THE INFLUENCE OF ANTICIPATORY PROCESSING ON VISUAL AND VERBAL WORKING MEMORY TASK PERFORMANCE

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Abstract: Cognitive models of Social Anxiety Disorder (SAD; e.g., Clark & Wells, 1995) have implicated anticipatory processing, an anxiety-related form of repetitive negative thinking, in the maintenance of SAD symptoms. However, research has yet to examine potential mechanisms responsible for symptom maintenance. In the current study, participants high (HSA; N = 45) and low (LSA; N = 45) in social anxiety symptoms engaged in either an anticipatory processing or distraction task and then completed verbal and visual working memory tasks. HSAs who engaged in anticipatory processing demonstrated lower performance on the visual working memory task relative to the other groups, suggesting that anticipatory processing impairs visual working memory. There were no differences among any groups on verbal working memory task scores. This study advances the literature on the importance of imagery in SAD. It also underscores importance of examining anticipatory processing in the social anxiety and repetitive negative thinking literatures.

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CHAPTER I

INTRODUCTION

Social anxiety disorder (SAD) is characterized by fear of negative evaluation in social interactions and/or performance situations (American Psychiatric Association, 2013). It is among one of the most commonly diagnosed anxiety disorders, with over 25 million individuals affected (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). Those with SAD experience poorer outcomes in most life domains, including economic, academic, occupational, social, medical, and psychological (Leon, Portera, & Weissman, 1995; Mogotsi, Kaminer, & Stein, 2000) functioning compared to matched healthy controls.

Despite the prevalence and impairment associated with SAD, research has been somewhat limited until recently (Liebowitz, Gorman, Fyer, & Klein, 1985). However, comprehensive models of SAD have gained empirical support in the last two decades. Specifically, cognitive models of SAD (Clark & Wells, 1995; Rapee & Heimberg, 1997) have implicated attention, interpretation, imagery, and repetitive negative thoughts in symptom maintenance. Research supports the link between these domains and SAD (Amir & Bomyea, 2010), but the majority of studies have examined cognitive processes in isolation, despite findings that these processes interact (Hirsch, Clark, & Mathews, 2006). Therefore, the purpose of the current study was to integrate the literature on

attention, which is commonly studied in SAD, and anticipatory processing, which is a rarely-studied repetitive negative thought style that has recently been implicated in SAD.

Cognitive research in SAD has drawn upon several basic models of attention. Baddeley (Baddeley & Hitch, 1974; Baddeley, 2000) suggests that attention consists of the interaction between a phonological loop that stores and rehearses verbal information, a visuospatial sketchpad that stores and rehearses visual information, an episodic buffer that links the phonological loop and visuospatial sketchpad (Baddeley, 2000), and a domain-general central executive that is involved with attentional focusing, shifting, and inhibition. Studies examining anxiety from this framework have found that anxiety mostly impairs central executive performance (Coy, O'Brien, Tabaczynski, Northern, & Carels, 2011; Eysenck, Payne, & Derakshan, 2005), but the phonological loop also can be impaired if the anxiety results in verbal cognitions (e.g., negative-self talk; Coy et al., 2011). Despite promising results examining the effect of anxiety on the phonological loop, research examining the influence of anxious imagery on visual working memory has been limited.

Cowan (1999; 2005) proposed an alternative model of working memory that generally focused on characteristics and functions of processes that Baddeley labeled as the central executive. Cowan (1999; 2005) suggested that attentional focus is limited in capacity and is controlled by both voluntary and involuntary processes. For example, individuals can use conscious processes to focus attention on tasks, but salient (e.g., loud, novel) and/or self-relevant (e.g., hearing your name) stimuli can automatically distract an individual's attention from the target task.

Both Baddeley's and Cowan's models suggest that attention is limited by capacity. Therefore, taxing working memory drains available resources, resulting in either impaired

performance or increased allocation of resources to maintain performance (Eysenck, Derakshan, Santos, & Calvo, 2007). Resource depletion appears to be domain-specific, such that engaging in purely verbal tasks mostly interferes with the phonological loop, but not the visuospatial sketchpad. Similarly, engagement in purely visual tasks appears to primarily tax the visuospatial sketchpad (e.g., Baddeley, 2012).

Research suggests that anxiety reduces attentional resources (Eysenck et al., 2007), resulting in automatic processes taking control of attention (Teachman, Joorman, Steinman, & Gotlib, 2012). For example, Amir and Bomyea (2011) found that trait socially-anxious participants had poorer performance than nonanxious controls on a working memory task with neutral stimuli, suggesting reduced attentional control. However, when the task was repeated with social-threat words (e.g., *foolish*, *blushing*), SAD participants demonstrated equal performance to nonanxious controls. Furthermore, the SAD group had better task performance for threat words compared to neutral words, suggesting that threatening words were processed with greater ease (e.g., automatically). These findings were consistent with the multitude of research that suggests socially-anxious individuals have biased processing toward threat-relevant stimuli (e.g., Schultz & Heimberg, 2008). Therefore, reduced attentional control could be a mechanism of the maintenance of anxiety symptoms; however, more research is needed on factors that influence the relationship between anxious and attentional processes. One such factor could be anticipatory processing.

Clark and Wells (1995) suggested that individuals high in social anxiety symptoms (HSAs) engage in repetitious negative thought called *anticipatory processing* (AP) prior to social interactions. AP has been hypothesized to include intrusive memories of past failures, negative images of the self, catastrophic images about what could go wrong during the

upcoming interaction, and plans to escape or avoid the interaction (Hinrichsen & Clark, 2003). Clark and Wells (1995) argued that AP results in an internal shift of attentional focus in order to monitor sensations of anxiety. The function of this internal attentional shift is to facilitate the identification of physical signs of anxiety that could indicate to others that the HSA individual is anxious. Ironically, as a result of this intense self-focused attention, HSAs become more anxious, attend less to the interaction, and experience a negative evaluation of the interaction (Clark & Wells, 1995). This provides confirmatory evidence to HSAs that they lack social prowess, and this confirmation maintains their anxiety in social situations. AP research has determined that it results in anxiety (Hinrichsen & Clark, 2003; Schulz, Alpers, & Hofmann, 2008; Vassilopoulos, 2005; Wong & Moulds, 2011), negative self-images (Vassilopoulos, 2005), self-focused attention, and negative interpretations (Mills, Grant, Judah, & Lechner, 2014; Mills, Grant, Judah, & White, 2014). Mills and colleagues (2013) identified a two-factor model of a common measure of AP (Anticipatory Social Behaviours Questionnaire; Hinrichsen & Clark, 2003), which suggested that AP could serve both avoidance and preparatory functions. In their study, those who tended to utilize the avoidance function experienced negative outcomes, whereas the preparatory function was unrelated to negative or positive outcomes (Mills, Grant, Lechner, & Judah, 2013). However, despite promising research, researchers have yet to test *how* AP maintains SAD.

