmi et al., 2012). Additionally, one study found a positive correlation between academic achievement and activation of dorsal ACC while performing the Stroop task (Veroude et al., 2013). The ACC also appears to have a relationship with its activation and the presence of anxiety (Saviola et al., 2020). Furthermore, this relationship could contribute to academic achievement (Saviola et al., 2020; Veroude et al., 2013). All of this suggests that if anxiety harms an individual's performance on the Stroop task, it may also adversely affect their academic performance (Hallion et al., 2017; Saviola et al., 2020; Veroude et al., 2013).

This study further explored the relationship that may exist between anxiety and interference in these tasks leading to a better understanding of the effects anxiety can have on one's processing speed and attention. This study's results extended the knowledge of how anxiety interacts with performance on attention-based tasks in a college population. Lastly, the results may shed more light on how anxiety affects how college students interact with their visual environment throughout their academic and non-academic endeavors.

CHAPTER II: METHOD

Participants

One hundred sixty-nine participants completed our study. They were recruited from undergraduate and graduate classes at Middle Tennessee State University (MTSU) and other colleges/universities. We eliminated 35 participants who were above our age criteria. We eliminated 24 participants who left one or more STAI items blank. Three participants who were students at a college other than Middle Tennessee State University were eliminated to avoid any additional unknown variability. The final sample included 107 students at Middle Tennessee State University in the age range of 18-25 ($M = 19.79$, $SD = 1.96$).

Participants were recruited through SONA, word of mouth, email, and social media (e.g., Facebook, Instagram, and Reddit). Because we intended to use college students as our sample, we only included participants in the age range of 18-25. Golden and Freshwater (2002) suggest a shift in Stroop scores after the age of 25, so the age of 25 was the cutoff for participants to qualify for the study.

Measures

PsyToolkit

All data was collected using PsyToolkit, a browser-based data collection tool with a large collection of psychological tests. The program allows researchers to assemble these individual tasks, along with demographic questions, and distribute them virtually for cloud-based data collection (Stoet, 2010, 2017). Traditionally, reaction time data is collected via in-person testing methods; the gold standard for collecting this type of data

is a program called E-prime 3.0. Kim et al. (2019) found a high degree of replicability in reaction time measurement between E-prime and PsyToolkit. No significant differences were observed in the response time results between the two, indicating that PsyToolkit is comparable to E-prime 3.0 for measuring reaction times (Kim et al., 2019). Using PsyToolkit allowed participants to complete the study without any in-person interaction, minimizing any chance of spreading COVID-19 and allowing us to distribute the study more widely. PsyToolkit is very secure and meets the standards of data protection laws in Europe and is supported by SONA.

There is currently no available reliability and validity on the Navon and Stroop task as measured through PsyToolkit. However, published studies used PsyToolkit to measure reaction times and inhibitory control (e.g., Invernizzi et al., 2022; Utamatinin & Pariwatcharakul, 2022). Other theses and dissertations have utilized PsyToolkit in studies measuring the Stroop task (e.g., Ackerman, 2022; Anjomshoae, 2022; Bertleff, 2022). This indicates that while there is not enough data on these tasks as measured on PsyToolkit, they should be comparable to pre-existing versions of the task that have validity and reliability measures. PsyToolkit was the best option for collecting the data needed, considering the time allotted and available budget.

State-Trait Anxiety Inventory. The State-Trait Anxiety Inventory (STAI) form Y was used to measure state anxiety (in the present moment) and trait anxiety (general sense of anxiety). The STAI is a 4-point Likert scale ranging from “not at all” to “very much so” (Spielberger et al., 1983). STAI-S is the state anxiety subscale consisting of 20 items and STAI-T is the trait anxiety subscale also consisting of 20 items. Examples of

items from the STAI-S include: *I feel secure, I feel tense* and examples of STAI-T include: *I feel satisfied with myself, I am “calm, cool, and collected”* (Spielberger et al., 1983).

In a sample of undergraduate students, the internal consistency reliability for males on the STAI-S was $\alpha = 0.89$, and on the STAI-T $\alpha = 0.90$. For females, STAI-S was $\alpha = 0.89$, and for STAI-T $\alpha = 0.89$ (Spielberger, 1970). In a meta-analysis, Barnes et al. (2002) reported an average internal consistency reliability for STAI Form Y of $\alpha = .92$. In a sample of undergraduate students, Creamer et al. (1995) found moderate test-retest correlation coefficients between the STAI-T and the Beck anxiety inventory (0.57 and 0.68), as well as the STAI-S with the Beck anxiety inventory (0.56 and 0.64).

Navon Task. The Navon task measures participants' global and local processing. It was chosen because it has been used in previous literature on anxiety and global/local processing (Becker et al., 2017; Shilton et al., 2019). The Navon task measures response times and errors in processing global and local visual elements (Navon, 1977; Nayar et al., 2015).

This task presents the participant with a global stimulus (i.e., a large letter). This global stimulus shape comprises many local stimuli (i.e., small letters). The Navon task in this study consists of 50 trials, where the participants were then asked to decide if they see the target letters (H or O) on either the global level or the local level of the stimuli (See figure 2) (Stoet, 2010, 2017; Navon, 1977). The PsyToolkit version of the task consists of 12-13 global congruent trials, 12-13 local congruent trials, and 24-26 trials that have neither H nor O in either the global or local elements and consist of only other

letters. Each global-level figure is seven local-element letters tall and five letters wide. For the Navon task, one study on undergraduate students had an average test-retest reliability using Pearson correlation coefficients $r = .66$ for global-level processing. It was $r = .73$ for local-level processing, which suggests acceptable reliability (Dale & Arnell, 2013).

First, participants viewed a screen with instructions and examples of congruent and incongruent trials, with no practice trials. Upon clicking through the instructions, the task began. During each trial, participants viewed a large letter made up of small letters. Participants had to indicate whether the figure contained the letters H or O with a key press. Participants pressed the “b” key if either of these letters were present, and the “n” key if neither letter was included in the figure. Participants had 4000 milliseconds to respond. A green smiling face would flash on the screen to alert participants if they correctly identified an H or O appearing on either the global or local level of the figure and a red frowning face would appear if the participant incorrectly identified an H or O appearing. If participants exceeded the time limit without a response, the word “slow” would appear on the screen leading to the next trial.

Stroop Task. The Stroop task was chosen for this study because it is widely used to measure executive skills and functioning (Rueda et al., 2016). The Stroop color-word task provided by PsyToolkit measures inhibition in executive control through response times. Often the Stroop task consists of a word trial that has the participant read words that are the names of colors (i.e., red), a color trial that has the participant naming the color of ink XXXXs are printed in, and a color-word trial (color name written in ink of

the same or a contrasting color). For this study, we exclusively used the color-word trials where the participant was asked to only respond to the color of the ink the word is in while ignoring its meaning. Participants were expected to inhibit the word's meaning in this task and respond only to its color. There were congruent (i.e., the word blue in the ink color blue) and incongruent trials (i.e., the word red in the ink color blue). The PsyToolkit version of the Stroop color-word task consists of 40 trials of the color-word Stroop task while ignoring the word's meaning, with 11-12 congruent trials and 28-29 incongruent trials. The task began with instructions and examples of congruent and incongruent trials, but there were no practice trials. Upon clicking through the instructions, the task began.