One approach to answering this and other questions may be to examine how processes interact with each other. Researchers have yet to fully examine how cognitive processes interact, which significantly limits the extant research. Recent research suggests that AP affects attention (Mills et al., 2014a; Mills et al., 2014b), but it is unclear how this leads to the maintenance of social anxiety. One possibility may by that AP consumes

resources, leaving HSAs with fewer resources with which to devote to interactions. Although this was suggested almost twenty years ago (Clark & Wells, 1995), no research has examined the influence of AP on cognitive resources. Similar questions in the worry (Hayes, Hirsch, & Mathews, 2008) and rumination (Joormann, Levens, & Gotlib, 2011) literatures suggest that those who tend to worry and ruminate experience impaired attentional resources during those processes (Hayes et al., 2008) or when attending to negative stimuli (Joormann et al., 2011). Therefore, the first aim of the current study was to evaluate the degree to which anticipation results in task interference, which can implicate taxed attentional resources as a mechanism of symptom maintenance.

Secondly, AP is hypothesized to consist of both verbal and imagery components (Hinrichsen & Clark, 2003), but this has not been tested. Therefore, the second aim of this study was to examine impairment between verbal and visual tasks. This information has important implications. Verbal thought processes are hypothesized to facilitate cognitive avoidance from negative imagery (Borkovec, Alcaine, & Behar, 2004; Newman & Llera, 2011), suggesting that one function of AP is to avoid distressing images. This cognitive avoidance may serve as an attempt to prepare for the upcoming interaction by minimizing negative imagery. On the other hand, image-based thought processes are associated with marked negative emotional responses (Lang & McTeague, 2009), suggesting that the function of AP could be to activate the fear response and facilitate behavioral avoidance. This would suggest that AP maintains social anxiety by preventing habituation or by preventing exposure to evidence that disconfirms the negative beliefs of HSAs. By understanding the degree to which AP is verbal and/or image-based, this study can provide information about the function of the process and therefore inform treatment strategies. This

question is particularly important, as SAD appears to fall in between acute fear-related anxiety disorders (e.g., specific phobia) and chronic anxious arousal disorders (e.g., generalized anxiety disorder; Lang & McTeague, 2009; McTeague & Lang, 2012; McTeague et al., 2009) based on psychophysiological reactions to fear-related imagery (i.e., skin conductance, heart rate variability, affective modulation of the startle response).

A core tenant of attention models suggests that engaging in concurrent verbal tasks impairs phonological loop performance, but has minimal effects on visual tasks, and vice versa, suggesting that these systems are somewhat independent (e.g., Baddeley, 2012). Therefore, if the cognitive processes that occur during AP are primarily verbal, we would expect more impairment in verbal memory tasks compared to visual memory tasks. Similarly, if AP is primarily associated with intrusive imagery, we would expect more impairment in visual tasks relative to verbal tasks.

A tertiary aim of the current study was to examine the effects of AP on physiological data. Preliminary results of a pilot study in our lab suggest that individuals ($N = 30$) engaging in an AP task experience increases in skin conductance and decreases in respiratory sinus arrhythmia (RSA) relative to a relaxation task. Other studies examining AP (Schulz et al., 2008; Wong & Moulds, 2011) have noted similar increases in skin conductance (Wong & Moulds, 2011) and decreases in RSA (Schulz et al., 2008), but no other studies have included psychophysiological assessment in the study of AP. These data can provide information beyond anxiety, as physiological arousal can serve as an indicator of cognitive activity (Muth, Moss, Rosopa, Salley, & Walker, 2012), which could provide additional evidence that participants are indeed engaging in anticipatory thoughts.

In the current study, participants high (HSA) and low (LSA) in social anxiety engaged in an AP or distraction task prior to a perceived social interaction. After engaging in anticipation or distraction, they completed counterbalanced visual and verbal cognitive load tasks. It was expected that HSAs engaging in AP would demonstrate impaired performance on both tasks compared to HSAs in the distraction task and LSAs in either task (See Figure 1). Furthermore, because AP is hypothesized to be associated with distressing imagery, we expect visual task performance to be more impaired than verbal task performance for HSAs in the anticipation condition. For physiological data, it was expected that HSAs in the Anticipation condition would have the highest mean skin conductance and lowest mean RSA during the manipulation compared to other groups, which would suggest that they were experiencing the highest levels of anxiety as a result of the manipulation. We also expect that these significant differences would be maintained throughout the remainder of the study.

CHAPTER II

METHODOLOGY

Participants

Participants high and low in social anxiety symptoms were recruited from the participant pool at a large Midwestern university. HSAs consisted of participants who scored at or above the cutoff (28) on the straightforward version of the Social Interaction Anxiety Scale (S-SIAS; Mattick & Clarke, 1998; Rodebaugh et al., 2011; Rodebaugh, Woods, & Heimberg, 2007). LSAs consisted of participants who scored at or below 20, which is the mean score of primarily-Caucasian Midwestern college students. Participants were recruited based on their scores on the S-SIAS and were readministered the S-SIAS at the time of participation. Out of the 114 individuals who participated in the study, 20 were removed from analyses because they no longer met criteria for HSA or LSA status based on their S-SIAS scores. Four participants were removed from analyses due to outliers (scores +3.29) on state affect questionnaires that were completed during the study. Therefore, the final sample included 90 participants (45 HSA and 45 LSA). Participants had a mean age of 19.90 (SD = 3.50) and were primarily female (74.4%), heterosexual (96.3%), and Caucasian (73.3%). HSA and LSA participants were equally distributed across conditions ($p = 1.00$) and had equal sex distribution ($p = .60$). Similarly, men and women were equally represented across conditions ($p = .55$). There

were no significant differences in age, trait social anxiety, AP, depression, rumination, worry, generalized anxiety disorder symptoms, attentional control, cognitive failures, state distress, or state positive affect (*p*s ranged from .07 for cognitive failures and .10 for depression to .95 for social anxiety; see Table 1). Therefore, it appears that random condition assignment was successful. However, those in the Anticipation condition had significantly higher state negative affect at the beginning of the study (i.e., "Time 1") than those in the Distraction condition ($p = .02$). This cannot be explained by differences in conditions, as the manipulation had not occurred at this point in the study. Therefore, we controlled for Time 1 negative affect for our primary analyses in order to rule it out as a confound.

The HSA and LSA groups differed on all trait symptom and repetitive negative thinking measures (all *p*s < .005), with HSAs consistently scoring higher (see Table 2). HSAs also reported more cognitive failures ($p < .001$). There was no difference in attentional control ($p = .09$) scores. HSAs had lower state positive and higher state negative affect at the beginning of the study, but HSAs and LSAs did not differ in state subjective distress ($p = .44$). See Table 2 for more details.

A priori power analyses were conducted based on a 2 (Condition; Anticipation, Control) X 2 (SA Group; HSA, LSA) X 2 (Task Order; Verbal First, Visual First) design. Similar studies in our laboratory have resulted in interaction effect sizes (f) of approximately .40. To achieve this effect size with this design, it was estimated that a sample of 74 (37 HSA, 37 LSA) participants will be needed. Therefore, our sample of 90 (45 HSA; 45 LSA) had adequate power.