A fixation cross flashed on the screen in these trials to direct the participant's attention. This was followed by the name of a color (blue, red, yellow, or green) in blue, red, yellow, or green ink flashing on the screen for 2000 milliseconds, during which the participants had to identify the color of the ink with a key press. The participant had to press the key on their keyboard that matches the corresponding color: b for blue, r for red, y for yellow, and g for green. In each trial, the participant had to respond within the 2000 milliseconds. If they chose the incorrect key or exceeded the time limit, the word "wrong" would appear on the screen leading to the next trial. If they chose the correct key, the word "correct" would appear. One study using undergraduate students found retest reliability for the standard Stroop color-word task's congruent color-word $\alpha = .71$ ($p < .001$) and an incongruent color-word of $\alpha = .79$ ($p < .001$) (Strauss et al., 2005).

Demographics. We collected ethnicity, gender identity, and age. We also collected data on the reception of psychotherapy for anxiety or depression and any diagnoses of anxiety disorders (see Appendix B). We collected the reported prescriptions for anxiety or attention-deficit/hyperactivity disorder, usage of psychotropic medication, and recreational drug usage (see Table 4). Lastly, we collected participants' reported history of severe head injuries and enrollment as a student at MTSU or other universities.

Of our 107 participants, 24 participants identified as male, 72 participants identified as female, nine participants identified as a non-binary or third gender, and two preferred not to say (see Table 1 for breakdown by groups). In the sample, 85 participants identified as white, 11 participants as Hispanic or Latino, nine participants as Black or African American, three participants as Asian, six participants as mixed ethnicity, and four as Other Ethnicity (see Table 2 for breakdown by groups).

Procedure

To begin, the participants visited the URL link and read the informed consent (see Appendix A). After agreeing to participate, participants completed the state anxiety index of the STAI. Participants then completed both the Navon and Stroop tasks. We chose to put the state anxiety subscale before the two tasks, to get as accurate a measurement of their current state as possible. We also chose to put the trait subscale after the tasks in an attempt to avoid inducing any additional anxiety in the participant. The study was counterbalanced so that equal numbers of participants started with the Navon or the Stroop task. We accomplished this by tracking the number of participants who completed the study and reversing the order of the tasks partway through data collection so that

roughly equal numbers of participants are exposed to each task order. There were no breaks between the two tasks, with the next task following the completion of the first task. Upon completion of both tasks, the participants then completed the trait anxiety index of the STAI. This was followed by the collection of demographic information (gender identification, age, ethnicity, university affiliation, and academic status).

Participants answered questions about previous/current forms of treatment they may have received for anxiety or depression (i.e., psychotherapy, psychopharmacology, etc.), existing diagnoses of anxiety, and history of head injuries. Lastly, a debriefing statement appeared on screen thanking the participants for their participation and ending the experiment.

CHAPTER III: RESULTS

Analysis Summary

All the data was analyzed using IBM SPSS (Version 28). Participants were split into low and high anxiety groups by their mean scores on the STAI-S and STAI-T subscales for each task. In the Navon task, we divided participants into a low trait anxiety group and a high trait anxiety group using a mean split of the STAI-T scores. We conducted a t-test to compare median response times on global congruent trials between high and low trait-anxiety participants. We used the same method to compare the two groups' response times for local congruent trials. For the Stroop task, we split participants according to state and trait anxiety, creating three groups (see Table 6 for details). We conducted an ANOVA to compare response times on incongruent trials across the three groups.

State-Trait Anxiety Inventory

We calculated each participant's state anxiety scores (STAI-S) and trait anxiety scores (STAI-T). Scores were calculated by summing the Likert responses (valued 1-4) on each 20-item subscale, with some items being reverse-coded per the STAI manual (Spielberger et al., 1983). For each subscale (STAI-T, STAI-S), scores can range from 20 to 80 (Spielberger et al., 1983). Participants' scores on each sub-scale of the STAI were used to create a mean split to divide participants into high and low trait anxiety and high and low state anxiety groups as indicated.

Participants' state anxiety subscale scores ($N = 107$, $M = 45.61$, $SD = 11.60$) were normally distributed, slightly skewed right with a .23 skewness, platykurtic with kurtosis

of $-.72$. Trait anxiety ($N = 107$, $M = 51.53$, $SD = 12.14$) was normally distributed, slightly skewed left with a $-.17$ skewness, platykurtic with kurtosis of $-.44$ (see Table 7).

Navon Task

Reaction times in each trial were measured in milliseconds, with a notation of whether the trial was a local or global congruent task. We calculated the median reaction time for each participant for global and local trials. We then divided participants into high trait and low trait anxiety groups using a mean split on their STAI-T scores (see Table 7). We created a mean global and local reaction time based on the median for each group and compared them using one-tailed t-tests.

We conducted a t-test on median global processing response times in milliseconds comparing low trait and high trait anxiety groups to address our hypothesis that participants with high trait anxiety would have slower reaction times on global processing than those with low trait anxiety. Equality of variance was assumed $F_{(1,105)} = 0.14$. We did not find a statistically significant difference, $t_{(105)} = 0.62$, $p = .538$, $d = 0.12$ between our low trait anxiety ($N = 54$, $M = 840.49$, $SD = 166.46$) and high trait anxiety ($N = 53$, $M = 820.14$, $SD = 174.45$) groups in reaction times on global trials. We also conducted a t-test on median local processing response times in milliseconds comparing low trait and high trait anxiety groups to address our hypothesis that participants with high trait anxiety would have faster reaction times on local processing than low trait anxiety participants. Equality of variance was assumed $F_{(1,105)} = .55$. We did not find a statistically significant difference, $t_{(105)} = -0.84$, $p = .405$, $d = -0.16$ between our low trait anxiety ($N = 54$, $M =$

822.48 $SD = 175.72$) and our high trait anxiety ($N = 53$ $M = 857.66$, $SD = 253.06$) groups in reaction times on local trials.

Stroop Task

Lastly, we conducted a one-way ANOVA between the low state/low trait group (LL) ($N = 40$, $M = 933.71$, $SD = 178.59$), low state/high trait and high state/low trait group (HL, LH) ($N = 33$, $M = 955.23$, $SD = 208.28$), and high state high trait group (HH) ($N = 34$, $M = 936.52$, $SD = 168.46$) on median Stroop incongruent trials. We combined low state/high trait participants and high state/low trait participants into one group due to not having enough participants in each group to conduct the analysis.

We did not find a statistically significant difference between groups, $F_{(2, 104)} = 0.14$, $p = .871$, $\eta^2 = .00$. This addressed our last hypothesis, that the two groups of anxiety (LH-HL and HH) would have slower reaction times on the incongruent trials of the Stroop task when compared to the control group (LL).