Measures

Participants completed several self-report questionnaires to assess for trait symptoms of AP and other forms of repetitive negative thought (i.e., worry and rumination), trait symptoms of social anxiety and depression, and everyday difficulties with attention and memory. These measures included:

Anticipatory Social Behaviours Questionnaire (ASBQ; Hinrichsen & Clark, 2003; Appendix C). The ASBQ is a 12-item measure that assesses the degree to which individuals engage in AP prior to a social interaction. Items are scored on a 1 (Never) to 4 (Always) scale. The total scale (α = .83 to .88) and Avoidance subscale (α = .82) have been shown to have good internal consistency, whereas the reliability of the Preparation subscale (α = .73) seems to be adequate (Mills et al., 2013). The reliability in the current study was excellent for the full ASBQ (α = .91) and good for the Avoidance (α = .85) and Preparation (α = .83) subscales.

Attentional Control Scale (ACS; Derryberry & Reed, 2002; Appendix D). The ACS is a 20-item measure that assesses trait attentional focusing and shifting. Items are rated on a 1 (Almost Never) to 4 (Always) scale. Reliability for the full scale (α = .82) and Focusing subscale are good (α = .81 to .82) and reliability for the Shifting subscale is adequate (α = .71 to .73; Judah, Grant, Mills & Lechner, 2014). In the current study, the reliability of the full scale was good (α = .81) and adequate for the Focusing (α = .78) and Shifting (α = .71) subscales.

Center for Epidemiological Studies - Depression Scale (CES-D; Radloff, 1977; Appendix E). The CES-D is a 20-item measure that assesses depressive symptoms experienced during the previous week. Responses range from 0 (Rarely or none of the time) to 3 (Most or all of the time). The CES-D has been found to have good

internal consistency (α = .85 for general population and .90 for a clinical sample; Radloff, 1977). It had excellent (α = .90) reliability in the current study).

Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, Fitzgerald, & Parkes, 1982; Appendix F). The CFQ is a 25-item measure that assesses common cognitive lapses in everyday life (e.g., failing to listen to people's names when meeting them, forgetting appointments). Items are rated on a 0 (Never) to 4 (Very Often) scale. The CFQ has good internal consistency (Broadbent et al., 1982). In the current study, the reliability of the CFQ was excellent (α = .91).

Demographics Form (Appendix G). The demographics form assessed participants' gender identity, LBGT identification, age, ethnicity, birthplace, primary language, GPA, and year in school.

Extended Post-Event Processing Questionnaire (E-PEPQ; Fehm, Hoyer, Schneider, Lindemann, & Klustmann; 2008; Appendix H). The E-PEPQ is an 18-item measure that is an extension and psychometric improvement upon the original Post-Event Processing Questionnaire (Rachman, Grueter-Andrew, & Shafran, 2000). This measure asks participants to think of a recent negative social event and answer questions related to that event. The E-PEPQ has been found to have high internal consistency (α = .90; Fehm et al., 2008). In the current study, reliability was excellent (α = .96).

Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990; Appendix I). The PSWQ is a 16-item measure that assesses frequency of worry. Items are rated on a 1 (Never) to 5 (Always) scale. The PSWQ has excellent internal consistency (α > .90; Meyer et al., 1990). For the current study, the reliability of the PSWQ was also excellent (α = .94).

Ruminative Responses Scale (RRS; Nolen-Hoeksema & Morrow, 1991; Treynor, Gonzales, & Nolen-Hoeksema, 2003; Appendix J). Treynor and colleagues (2003) revised the original RRS (Nolen-Hoeksema & Morrow, 1991) by removing items that were confounded with depressive symptoms, resulting in a scale that only assessed rumination as a cognitive process. The revised RRS contains 10 items and assesses ruminative thoughts that map onto two subscales, Brooding (negatively-valenced and self-blaming) and Reflection (nonjudgmental and focused on problem-solving). Responses range from 1 (Almost Never) to 4 (Almost Always). The revised RRS has good internal consistency (α = .90; Treynor et al., 2003). In the current study, reliability was good for the full scale (α = .89), the Brooding subscale (α = .83), and the Reflection subscale (α = .85).

Social Interaction Anxiety Scale, Straightforward Version (S-SIAS; Mattick & Clarke, 1998: Rodebaugh et al., 2007; Rodebaugh et al., 2011; Appendix K). The S-SIAS is a 17-item assessment of anxiety experienced during social interactions. The S-SIAS is a modified version of Mattick and Clarke's (1998) original SIAS. Rodebaugh and colleagues (2007) found that reverse-scored items on the SIAS reduced construct validity and suggested dropping the items from the scale. The S-SIAS has excellent internal consistency (α = .93; Rodebaugh et al., 2007; 2011). In the current study, reliability was also excellent (α = .93).

The following measures were given to participants at various times throughout the study (see Figure 2).

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988; Appendix L). The PANAS was used as a measure of state affect several times

throughout the study. The PANAS consists of 10 positive affect (e.g., enthusiastic, inspired, relaxed) and 10 negative affect (e.g., anxious, hostile, angry) items that are rated on a 1 (Not at all) to 5 (Extremely) scale. Participants were asked to rate how they feel at the current moment. This scale can be completed quickly and is psychometrically strong, despite its brevity (Watson et al., 1988). Participants completed the PANAS with the trait questionnaires at the beginning of the study (Time 1), after the AP or Distraction Tasks (Time 2), and at the end of the study (Time 3). Reliability ranged from good-to-excellent for both scales at all three time points. For the Positive Affect subscale, $\alpha = .90$ at Time 1, .91 at Time 2, and .89 at Time 3. For Negative Affect, $\alpha = .84$ at Time 1, .82 at Time 2, and .82 at Time 3.

Subjective Units of Distress (SUDS). Participants were asked to rate the extent to which they felt "either anxious, nervous, uncomfortable, or distressed" on a scale that ranged from 0 (no discomfort) to 100 (intense discomfort). Similar assessments have been used in other studies of AP (Hinrichsen & Clark, 2003; Mills et al., 2014a; Schulz et al., 2008; Wong & Moulds, 2011). This question was administered during the same three time points as the PANAS. At Time 1, participants were asked to rate their current distress "at the moment," because they were not informed about the social interaction until later in the study. At Time 2 and Time 3, participants were asked to rate their current distress "about the upcoming social interaction."

Strategy Use Questionnaire (STQ; Brown & Wesley, 2013; Appendix M). The STQ is a 5-item measure that assesses the degree to which participants used visual or verbal strategies during the completion of a task. The STQ was developed to be used with the modified Visual Patterns Test (VPT; Brown, et al., 2006). For the current study,

a second, modified version of the STQ was constructed and administered after the verbal task as well.

Manipulation Check Questionnaire (Appendix N). The manipulation check questionnaire is a 20-item measure generated by the researchers and used in previous studies (Mills et al., 2014a; Mills, Grant, Judah, & White, 2014). The first question displays 18 prompts to participants and asks them to indicate whether they were asked to think about each prompt during the study. Six of the prompts consisted of the prompts from the Anticipation condition, six consisted of the prompts from the Distraction condition, and the remaining six were filler prompts. The filler prompts consisted of three rumination prompts and three distraction prompts taken from Nolen-Hoeksema and Morrow (1993).