CHAPTER IV: DISCUSSION

This study explored the possible interactions between state and trait anxiety with attention in college students through performance on versions of the Navon and Stroop tasks available on PsyToolkit (Stoet, 2010, 2017). We measured the relationship of the severity of trait anxiety with global and local processing measures through the Navon task. We also measured the relationship between the severity of state anxiety and trait anxiety on cognitive inhibition in executive control through the Stroop task. We did not find statistically significant results to support our three hypotheses. There was no association found between anxiety and attention in this study.

Anxiety and Global/Local Processing

We hypothesized that participants with high trait anxiety would have slower reaction times on global processing than those with low trait anxiety. Additionally, based on previous findings we hypothesized that participants with high trait anxiety would have faster reaction times on local processing than low-anxiety participants. However, our results showed no significant group differences on either task. Some evidence suggests the lack of a finding in our global processing t-test is not surprising (Shilton et al., 2019). There was quite a bit of evidence from previous literature for our local processing hypothesis (Basso et al., 1996; Becker et al., 2017; Derryberry & Reed, 1998; Shilton et al., 2019). Interestingly, while it was not statistically significant, we found the opposite direction for both global and local processing. On average, for global trials, high trait participants ($M = 820.14$) had faster reaction times than low trait anxiety participants ($M = 840.49$). For local trials, the high trait participants ($M = 857.66$) had average slower

reaction times than the low trait participants ($M = 822.48$). Our high trait anxiety participants did not display a local processing bias. Variations between our design and previous studies may explain our findings (e.g., online study or having specific target letters). Some of the previous literature used different global and local processing paradigms (Basso et al., 1996; Shilton et al., 2019). Other variables we may not be aware of could also explain the observed results, including variability due to uncontrolled testing environments, as participants completed the study online with no restrictions about the type of location where they completed the tasks.

We did not find statistically significant results, however, there is still a necessity to continue investigating global and local processing in college samples. Tan et al. (2017) found evidence that undergraduate students were more willing to take academic risks when globally primed than participants locally primed. This willingness to take more significant risks in an educational setting could lead to greater academic achievement. To our knowledge, there is little literature on global and local processing and academic success. One study used a global and local processing paradigm to predict academic achievement. However, this study focuses on meta-motivation, and it was unclear how global and local processing affects academic achievement (Nguyen et al., 2023). One study found that in children with attention deficit hyperactivity disorder, global and local processing ability was predictive of mathematic ability (Sjöwall & Thorell, 2014). Additionally, the ability to efficiently process one's visual environment on the global level appears to be beneficial in understanding written communication (Wolfin et al., 2012). This may translate to the ability to understand the information in a textbook while

studying. Suggesting that based on previous results of anxiety and global processing, high trait anxiety may impair reading ability while studying (Basso et al., 1996).

Anxiety and Stroop Task

We hypothesized that the low trait anxiety, high state anxiety, and high trait anxiety, low state anxiety LH-HL ($M = 955.23$) and the high trait anxiety high state anxiety group HH ($M = 936.52$) would have slower reaction times on the incongruent trials of the Stroop task when compared to the control group (LL) ($M = 933.71$). According to the ANOVA, our analysis of executive attention through response inhibition did not yield statistically significant results. While our groups were relatively evenly distributed, better distribution and the ability to have three heightened levels of anxiety groups may contribute to our observed results (see limitations for a more in-depth discussion).

It is important to continue investigating how various factors influence executive attention. Studies have found that from early childhood through college, there is a correlation between executive functioning and academic achievement (Baars et al., 2015; Best et al., 2011).

Limitations of the Study

This study had several limitations, one of which was group dispersion. For our ANOVA, we initially wanted roughly 25 participants in four groups. These four groups were a control group (LL), a low trait anxiety high state anxiety group (LH), a high trait anxiety low state anxiety group (HL), and a high trait anxiety high state anxiety group (HH). The number of participants in our initial LH and HL groups was too low to run the

analysis, so we combined them to make one group (LH-HL). Given the conflicting findings and theories, being able to keep both groups separate would have been useful to see how trait anxiety and state anxiety alone affected performance on the Stroop task (Eysenck et al., 2007; Pacheco-Unguetti et al., 2010; Ursache & Cybele Raver, 2014). Additionally, by combining the groups, the LH-HL average scores on the STAI-T and STAI-S were very similar to our total sample's average scores on these scales.

We measured state anxiety without any stress induction or any way to control it. This caused us to rely on participants already being in an anxious state to have an even distribution of groups. In addition to a group distribution issue, our sample size also comes into question. However, many of the studies used to generate our hypothesis had around half the number of participants or fewer (Basso et al., 1996; Hallion et al., 2017; Pacheco-Unguetti et al., 2010; Shilton et al., 2019).

The average age of participants in our study was only 19.78. Previous studies had participants ranging in age from 17 to 71. Many previous studies used participants with a wider range of ages; it is possible that age may contribute to the discrepancies between those studies and our results (Hallion et al., 2017; Pacheco-Unguetti et al., 2010; Rosa-Alcázar et al., 2021). Our study may better represent anxiety's effect on college students between the ages of 18-25 but it may not be generalizable to other demographics or the general population. We collected our participants' diagnoses of anxiety and other mental disorders but did not use this knowledge for anything in the study. It would be interesting to examine how pre-existing diagnoses affect performance as a possible covariate in future studies.

Preferably, we would have recruited more participants to allow us to exclude additional factors that may have affected their performance. We would have preferred to exclude any participants who have reported that they are currently using psychotropic medication. Additionally, we would've preferred to exclude anyone who is currently receiving treatment (i.e., psychotherapy, psychopharmacology, etc.) for anxiety, attention-deficit/hyperactivity disorder, or depression. Lastly, we would've preferred to exclude any participants who reported that they have experienced a head injury (i.e., traumatic brain injury, concussion) in the past.

We wanted to exclude participants who were receiving treatment for anxiety. This is because while they may still report high levels of anxiety, ideally through therapy or medicine they have reduced their anxiety which would in theory impact their performance on the tasks used in this study. In our sample, 14.95% of participants reported a previous severe head injury (see Table 5). There is data that suggest traumatic brain injuries contribute to poorer performance in response inhibition tasks, such as the Stroop task (Dimoska-Di Marco et al., 2011). Due to these inclusions, there may be unwanted factors contributing to our participants' observed results.

Because the study was entirely online, we are unaware of the environment each participant completed the study in (e.g., in a distracting environment, in a quiet environment). We have no information about what kind of computer setup each participant used (e.g., monitor screen size, keyboard arrangement), nor could we account for any computer error participants might have encountered during the study. We also had no way of checking each participant's quality of vision, necessity for corrective

lenses, or effort levels. This participant-to-participant variation could have an unknown effect on some of the recorded reaction times. Additionally, the PsyToolkit versions of both tasks required the use of key inputs. This motor input might have had unintended activation of areas of the brain (Cramer et al., 1999). Ultimately, adding additional variables being unintentionally measured.