Another manipulation check question asked participants to rate the extent to which they were thinking about the prompts during the attention tasks using a 0 (I did not think about the prompts at all during the tasks) to 10 (I thought of the prompts the entire time I completed the task) scale (Mills et al., 2014a; Mills et al., 2014b).

Early in the study, participants were informed that they would be engaging in a social interaction later in the study; however, no interaction took place. In order to determine the extent to which participants believed the interaction was going to happen, a final manipulation check question asked participants to rate how much they believed that an interaction would take place on a 0 (I was completely convinced there would NOT be an interaction) to 10 (I was completely convinced there WOULD be an interaction) scale (Mills et al., 2014a; Mills et al., 2014b). Because this question confirms that no interaction will take place, it was administered last.

Procedure

Each participant completed the informed consent process with the researcher. Then, participants completed the aforementioned trait questionnaires, which were administered via computer. After the participant completed the questionnaires, the researcher escorted him/her to a desk that contains a monitor, mouse, and intercom.

Physiological Hook-Up. Physiological data were collected using the BIOPAC MP150 hardware system and AcqKnowledge 4.0 data acquisition and analysis software. Electrocardiograph (heart rate) data was recorded by three electrodes. Electrodes were placed in a three-lead configuration, consistent with previous literature (Porges, 2007). The experimenter demonstrated the correct placement of electrodes and then left the room while the participant placed them on himself/herself. The participant communicated with the researcher via intercom to let the researcher know when the electrodes have been placed. For skin conductance, electrodes were placed on the middle segment of the 1st and 3rd fingers. The overall sampling rate was set at 1000 Hz, which matched the highest sampling rate needed for the study (heart rate). Before beginning any study tasks, the researchers ensured that the electrodes were working properly.

Relaxation. To allow habituation to the electrodes, the participant was instructed to engage in a 5 minute relaxation period.

Social Threat. After the relaxation period, participants were told that later in the study they would be engaging in a social interaction with a researcher in order to examine their social skills. Because AP is hypothesized to influence HSAs prior to a social interaction, it was important that they believed that a social interaction was upcoming while they engaged in AP.

Manipulation. The participant was then instructed to engage in AP or a distraction task, depending on their random condition assignment. Those in the Anticipation condition saw six AP instructions (Hinrichsen & Clark, 2003) on a computer screen (Appendix B). Participants in the distraction condition saw six prompts about random stimuli (e.g., "Think about the shape of a black umbrella," "Think about the baggage claim area at the airport"). Prompts were displayed individually for 45 seconds each, for a total of 4.5 minutes. The color, size, location, and duration of the prompts were equivalent between conditions. After the prompts, participants completed the PANAS and SUDS.

This manipulation has been successfully used in the past (Mills et al., 2014a; Mills et al., 2014b) to induce AP in those assigned to the Anticipation condition and to generally prevent participants from engaging in AP during the Distraction condition.

Attention Tasks. Participants completed separate visual and verbal working memory load tasks during the study. The visual task was the Visual Patterns Test (VPT) used by Brown and colleagues (2006) that consists of ambiguous patterns that cannot easily be encoded verbally. For each trial of this task, participants viewed a fixation cross for one second, followed by the stimulus image, which is a matrix of varying complexity, for 3 seconds, followed by a blank slide for 10 seconds, followed by an untimed slide with an empty matrix that matches the size and shape of the original stimulus matrix (see Figure 3). Participants used a computer mouse to click in the cells that were previously presented in black. Research assistants used a template form to mark correct cells and trials as the participant completed the task. The dimensions of the matrices ranged from 2 x 2 to 5 x 6. The matrices were designed to prevent the use of

verbal strategies. For example, the cells in each matrix are arranged so they do not resemble letters, words, shapes, or figures (Brown et al., 2006).

The verbal task was based on Joorman and colleagues (2011). During this task, participants saw a fixation cross for one second, then 3-7 neutral words for three seconds, a black screen for 10 seconds, and then an untimed slide with the word "Recall." Participants repeated the words back in the order in which they were presented (see Figure 3). Research assistants listened to the participant through an intercom and marked whether individual words and entire trials were recalled successfully. The words were chosen from the Affective Norms for English Words (ANEW) database (Bradley & Lang, 1999). Words in the ANEW database vary by arousal level, affective valence, and length. For the current study, words that were 5-7 characters long and rated as unarousing and affectively neutral were randomly chosen for this task. For both the visual and verbal tasks, participants completed 45 trials of varying complexity with a 30 second break after the 15th and 30th trial.

The tasks were counterbalanced, so some participants completed the visual task first, whereas the others completed the verbal task first. After both tasks were completed, participants completed the STQ once for each task. Each version of the STQ had slightly modified wording from the original version to specify for which task the STQ should be completed. Participants also completed the PANAS and SUDS at this time.

Manipulation Check. Participants were asked to complete the manipulation check questionnaire after completing both of the attention tasks. Then, the researcher informed the participants that there would not actually be a social interaction and administered the Belief in Interaction question.

Debriefing. At the end of the study, the researcher instructed the participant how to remove the electrodes. The researcher explained the nature of the study and provided the participant with a debriefing form.

CHAPTER III

RESULTS

Analytic Strategy

Data were cleaned as suggested by Tabachnick and Fidell (2007). Skewness and kurtosis values were examined in order to assume normality of the data, with skewness values of $\geq$ |2.0| and kurtosis values $\geq$ |4.0| used as cutoffs. The PANAS Negative Affect scale had skewness and kurtosis values that exceeded these cutoffs at both Time 1 and Time 2. After participants with significant outliers (z +/-|3.29|) were removed from these analyses ($N = 4$), no variables exceeded either of these metrics of non-normality. No other outliers were identified in the data.

Levene's test was used to examine variance homogeneity for each analysis, although the analyses were robust to violations of homogeneity of variance because the ratio of largest-to-smallest cell size was 1:1, which did not exceed the 4:1 cutoff recommended by Tabachnick and Fidell (2007).

Attention Task Performance

A 2 (Condition; Anticipation, Control) X 2 (Group; HSA, LSA) X 2 (Task Order; Verbal First, Visual First) mixed MANCOVA was used to examine the differences in task performance (i.e., number of correct trials) between social anxiety groups,

conditions, and the interaction of the two. MANCOVA was used due to the interdependence of visual and verbal cognitive load scores (r = .30, p = .005; Stevens, 2009), and due to significant differences between conditions in Time 1 Negative Affect, this variable was added as a covariate. Levene's test was not significant for Verbal and Visual trial scores (both ps = .45). Box's test also was not significant (p = .60), suggesting that covariance matrices did not differ.

There was a significant SA Group X Condition interaction (F[2, 80] = 3.56, p = .03, η^2 = .08) that was specific to the Visual task (F[1, 81] = 7.04, p = .01, η^2 = .08). The SA Group X Condition interaction was not significant for Verbal task scores (p = .73; see Figure 4). Follow-up analyses with Bonferroni correction revealed that, as hypothesized, HSAs in the Anticipation condition (M = 19.64, SD = 4.54) had lower Visual task scores than LSAs in the Anticipation condition (M = 22.66, SD = 4.42; p = .03), but scores did not differ between HSAs and LSAs in the Distraction condition (p = .17). Similarly, HSAs in the Anticipation condition had significantly lower Visual task scores than HSAs in the Distraction condition (M = 22.43, SD = 4.36; p = .04), but LSAs' scores did not differ between conditions (p = .12; Figure 4).

There was a main effect of Task Order (F[2, 80] = 3.56, p = .03, η^2 = .08) that was specific to the Verbal task (p < .01), such that participants had higher scores on the Verbal task when they completed it first (M = 9.92, SD = 2.87) compared to when they completed it after the Visual task (M = 8.24, SD = 3.00). However, Task Order did not interact with any other factors (ps range from .44 to .66). There were no other significant main effects or interactions.

Subjective Distress (SUDS)

For SUDS scores, Mauchly's Test of Sphericity was significant, suggesting that the error covariance matrices between various levels of the repeated-measures DVs were not equal. Therefore, the Greenhouse-Geisser correction was used for these analyses (Stevens, 2009).

There was a significant Time X SA Group interaction for SUDS (F[1.57, 134.85) = 18.48, $p < .001$, $\eta^2 = .18$). Follow-up analyses with Bonferroni correction revealed no difference in Time 1 SUDS levels between SA Groups ($p = .45$), but HSAs reported higher SUDS values at Times 2 ($M = 33.24$, $SD = 24.43$) and 3 ($M = 33.44$, $SD = 22.10$) relative to LSAs ($M = 12.91$, $SD = 15.80$ and $M = 16.16$, $SD = 20.56$, respectively; ps both < .001). LSAs experienced a significant drop in SUDS from Time 1 to Time 2 (p < .001) that did not change at Time 3 ($p = .35$), whereas HSAs' SUDS did not change from Time 1 to Time 2 ($p = .10$) or from Time 2 to Time 3 ($p = 1.00$).

There also was a significant SUDS X Condition interaction (F[1.57, 134.85] = 3.24, $p < .05$, $\eta^2 = .07$). Follow-up analyses with Bonferroni correction found that participants in the Anticipation and Distraction conditions did not differ in SUDS scores at Time 1 ($p = .62$), but those in the Anticipation condition had higher ($p = < .01$) SUDS ratings at Time 2 ($M = 28.87$, $SD = 24.21$) and marginally higher ($p = .07$) SUDS ratings at Time 3 ($M = 28.87$, $SD = 25.09$) compared to those in the Distraction condition (M = 17.29, SD = 20.07; $M = 20.64$, $SD = 21.91$, respectively). Over the course of the study, those in the Anticipation condition had minimal change in SUDS scores (ps = 1.0), but those in the Distraction condition experienced a significant drop from Time 1 to Time 2 ($p < .01$) and no change from Time 2 to Time 3 ($p = .32$).

State Affect (PANAS)

Because of the unexplained Time 1 difference in Negative Affect between conditions, analyses were not performed for the remaining time points. For Positive Affect (PA), there were no significant effects.

Physiology

For physiological analyses, the study was divided into five separate time points, corresponding to the main tasks of the study. These included Task 1 (Relaxation), Task 2 (Social Threat and Manipulation/Thinking Prompts), Task 3 (Attention Task 1), Task 4 (Attention Task 2) and Task 5 (Final Measures).

Mauchly's Test of Sphericity was again significant ($p < .001$) for both SC and RSA analyses, so Greenhouse-Geisser corrections were used in both cases. There were no significant two- or three-way interactions between Time, SA Group, and/or Condition for mean skin conductance (SC) scores, and, contrary to expectations, there were no main effects for SA Group ($p = .85$) or Condition ($p = .79$). There was a main effect for Task ($F[1.53, 128.23] = 130.01$, $p < .001$, $\eta^2 = .61$). Specifically, skin conductance significantly increased at each time point (all ps $< .001$) except between Tasks 4 and 5 ($p = 1.00$).

For RSA, after Greenhouse-Geisser corrections, there were two marginally-significant interactions for Task X SA Group ($p = .07$) and Task X Condition ($p = .07$). For the Task X SA Group interaction, HSAs had marginally lower RSA values at Task 2 ($p = .07$) than LSAs, but their RSA did not differ at any other time points. LSAs experienced no significant change in RSA throughout the study (ps ranged from .15 to 1.00), but HSAs experienced a significant drop from Task 1 to Task 2 ($p < .001$), a significant increase from Task 2 to Task 3 ($p = .01$), no change between Tasks 3 and 4

(the attention tasks; $p = 1.00$), and then another significant drop from Task 4 to Task 5 ($p = .01$).

For the Task X Condition interaction, those in the Anticipation and Distraction conditions did not have any significant differences at any time point (ps ranged from .26 to .72). Throughout the study, those in both conditions experienced drops in RSA from Task 1 to Task 2 (Anticipation $p < .001$, Distraction $p = .03$), but those in the Anticipation condition experienced no additional significant changes during the study. On the other hand, those in the Distraction condition experienced a significant increase in RSA from Task 2 to Task 3 ($p = .01$), no change between Tasks 3 and 4 ($p = 1.00$) and a significant drop from Tasks 4 to 5 ($p < .05$).

Manipulation Checks

The physiological data and SUDS data suggest that the manipulation was effective. Specifically, those in the Anticipation condition reported higher SUDS ratings after the manipulation (and a marginally higher SUDS rating prior to the social interaction) than those in the Distraction condition. Furthermore, those in the Anticipation condition demonstrated a decrease in RSA during the manipulation that remained unchanged throughout the study, whereas those in the Distraction condition demonstrated a significant increase in RSA during the attention tasks, potentially suggesting a decrease in anxiety during those tasks.

Belief in Interaction. Participants generally believed there would be a social interaction at the end of the study ($M = 6.74$, $SD = 2.66$, with 0 = *I was absolutely convinced there would NOT be an interaction* and 10 = *I was absolutely convinced that*

there would be an interaction). This did not differ between SA Groups (p = .25) or Condition (p = .26), or the interaction of the two (p = .70).

Thought Prompts During Attention Tasks. Participants reported that they generally did not think about the prompts during the attention tasks (M = 2.29, SD = 2.82, with 0 = *I did not think about the prompts at all during the tasks* and 10 = *I thought of the prompts the entire time I completed the tasks*). This also did not differ between SA Groups (p = .89), Conditions (p = .28), or their interaction (p = .29).

Images and Words During Prompts. Participants experienced mostly images (with some verbal content) during the manipulation (M = 2.09, SD = 1.29, with 1 = *Almost all images*, 3 = *Half images/Half words*, and 5 = *Almost all words*). Those in the Distraction condition experienced almost entirely imagery (M = 1.05, SD = .23), whereas those in the Anticipation condition experienced more of a balance between images and words (M = 2.59, SD = 1.29; $p < .001$). This is consistent with at least one previous study that has found the Distraction condition to be more imagery-laden than the Anticipation condition (Mills et al., 2014a). The SA Groups experienced the same levels of imagery during the prompts (p = .75) and there was no significant SA Group X Condition interaction (p = .96).