Despite this, Hallion et al. (2017) also had a computer-adapted version of the Stroop task where they found evidence to suggest that the presence of GAD predicted Stroop task results. Previous studies that used the traditional Stroop Color Word Test design with word trials and color trials may also contribute to the observed differences (Hallion et al., 2017; Rosa-Alcázar et al., 2021). The PsyToolkit version of the Stroop task required four different button strokes, which might have made the task more confusing and possibly measured more than response inhibition.

As previously mentioned, we eliminated timed-out and incorrect trials, where the traditional Stroop Color Word Test asks the test taker to retry the item as the timer goes down. This requires the test taker to inhibit every trial correctly. Differences between versions of the task may influence observed performance. We also used versions of these tasks that do not have normative data. Finally, our sample is a bit biased because it was mainly comprised of females and white people. This gender ratio likely did not influence the observed results, as most of the previous literature also had a skew of females to males (Becker et al., 2017; Derryberry & Reed, 1998; Hallion et al., 2017; Pacheco-Unguetti et al., 2010; Shilton et al., 2019).

However, having a higher percentage of males in our low anxiety groups may have had an impact on the observed results. Males and females are known to have neural structural differences (Ingahalikar et al., 2013). Specifically, there are findings in other visual perception tasks that target the right parietal lobe that display a difference in performance between males and females (Kalichman, 1988; Linn & Petersen, 1985). Given this, our findings on global processing which targets the right parietal lobe may be affected by gender differences between groups (Kimchi & Merhav, 1991; Robertson, 1992).

Future Directions

Future studies examining how emotions, mood, and anxiety may contribute to deficits in attention should consider a more general and comprehensive battery, such as tasks designed to measure the other two neural networks of attention, proposed by Posner and Petersen (1990) (alerting and orienting). In this study, only one aspect of executive attention was measured, being response inhibition. There are other parts of executive functioning and other tasks that measure these aspects (e.g., Tower of London, Trail Making Test, and Wisconsin Card Sorting Test) that could be used for future research (Etnier & Chang, 2009). Future studies comparing all male to all female participants may be beneficial to observe if there are any gender differences in these tasks as measured by PsyToolkit. Additionally, the ecological validity of these versions of the Navon and Stroop task comes into question. It would be beneficial to have future research that attempts to replicate similar results between the PsyToolkit version of these tasks and

traditional versions. Furthermore, establishing normative data for these versions of the tasks may also allow for future clinical utility.

Lastly, future studies should consider measuring how mood, emotions, and anxiety influence a college sample's short-term and working memory as well. Data suggests that performance on short-term memory tasks, such as digit span correlates with academic achievement (Jaquith, 1996).

Conclusion

Results of this project are inconsistent with previous findings (Basso et al., 1996; Becker et al., 2017; Derryberry & Reed, 1998; Hallion et al., 2017; Pacheco-Unguetti et al., 2010; Rosa-Alcázar et al., 2021; Shilton et al., 2019). Anxiety symptoms appear prevalent in college students, and academic achievement has been observed as one of the most significant stressors in a student's life (Asher BlackDeer et al., 2021; Beiter et al., 2015). Additionally, while not replicated in this study, there is previous literature that suggests anxiety can harm not only attention but academic achievement, as well (Basso et al., 1996; Cassady & Johnson, 2002; Hoegler & Nelson, 2018; Najmi et al., 2012; Pacheco-Unguetti et al., 2010; Rosa-Alcázar et al., 2021; Vitasari et al., 2010). Literature suggests that better performance on the tasks used in this study can predict academic achievement. Future studies are needed to address the uncertainty of effects state anxiety may have on the Stroop task. There are still mixed findings and conflicting theories about whether state anxiety is beneficial or detrimental to executive functioning (Eysenck et al., 2007; Pacheco-Unguetti et al., 2010; Ursache & Cybele Raver, 2014). Overall, our study did not find any statistically significant differences. However, this study had a large

sample size of college students between the ages of 18 to 25. This study provides a valuable understanding and representation of how state and trait anxiety affect performance on these two tasks as measured by PsyToolkit in this specific sample of students at Middle Tennessee State University (Stoet, 2010, 2017).

REFERENCES

- Ackerman, S. (2022). *COVID-19 and Executive Functions*. [Bachelor's thesis, Eastern Kentucky University]
- Albert, J., López-Martín, S., Hinojosa, J. A., & Carretié, L. (2013). Spatiotemporal characterization of response inhibition. *NeuroImage*, *76*, 272-281.
<https://doi.org/10.1016/j.neuroimage.2013.03.011>
- Anjomshoae, F. (2022). *Testing Effects of Bilingualism on Inhibition, Shifting and Working Memory Ability in Adults*. [Master's thesis, University of Alberta]
- Asher BlackDeer, MSW, PhD Candidate, A., Patterson Silver Wolf, PhD, D. A., Maguin, PhD, E., & Beeler-Stinn, PhD, S. (2023). Depression and anxiety among college students: Understanding the impact on grade average and differences in gender and ethnicity. *Journal of American College Health*, *71*(4), 1091-1102.
<https://doi.org/10.1080/07448481.2021.1920954>
- Baars, M. A., Nije Bijvank, M., Tonnaer, G. H., & Jolles, J. (2015). Self-report measures of executive functioning are a determinant of academic performance in first-year students at a university of applied sciences. *Frontiers in Psychology*, *6*, 1131.
<https://doi.org/10.3389/fpsyg.2015.01131>
- Banich, M. T., Milham, M. P., Atchley, R., Cohen, N. J., Webb, A., Wszalek, T., ... & Magin, R. (2000). fMRI studies of Stroop tasks reveal unique roles of anterior and posterior brain systems in attentional selection. *Journal of cognitive neuroscience*, *12*(6), 988-1000. <https://doi.org/10.1162/08989290051137521>

- Barnes, L. L., Harp, D., & Jung, W. S. (2002). Reliability generalization of scores on the Spielberger state-trait anxiety inventory. *Educational and psychological measurement, 62*(4), 603-618. <https://doi.org/10.1177/0013164402062004005>
- Basso, M., Schefft, B., Ris, M., & Dember, W. (1996). Mood and global-local visual processing. *Journal of the International Neuropsychological Society, 2*(3), 249-255. <https://doi.org/10.1017/S1355617700001193>
- Becker, K. R., Plessow, F., Coniglio, K. A., Tabri, N., Franko, D. L., Zayas, L. V., Germine, L., Thomas, J. J., & Eddy, K. T. (2017). Global/local processing style: Explaining the relationship between trait anxiety and binge eating. *International Journal of Eating Disorders, 50*(11), 1264–1272. <https://doi.org/10.1002/eat.22772>
- Beiter, R., Nash, R., McCrady, M., Rhoades, D., Linscomb, M., Clarahan, M., & Sammut, S. (2015). The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *Journal of Affective Disorders, 173*, 90–96. <https://doi.org/10.1016/j.jad.2014.10.054>
- Bertleff, A. J. (2022). *Automaticity in Musicians as Demonstrated by a Modified Stroop Task* [Doctoral dissertation, Kent State University].
- Best, J. R., Miller, P. H., & Naglieri, J. A. (2011). Relations between executive function and academic achievement from ages 5 to 17 in a large, representative national sample. *Learning and individual differences, 21*(4), 327-336. <https://doi.org/10.1016/j.lindif.2011.01.007>

- Bishop, S. J. (2009). Trait anxiety and impoverished prefrontal control of attention. *Nature Neuroscience*, *12*(1), 92-98. <https://doi.org/10.1038/nn.2242>
- Bush, G., Luu, P., & Posner, M. I. (2000). Cognitive and emotional influences in anterior cingulate cortex. *Trends in cognitive sciences*, *4*(6), 215-222. [https://doi.org/10.1016/S1364-6613\(00\)01483-2](https://doi.org/10.1016/S1364-6613(00)01483-2)
- Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary educational psychology*, *27*(2), 270-295. <https://doi.org/10.1006/ceps.2001.1094>
- Chapell, M. S., Blanding, Z. B., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of educational Psychology*, *97*(2), 268. <https://psycnet.apa.org/doi/10.1037/0022-0663.97.2.268>
- Chaplin, T., (1989). The relationship of trait anxiety and academic performance to achievement anxiety: students at risk *Journal of college student development*, *30*, 229-236.
- Chew, P. K. H., & Dillon, D. B. (2014). Statistics anxiety update: Refining the construct and recommendations for a new research agenda. *Perspectives on Psychological Science*, *9*(2), 196–208. <https://doi.org/10.1177/1745691613518077>
- Cramer, S. C., Finklestein, S. P., Schaechter, J. D., Bush, G., & Rosen, B. R. (1999). Activation of distinct motor cortex regions during ipsilateral and contralateral finger movements. *Journal of neurophysiology*, *81*(1), 383-387. <https://doi.org/10.1152/jn.1999.81.1.383>

- Creamer, M., Foran, J., & Bell, R. (1995). The Beck Anxiety Inventory in a non-clinical sample. *Behaviour research and Therapy*, 33(4), 477-485.
[https://doi.org/10.1016/0005-7967\(94\)00082-U](https://doi.org/10.1016/0005-7967(94)00082-U)
- Dale, G., & Arnell, K. M. (2013). Investigating the stability of and relationships among global/local processing measures. *Attention, Perception, & Psychophysics*, 75, 394-406. <https://doi.org/10.3758/s13414-012-0416-7>
- Derryberry, D., & Reed, M. A. (1998). Anxiety and attentional focusing: Trait, state and hemispheric influences. *Personality and individual differences*, 25(4), 745-761.
[https://doi.org/10.1016/S0191-8869\(98\)00117-2](https://doi.org/10.1016/S0191-8869(98)00117-2)
- Dimoska-Di Marco, A., McDonald, S., Kelly, M., Tate, R., & Johnstone, S. (2011). A meta-analysis of response inhibition and Stroop interference control deficits in adults with traumatic brain injury (TBI). *Journal of clinical and experimental neuropsychology*, 33(4), 471-485. <https://doi.org/10.1080/13803395.2010.533158>
- Egner, T., & Hirsch, J. (2005). The neural correlates and functional integration of cognitive control in a Stroop task. *Neuroimage*, 24(2), 539-547.
<https://doi.org/10.1016/j.neuroimage.2004.09.007>
- Etnier, J. L., & Chang, Y. K. (2009). The effect of physical activity on executive function: a brief commentary on definitions, measurement issues, and the current state of the literature. *Journal of Sport and Exercise Psychology*, 31(4), 469-483.
<https://doi.org/10.1123/jsep.31.4.469>

- Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. *Emotion*, 7(2), 336. <https://doi-org.ezproxy.mtsu.edu/10.1037/1528-3542.7.2.336>
- Gasper, K., & Clore, G. L. (2002). Attending to the Big Picture: Mood and Global Versus Local Processing of Visual Information. *Psychological Science*, 13(1), 34–40. <https://doi.org/10.1111/1467-9280.00406>
- Hallion, L. S., Tolin, D. F., Assaf, M., Goethe, J., & Diefenbach, G. J. (2017). Cognitive control in generalized anxiety disorder: Relation of inhibition impairments to worry and anxiety severity. *Cognitive Therapy and Research*, 41(4), 610-618. <https://doi.org/10.1007/s10608-017-9832-2>
- Heller, W., Nitschke, J. B., Etienne, M. A., & Miller, G. A. (1997). Patterns of regional brain activity differentiate types of anxiety. *Journal of abnormal psychology*, 106(3), 376. <https://doi.org/10.1037/0021-843X.106.3.376>
- Hoegler, S., & Nelson, M. (2018). The Influence of anxiety and self-efficacy on statistics performance: A path analysis. *Psi Chi Journal of Psychological Research*, 23(5). <https://doi.org/10.24839/2325-7342.JN23.5.364>
- Ingalhalikar, M., Smith, A., Parker, D., Satterthwaite, T. D., Elliott, M. A., Ruparel, K., ... & Verma, R. (2014). Sex differences in the structural connectome of the human brain. *Proceedings of the National Academy of Sciences*, 111(2), 823-828. <https://doi.org/10.1073/pnas.1316909110>
- Invernizzi, P. L., Rigon, M., Signorini, G., Colella, D., Trecroci, A., Formenti, D., & Scurati, R. (2022). Effects of varied practice approach in physical education

- teaching on inhibitory control and reaction time in preadolescents. *Sustainability*, 14(11), 6455. <https://doi.org/10.3390/su14116455>
- Jaquith, J. (1996). The role of short-term memory on academic achievement. *National Association of Child Development*.
- Kalichman, S. C. (1988). Individual differences in water-level task performance: A component-skills analysis. *Developmental Review*, 8(3), 273-295. [https://doi.org/10.1016/0273-2297\(88\)90007-X](https://doi.org/10.1016/0273-2297(88)90007-X)
- Kim, J., Gabriel, U., & Gyax, P. (2019). Testing the effectiveness of the Internet-based instrument PsyToolkit: A comparison between web-based (PsyToolkit) and lab-based (E-Prime 3.0) measurements of response choice and response time in a complex psycholinguistic task. *PloS one*, 14(9), e0221802. <https://doi.org/10.1371/journal.pone.0221802>
- Kimchi, R., & Merhav, I. (1991). Hemispheric processing of global form, local form, and texture. *Acta Psychologica*, 76(2), 133–147. [https://doi.org/10.1016/0001-6918\(91\)90042-x](https://doi.org/10.1016/0001-6918(91)90042-x)
- Kosslyn, S. M., Brown, H. D., & Dror, I. E. (1999). Aging and the scope of visual attention. *Gerontology*, 45(2), 102-9. <https://doi.org/10.1159/000022071>
- Linn, M. C., & Petersen, A. C. (1985). Emergence and characterization of sex differences in spatial ability: A meta-analysis. *Child development*, 56(6), 1479-1498. <https://doi.org/10.2307/1130467>
- Marek, T., Fafrowicz, M., Golonka, K., Mojsa-Kaja, J., Oginska, H., Tucholska, K., ... & Domagalik, A. (2010). Diurnal patterns of activity of the orienting and executive

attention neuronal networks in subjects performing a Stroop-like task: a functional magnetic resonance imaging study. *Chronobiology international*, 27(5), 945-958.