Memory for Thinking Prompts. Participants were tested on their ability to distinguish between thinking prompts they were administered versus those they were not. Out of the 18 prompts, participants generally were successful in remembering prompts that they viewed (M = 17.56, SD = .87), and there were no differences in SA Group (p = .44), Condition (p = .32), or the interaction of the two (p = .71).

Strategy Use Questionnaire. For the Visual task, participants tended to use a mix of visual and verbal strategies to help them remember the location of the black cells (M = 3.4, SD = 1.1), and this did not differ between SA Groups (p = .82) or Conditions (p = .09). The interaction was not significant (p = .22). They tended to rely mostly on verbal strategies for the Verbal task (M = 1.86, SD = .92). Again, there were no between group differences or interactions.

CHAPTER IV

DISCUSSION

The purpose of the current study was to determine the potential effects of anticipatory processing (AP) on visual and verbal cognitive load task performance in a sample of high and low socially anxious individuals. AP has been identified as a form of repetitive negative thinking that is potentially unique to socially-anxious individuals (Clark & Wells, 1995), but research only recently examined specific consequences of AP (e.g., Hinrichsen & Clark, 2003; Mills et al., 2014a; Mills et al., 2014b; Schulz et al., 2008; Vassilopoulos, 2004; 2005b; Wong & Moulds, 2011; 2012). The current study found that HSAs who engaged in AP prior to a threatened social task had more difficulty with the visual attention task, as evidenced by poorer scores compared to HSAs who engaged in the Distraction task and LSAs who also engaged in AP. This suggests that the negative mental imagery associated with the AP task was difficult to ignore during the visual task. This is somewhat consistent with a recent study that suggested socially anxious individuals actually have *higher* trait visual working memory capacity compared to nonanxious controls unless they are under a social threat, at which point their visual working memory capacity is lower than controls (Moriya & Sugiura, 2012). Emerging research has emphasized the importance of imagery in social anxiety (Heimberg et al.,

2010; Lang & McTeague, 2009; McTeague et al., 2009). Specifically, social anxiety has been shown to be associated with intrusive negative self-images (Heimberg et al., 2010), and socially anxious individuals are more emotionally impacted by negative images than healthy individuals (McTeague et al., 2009).

AP has been found to result in negative imagery (Vassilopoulos, 2005), but this study is the first to show that AP also interferes with visual working memory load. Impaired visual attention could be implicated as a maintenance factor for social anxiety symptoms. Studies have found that individuals who hold negative images in their minds during social interactions have higher anxiety and lower ratings of their social performance than individuals not experiencing negative imagery (Hirsch, Clark, Mathews, & Williams, 2003; Hirsch, Meynen, & Clark, 2004). Furthermore, and perhaps more importantly, while these individuals are experiencing negative imagery, they are perceived as more anxious and rated more negatively by objective assessors (Hirsch et al., 2003; Hirsch, et al., 2004), than individuals without negative imagery. High anxiety, low self-ratings, and poor objective ratings likely converge to form a negative social experience, thereby reinforcing the individual's social anxiety. Therefore, this study suggests that AP maintains social anxiety symptoms by specifically impairing visual attentional load.

AP did not influence verbal working memory load, suggesting that AP may not maintain social anxiety simply by increasing general cognitive load, but instead, the nature of the cognitive load is either restricted to visual material (Baddeley, 2012) and/or the visual material is particularly salient to HSAs (Cowan 1999; 2005) and therefore prioritized. The lack of findings for the verbal task was surprising, as previous research

has found that rumination (Joorman et al., 2011) and worry (Rapee, 1993) interfere with verbal working memory. However, these differences may be due to the unique role of imagery in AP and social anxiety compared to rumination and worry, which are heavily verbal processes. Another possibility is that the visual load resulting from engaging in AP lasts longer than the verbal load, and therefore only the visual consequences of AP were present when participants were completing the cognitive tasks. Joorman and colleagues (2011) demonstrated that depressed individuals had difficulty disengaging from negative verbal stimuli, suggesting that rumination may persist in depressed individuals once it begins. We had similar expectations for AP, but it is possible that socially anxious individuals have more trouble disengaging from negative imagery compared to verbal content, and therefore only the imagery impacted their later task performance. Further research could consider this, as well as determine the degree to which the Avoidance and Preparation components of AP are associated with imagery and verbal content.

These results also significantly advance the literature on repetitive negative thinking, which has primarily focused on rumination and worry, and has recently trended toward conceptualizing all negative thought styles as unitary (McEvoy, Mahoney, & Moulds, 2010). However, examining only worry and rumination and generalizing those results to a larger body of negative thought processes may lead to premature conclusions of transdiagnosticity, as worry and rumination are *very* similar verbal forms of repetitive negative thinking (Papageorgiou & Wells, 1999). AP, worry, and rumination have all shown different predictive capabilities when examined simultaneously with symptoms of psychopathology (Mills et al., 2014), and the current study demonstrates that AP seems to

have little effect on verbal working memory load, and may be better conceptualized as an imagery-based form of repetitive thought. Various disorders have demonstrated different relationships with imagery (Lang & McTeague, 2009), and imagery content of repetitive negative thought processes may be one factor by which to differentiate disorders with high symptom overlap.

The study was associated with some limitations that should be addressed. The use of an undergraduate sample can limit the degree to which the results can be generalized to a clinical sample. However, symptoms of social anxiety are conceptualized as dimensional (Ruscio, Brown, Chiu, & Kessler, 2008), social anxiety is common among college students (American College Health Association, 2009), and our mean S-SIAS scores for the HSA (37.6) group were similar to those in clinical samples of other studies (43.9; Rodebaugh et al., 2011). Therefore, we believe our results provide important information about the nature of social anxiety despite the use of an undergraduate sample.

The verbal and visual tasks originated from different studies, and therefore, results could not be directly compared. Future studies may consider using tasks that have been normed to allow comparability. However, because we found no differences in verbal task scores between groups or conditions, the inability to directly compare scores between tasks did not limit the results of the study.

The current study advances the social anxiety, anticipatory processing, and repetitive negative thinking literatures significantly. The imagery with AP appears to be particularly problematic for socially anxious individuals, as it was found to interfere with their visual attention. The role of imagery is well-established in SAD, but if the negative imagery is generated as a result of engaging in AP, it is possible to develop treatment

protocols that help socially anxious individuals intervene with anticipation before it results in persistent and impairing negative imagery.

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Table 1.
Demographic Data by SA Group & Condition

	HSA ($N = 45$)	LSA ($N = 45$)	χ^2	Anticipate ($N = 45$)	Distract ($N = 45$)	χ^2
Sex (% female)	75.6%	73.3%	1.02	73.3%	75.6%	1.20
Sex (% male)	24.4%	24.4%	1.02	26.7%	22.2%	1.20
Caucasian	68.9%	77.8%	.91	68.9%	77.8%	.91
Non-Caucasian	31.1%	22.2%	.91	31.1%	22.2%	.91
	HSA ($N = 45$)	LSA ($N = 45$)	*F*	Anticipate ($N = 45$)	Distract ($N = 45$)	*F*
Age	19.73 (3.10)	20.07 (3.89)	.20	19.76 (3.05)	20.04 (3.93)	.70

Table 2

Trait Participant Characteristics by SA Group and Condition.