<https://doi.org/10.3109/07420528.2010.489400>

Milham, M. P., Banich, M. T., Claus, E. D., & Cohen, N. J. (2003). Practice-related effects demonstrate complementary roles of anterior cingulate and prefrontal cortices in attentional control. *Neuroimage*, 18(2), 483-493.

[https://doi.org/10.1016/S1053-8119\(02\)00050-2](https://doi.org/10.1016/S1053-8119(02)00050-2)

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "Frontal Lobe" tasks: A latent variable analysis. *Cognitive psychology*, 41(1), 49–100.

<https://doi.org/10.1006/cogp.1999.0734>

Najmi, S., Kuckertz, J. M., & Amir, N. (2012). Attentional impairment in anxiety: inefficiency in expanding the scope of attention. *Depression and Anxiety*, 29(3), 243-249.

<https://doi.org/10.1002/da.20900>

Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. *Cognitive Psychology*, 9(3), 353–383.

[https://doi.org/10.1016/0010-0285\(77\)90012-3](https://doi.org/10.1016/0010-0285(77)90012-3)

Nayar, K., Franchak, J., Adolph, K., & Kiorpes, L. (2015). From local to global processing: the development of illusory contour perception. *Journal of Experimental Child Psychology*, 131, 38–55.

<https://doi.org/10.1016/j.jecp.2014.11.001>

- Nguyen, T., Scholer, A. A., Miele, D. B., Edwards, M. C., & Fujita, K. (2023). Predicting academic performance with an assessment of students' knowledge of the benefits of high-level and low-level construal. *Social Psychological and Personality Science*, 14(2), 195-206. <https://doi.org/10.1177/19485506221090051>
- Owens, M., Stevenson, J., Hadwin, J. A., & Norgate, R. (2012). Anxiety and depression in academic performance: An exploration of the mediating factors of worry and working memory. *School Psychology International*, 33(4), 433-449. <https://doi.org/10.1177/0143034311427433>
- Pacheco-Unguetti, A. P., Acosta, A., Callejas, A., & Lupiáñez, J. (2010). Attention and anxiety. *Psychological Science*, 21(2), 298–304. <https://doi.org/10.1177/0956797609359624>
- Paulus, M. P., Feinstein, J. S., Simmons, A., & Stein, M. B. (2004). Anterior cingulate activation in high trait anxious subjects is related to altered error processing during decision making. *Biological Psychiatry*, 55(12), 1179-1187. <https://doi.org/10.1016/j.biopsych.2004.02.023>
- Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience*, 13(1), 25–42. <https://doi.org/10.1146/annurev.ne.13.030190.000325>
- Posner, M.I., Rueda, M.R. & Kanske, P. (2007). Probing the mechanisms of attention. In J.T. Cacioppo, J.G. Tassinary & G.G. Berntson (eds), *Handbook of Psychophysiology*, Third Edition. Cambridge U.K.: Cambridge University Press (pp 410-432).

- Qin, J., & Han, S. (2007). The role of parietal cortex in global/local processing of hierarchical stimuli: a transcranial magnetic stimulation study. *Neuroreport*, *18*(18), 1921-1924.
- Robertson, L.C. (1992). Perceptual organization and attentional search in cognitive deficits. In D. I. Margolin (Ed.), *Cognitive neuropsychology in clinical practice* (pp. 70-95). New York: Oxford.
- Rosa-Alcázar, A. I., Rosa-Alcázar, Á., Martínez-Esparza, I. C., Storch, E. A., & Olivares-Olivares, P. J. (2021). Response Inhibition, Cognitive Flexibility and Working Memory in Obsessive-Compulsive Disorder, Generalized Anxiety Disorder and Social Anxiety Disorder. *International Journal of Environmental Research and public health*, *18*(7), 3642. <https://doi.org/10.3390/ijerph18073642>
- Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2016). The development of executive attention: Contributions to the emergence of self-regulation. In *Measurement of Executive Function in Early Childhood* (pp. 573-594). Psychology Press.
- Saviola, F., Pappaianni, E., Monti, A., Grecucci, A., Jovicich, J., & De Pisapia, N. (2020). Trait and state anxiety are mapped differently in the human brain. *Scientific Reports*, *10*(1), 1-11. <https://doi.org/10.1038/s41598-020-68008-z>
- Shilton, A. L., Laycock, R., & Crewther, S. G. (2019). Different effects of trait and state anxiety on global-local visual processing following acute stress. *Cognition, Brain, Behavior. An Interdisciplinary Journal*, *23*(3), 155–170. <https://doi.org/10.24193/cbb.2019.23.09>

- Sjöwall, D., & Thorell, L. B. (2014). Functional impairments in attention deficit hyperactivity disorder: the mediating role of neuropsychological functioning. *Developmental neuropsychology*, 39(3), 187-204.
<https://doi.org/10.1080/87565641.2014.886691>
- Spielberger, C. D. (1970). Manual for the state-trait anxiety inventory (Self-evaluation questionnaire). *Consulting Psychologists Press*.
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Stoet, G. (2010). PsyToolkit - A software package for programming psychological experiments using Linux. *Behavior Research Methods*, 42(4), 1096-1104.
<https://doi.org/10.3758/BRM.42.4.1096>
- Stoet, G. (2017). PsyToolkit: A novel web-based method for running online questionnaires and reaction-time experiments. *Teaching of Psychology*, 44(1), 24-31. <https://doi.org/10.1177/0098628316677643>
- Strauss, G. P., Allen, D. N., Jorgensen, M. L., & Cramer, S. L. (2005). Test-retest reliability of standard and emotional stroop tasks: an investigation of color-word and picture-word versions. *Assessment*, 12(3), 330-337.
<https://doi.org/10.1177/1073191105276375>
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18(6), 643-662. <https://doi.org/10.1037/h0054651>