	SA Group			Condition		
Variable	HSA ($N = 45$)	LSA ($N = 45$)	F	Anticipate ($N = 45$)	Distract ($N = 45$)	F
ASBQ	34.22 (7.27)	26.00 (7.71)	27.07**	30.36 (8.59)	29.87 (8.55)	.79
ATTC	47.44 (5.55)	45.42 (5.49)	3.02	46.16 (6.34)	46.71 (4.77)	.64
CES-D	25.18 (9.88)	12.86 (7.79)	43.19**	20.88 (11.31)	17.16 (10.05)	.10
CFQ	75.56 (17.02)	60.24 (13.39)	22.49**	71.11 (16.37)	64.69 (17.32)	.07
E-PEPQ	101.27 (34.66)	70.44 (43.90)	13.66**	86.91 (47.70)	86.91 (36.57)	.81
GAD-7	10.49 (5.66)	4.89 (4.13)	29.97**	8.24 (5.80)	7.11 (5.57)	.35
PSWQ	59.58 (13.53)	49.67 (15.68)	10.31**	56.24 (14.63)	53.00 (16.12)	.32
RRS	25.09 (7.32)	18.53 (6.42)	20.42**	22.44 (8.07)	21.18 (7.12)	.43
S-SIAS	37.62 (7.94)	9.27 (5.94)	368.06**	23.33 (15.65)	23.56 (16.27)	.95
T1 PANAS PA	23.93 (8.09)	29.91 (9.79)	9.96**	27.24 (9.81)	26.60 (9.13)	.75
T1 PANAS NA	15.67 (5.04)	12.76 (3.15)	10.81**	15.29 (4.75)	13.13 (3.84)	.02*
T1 SUDS	26.89 (15.91)	29.24 (13.19)	.60	28.89 (14.13)	27.24 (15.14)	.60

Note: * $p < .05$; ** $p < .01$. ASBQ assessed AP, ATTC assessed attentional control, CES-D assessed depression, CFQ assessed cognitive failures, E-PEPQ assessed postevent processing, GAD-7 assessed GAD, PSWQ assessed worry, RRS asssessed rumination, S-SIAS assessed social anxiety, T1 PANAS PA assessed state positive affect at Time 1, T1 PANAS NA assessed state negative affect at Time 1, and T1 SUDS assessed subjective distress at Time 1.