- Tan, E. W., Lim, S. W. H., & Manalo, E. (2017). Global-local processing impacts academic risk taking. *Quarterly Journal of Experimental Psychology*, 70(12), 2434-2444. <https://doi.org/10.1080/17470218.2016.1240815>
- Taylor, S. F., Kornblum, S., Lauber, E. J., Minoshima, S., & Koeppe, R. A. (1997). Isolation of specific interference processing in the Stroop task: PET activation studies. *Neuroimage*, 6(2), 81-92. <https://doi.org/10.1006/nimg.1997.0285>
- Tsujimoto, S. (2008). The prefrontal cortex: Functional neural development during early childhood. *The Neuroscientist*, 14(4), 345-358. <https://doi.org/10.1177/1073858408316002>
- Tyler, S. K., & Tucker, D. M. (1982). Anxiety and perceptual structure: individual differences in neuropsychological function. *Journal of Abnormal Psychology*, 91(3), 210. <https://doi-org.ezproxy.mtsu.edu/10.1037//0021-843x.91.3.210>
- Ursache, A., & Raver, C. C. (2014). Trait and state anxiety: Relations to executive functioning in an at-risk sample. *Cognition & emotion*, 28(5), 845-855. <https://doi.org/10.1080/02699931.2013.855173>
- Utamatanin, N., & Pariwatcharakul, P. (2022). The Effect of Caffeine and Sleep Quality on Military Pilot Students' Flight Performance-Related Cognitive Function. *The International Journal of Aerospace Psychology*, 32(2-3), 152-164. <https://doi.org/10.1080/24721840.2022.2034505>
- Veroude, K., Jolles, J., Knežević, M., Vos, C. M., Croiset, G., & Krabbendam, L. (2013). Anterior cingulate activation during cognitive control relates to academic

performance in medical students. *Trends in Neuroscience and Education*, 2(3-4), 100-106. <https://doi.org/10.1016/j.tine.2013.10.001>

Vitasari, P., Wahab, M. N. A., Othman, A., Herawan, T., & Sinnadurai, S. K. (2010). The relationship between study anxiety and academic performance among engineering students. *Procedia-Social and Behavioral Sciences*, 8, 490-497.

<https://doi.org/10.1016/j.sbspro.2010.12.067>

Warren, S. L., Heller, W., & Miller, G. A. (2021). The structure of executive dysfunction in depression and anxiety. *Journal of affective disorders*, 279, 208-216.

<https://doi.org/10.1016/j.jad.2020.09.132>

Woltin, K. A., Corneille, O., & Yzerbyt, V. Y. (2012). Improving communicative understanding: The benefits of Global Processing. *Journal of Experimental Social Psychology*, 48(5), 1179–1182. <https://doi.org/10.1016/j.jesp.2012.03.004>

TABLES

Table 1*Percentage of the Reported Gender*

Anxiety Groups	Male	Female	Non-binary	Prefer not to Say
Total	22.43%	67.29%	8.41%	1.87%
Low Trait Anxiety	31.48%	62.96%	5.56%	0%
High Trait Anxiety	13.20%	71.70%	11.32%	3.77%
LL	37.50%	57.50%	5.00%	0%
LH-HL	18.18%	72.73%	6.06%	3.03%
HH	8.82%	73.53%	14.71%	2.94%

Table 2*Percentage of the Reported Ethnicity*

Anxiety Groups	White	Hispanic	Black	Asian	Mixed	Other
Total	79.44%	10.28%	8.41%	2.80%	5.61%	3.74%
Low Trait Anxiety	77.78%	11.11%	11.11%	3.70%	7.41%	3.70%
High Trait Anxiety	81.13%	9.43%	5.66%	1.89%	3.77%	3.77%
LL	72.50%	15.00%	12.50%	5.00%	10.00%	5.00%
LH-HL	87.88%	3.03%	3.03%	0%	3.03	6.06%
HH	79.41%	11.76%	8.82%	2.94%	2.94%	0%

Note. Participants were allowed to select more than one ethnicity.

Table 3*Percentage of the Reported Diagnosis*

Diagnoses	Total	Low Trait	High Trait	LL	LH-HL	HH
N/A	57.01%	62.96%	50.94%	70.00%	48.48%	50.00%
Anxiety	37.38%	31.48%	43.40%	25.00%	45.45%	44.12%
Depression	7.48%	1.85%	13.21%	2.50%	3.03%	17.65%
ADHD	4.67%	7.41%	1.89%	5.00%	6.06%	2.94%
PTSD	5.61%	3.70%	7.41%	0.00%	9.09%	8.82%
OCD	1.87%	0%	3.77%	0.00%	3.03%	2.94%
Bipolar	3.74%	1.85%	5.66%	2.50%	0%	8.82%
ASD	1.87%	1.85%	1.89%	2.50%	3.03%	0%
BPD	1.87%	0%	3.77%	0%	0%	5.88%
ED	0.93%	0%	1.89%	0%	0%	2.94%
PNS	1.87%	0%	3.77%	0%	3.03%	2.94%

Note. Participants were allowed to select more than one diagnosis. Attention deficit hyperactivity disorder (ADHD), post traumatic stress disorder or related disorder (PTSD), obsessive compulsive disorder or related disorders (OCD), autism spectrum disorder (ASD), borderline personality disorder (BPD), an eating disorder (ED), and prefer not to Say (PNS)

Table 4*Percentage of the Reported Drug and Substance Usage of Participants*

Anxiety Groups	Prescription	Psychotropic	Recreational
Total	29.91%	28.97%	16.82%
Low Trait Anxiety	27.78%	20.37%	12.96%
High Trait Anxiety	32.08%	37.74%	20.75%
LL	20.00%	15.00%	15.00%
LH-HL	42.42%	39.39%	15.15%
HH	29.41%	29.42%	20.59%

Table 5*Percentage Reported a History of Severe Head Injury of Participants*

Anxiety Groups	Reported	Did not report
Total	14.95%	85.05%
Low Trait Anxiety	12.96%	87.04%
High Trait Anxiety	16.98%	83.02%
LL	15.00%	85.00%
LH-HL	12.12%	87.88%
HH	17.65%	79.41%

Table 6*Groups of Anxiety Measured for the Stroop Task*

Group 1	Group 2	Group 3
Low trait anxiety, low state anxiety (LL) (control group)	Low trait anxiety, high state anxiety, and high trait anxiety, low state anxiety (LH-HL)	High trait anxiety, high state anxiety (HH)

Table 7*STAI-T Scores and STAI-S Mean Scores*

Anxiety Groups	<i>N</i>	STAI-T	<i>SD</i>	STAI-S	<i>SD</i>
Total	107	51.53	12.14	45.61	11.60
Low Trait Anxiety	54	41.89	7.66	N/A	N/A
High Trait Anxiety	53	61.36	6.77	N/A	N/A
LL	40	40.48	7.89	35.40	6.00
LH-HL	33	53.48	8.80	44.67	7.00
HH	34	62.65	6.75	58.53	6.56

Table 8*Global Processing Reaction Times*

Anxiety Groups	<i>N</i>	Mean	<i>SD</i>	<i>SE</i>
Low Trait Anxiety	54	840.49	166.46	22.65
High Trait Anxiety	53	820.14	174.45	23.96

Table 9*Local Processing Reaction Times*

Anxiety Groups	<i>N</i>	Mean	<i>SD</i>	<i>SE</i>
Low Trait Anxiety	54	822.48	175.72	23.91
High Trait Anxiety	53	857.66	253.06	34.76

Table 10*Stroop Task Reaction Times*

Anxiety Groups	<i>N</i>	Mean	<i>SD</i>	<i>SE</i>
LL (control)	40	933.71	178.59	28.24
LH-HL	33	955.23	208.28	36.26
HH	34	936.52	168.46	28.89

Note. Low state low trait group (LL), low state high trait and high state low trait group (LH, HL), and high state high trait group (HH)

Table 11*Independent Sample Tests*

Variable Measured	<i>F</i>	<i>t</i>	<i>p</i>
Global Processing t-test	0.14	0.62	.538
Local Processing t-test	0.55	-0.84	.405
Stroop task ANOVA	0.14	N/A	.871

FIGURES

```
X      X
X      X
X      X
XXXXXX
X      X
X      X
X      X
```

Figure 1

Example of a Navon figure from PsyToolkit.

Note. The global level is the letter H, and the local level is the X's (Stoet, 2010, 2017).

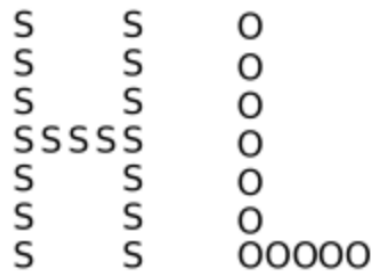


Figure 2

Example of Navon figures from PsyToolkit

Note. The figure on the left is global congruent (H or O at the global level) and the figure on the right is local congruent (H or O on the local level) (Stoet, 2010, 2017).



YELLOW

Figure 3

Example of Stroop stimuli from PsyToolkit.

Note. The color of the word is red and the word that is required to be inhibited is yellow (Stoet, 2010, 2017).

APPENDICES

Appendix A: Informed Consent

Please read the following and respond to the consent questions in the bottom if you wish to enroll in this study.

Purpose: This research project is designed to measure symptoms of State and Trait Anxiety as it relates to performance on the Navon Task and Stroop Task.

Description: There are several parts to this project. They are: two anxiety screening surveys and two tasks.

IRB Approval Details

Protocol Title: Effects of Anxiety on Attention-based Tasks in a College Population

Primary Investigators: Jacob DeSoto & Dr. Jessica Gaby

PI Department & College: Department of Psychology, College of Behavioral and Health Sciences

Protocol ID: IRB-FY2023-122 Approval Date: 05/05/2023

Duration: The whole activity should take about 25 minutes.

Here are your rights as a participant:

Your participation in this research is voluntary.

You may stop the experiment at any time (but see the note below).

If you leave an item blank by either not clicking or entering a response, you may be warned that you missed one, just in case it was an accident.

Some items may require a response to accurately present the survey.

Risks & Discomforts: This study does not expose you to any risks greater than those encountered in your daily life.

Benefits:

Benefits to you: There are no direct benefits to you.

Benefits to the field of science or the community: your participation will help us to better understand the effects state and trait anxiety may have on attention in a college population.

Identifiable Information: You will NOT be asked to provide identifiable personal information/You may provide contact information for follow-up / We may request your contact information for compensation purposes.

Compensation: There is no compensation for participating in this study. Some students may sign up for this study through SONA in order to earn class credit or as an extra credit opportunity by professor. Otherwise, no compensation will be provided.

Confidentiality. All efforts, within reason, will be made to keep your personal information private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, if you or someone else is in danger or if we are required to do so by law.

I have read this informed consent document pertaining to the above identified research.

The research procedures to be conducted are clear to me.

I confirm I am 18 years or older.

I am aware of the potential risks of the study.

Appendix B: Demographics Questions

What Gender do you identify as?

Male

Female

Non Binary/3rd Gender • Other

Prefer not to say

What is your age?

Are you currently or have you ever received psychotherapy for anxiety or depression?

Currently

In the past month

In the last 6 months

In the past year

More than a year ago

Never

Prefer not to say

Please list any diagnosis you have had of an anxiety disorder. (Type N/A if you are if you have never been diagnosed with an anxiety disorder or prefer not to say).

Please list any medication you are currently prescribed for anxiety or attention-deficit/hyperactivity disorder (ADHD). (Type N/A if you are not currently prescribed any medication).

Are you currently taking any prescribed or nonprescribed psychotropic medication? (e.g., Anti-depressant, SSRIs, stimulants, mood stabilizers, or antipsychotics).

Yes

No

Are you currently taking any drugs or substances (illegal or legal) recreationally?

Yes

No

Have you ever had a severe head injury (i.e., concussion, TBI)?

Yes

No

What is your Ethnicity? (Select all that apply)

White

Hispanic or Latino

Black or African American

Asian

Native Hawaiian or Pacific Islander
Mixed Ethnicity
Other

Are you a student at MTSU?
Yes
No

Are you currently enrolled as an undergraduate or graduate student in a college or university that is NOT Middle Tennessee State University?
Yes
No

Appendix C: IRB Approval Letter

Date: May 8, 2023

PI: Jacob DeSoto

Department: Middle Tennessee State University, Psychology

Re: Initial - IRB-FY2023-122

Effects of Anxiety on Attention-based Tasks in a College Population

The Middle Tennessee State University Institutional Review Board has rendered the decision below for Effects of Anxiety on Attention-based Tasks in a College Population.

The approval is effective starting May 5, 2023.

Decision: Approved

Category: 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Findings:

Research Notes:

Please note:

Any **modifications to the approved study must be submitted for review through Cayuse IRB**. Please note, as well, that according to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to complete the required training. If you add researchers to an approved project, please add them to the project within Cayuse IRB for approval **before** they begin to work on the project.

Any unanticipated harm to participants or adverse events must be reported to the Office of Compliance, and any subsequent changes to the protocol must be submitted to the IRB for review before implementing this change.

You must submit an end-of-project form to the Office of Compliance upon completion of your research. Completed research means that you have finished collecting data.

All research materials must be retained by the PI or faculty advisor (if the PI is a student) for at least three (3) years after study completion and then destroyed in a manner that maintains confidentiality and anonymity.

All approval letters and study documents are located within the Study Details in Cayuse IRB.

We wish you a successful research project,

Middle Tennessee State University Institutional Review Board

Appendix D: Debriefing Statement

DEBRIEFING STATEMENT

Thank you for your participation! Your information will help us better understand the role of anxiety in attention for university students. If you have any questions concerning the research study, please contact me at Jrd8m@mtmail.mtsu.edu. Alternatively, you may contact my faculty advisor, Dr. Jessica Gaby, (615) 898-5640 or Jessica.gaby@mtsu.edu. Please click continue one more time to submit your responses for this study.

If, after participating in this study today, you have concerns about your experiences with anxiety or aspects of your mental health, the following resources have professionals who might be able to help you. Feel free to contact any of these service providers directly should you want help with any concerns about your emotional health.

MTSU Counseling Services KUC 326-S

(615) 898-2670

Office Hours:

Monday-Friday 8:00am-4:30pm

For after-hour emergencies call Mobile Crisis: 1-800-704-2651. Or go to the nearest emergency room. The Guidance Center/Volunteer Behavioral 1504 Williams Drive Murfreesboro, TN 37129 Phone: (615)898-0771 Fax: (615)849-2333 Hours of Operation: Monday-Friday 8:00am-5:00pm.

The following hotline can provide resources to mental health care providers in most states and U.S. providences National Alliance on Mental Illness (NAMI): 1-800-950-NAMI (6264).