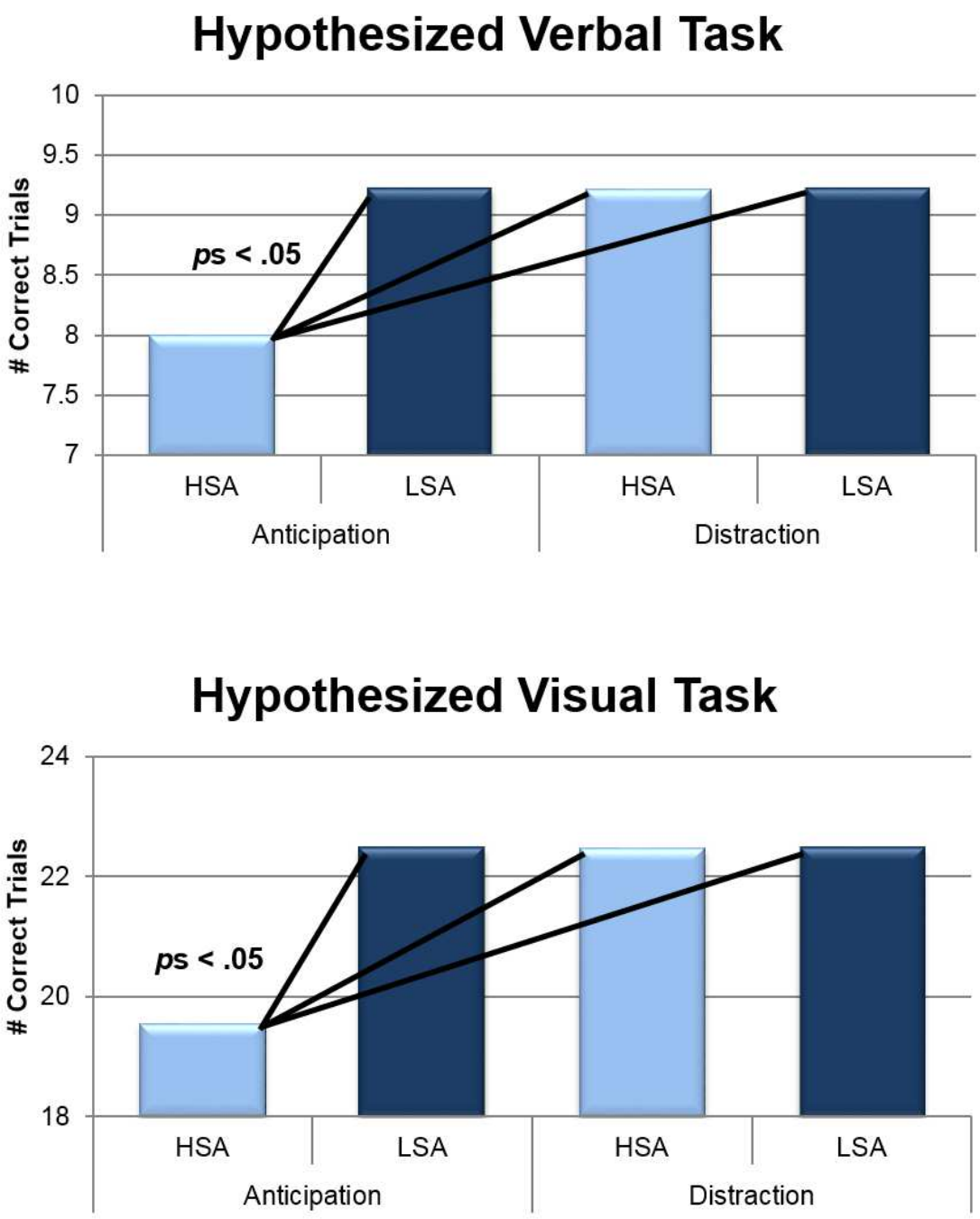

Figure 1. Hypothesized results

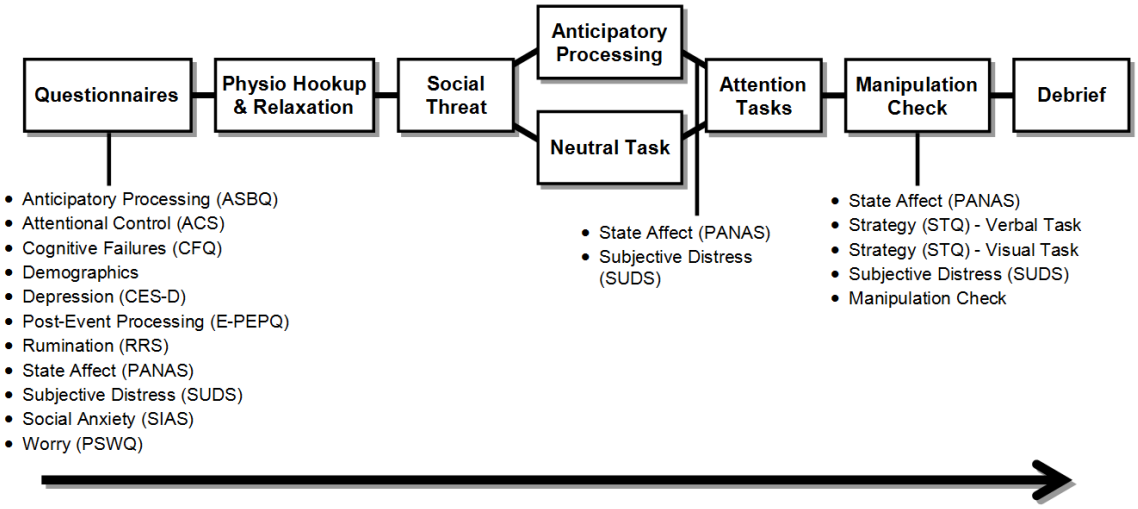

Figure 2. Study procedure.

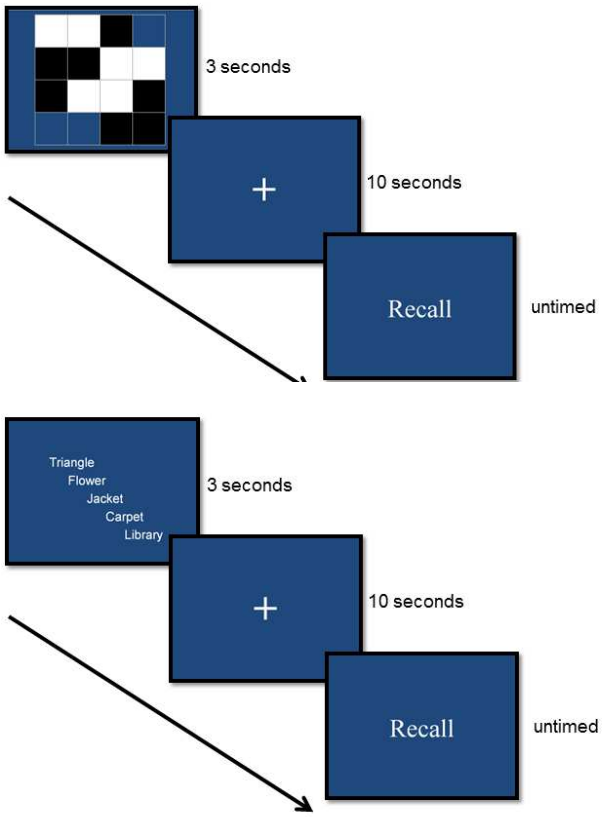

Figure 3. Visual and Verbal Attention Task Example Trials

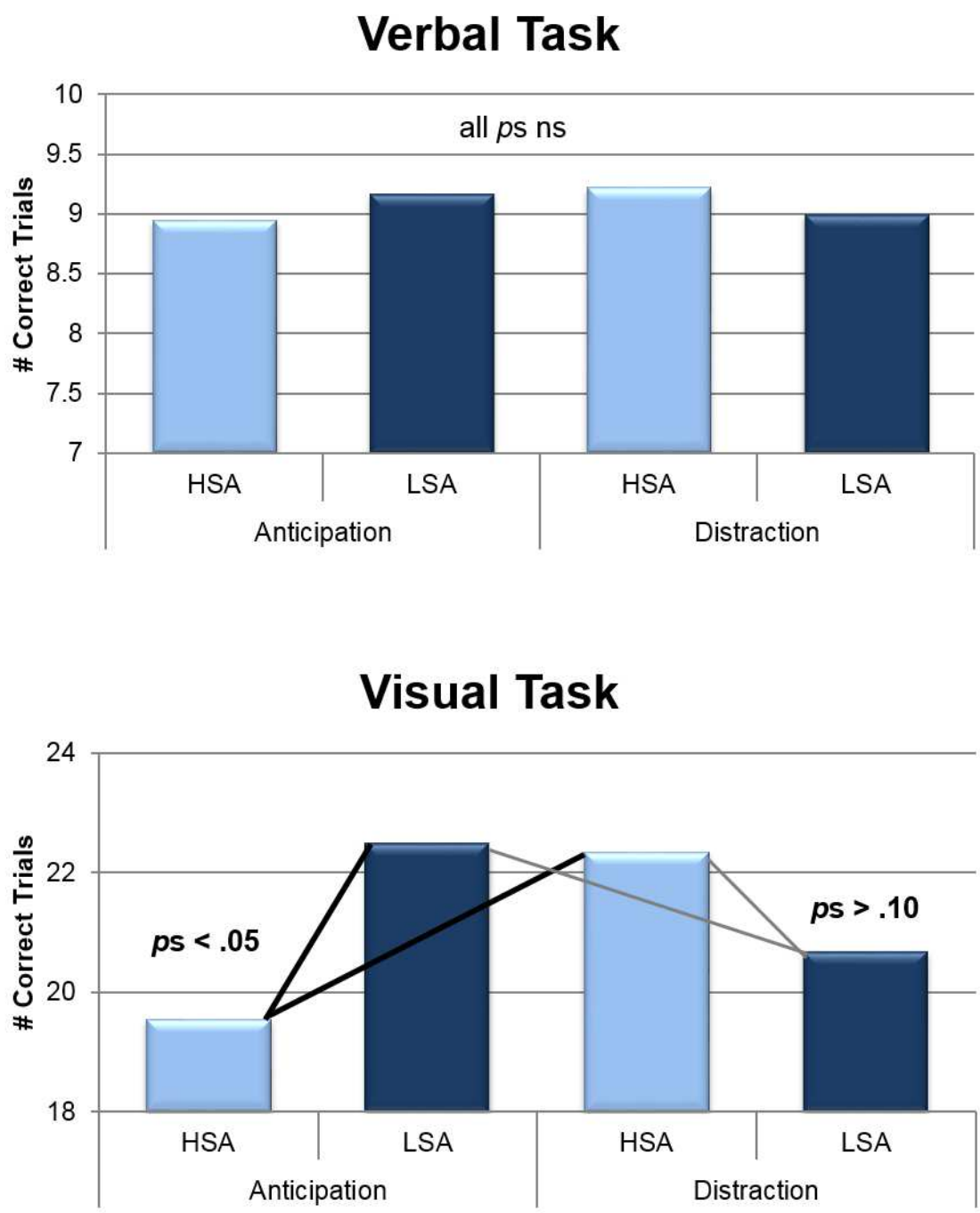

Figure 4. Observed Results

APPENDIX A

REVIEW OF THE LITERATURE

Social Anxiety Disorder

Social anxiety disorder (SAD) is a debilitating condition characterized by intense fear of negative evaluation in social interactions and/or performance situations (American Psychiatric Association, 2013). In the United States, it is estimated that over 25 million individuals are affected by SAD (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). SAD is associated with poor economic, interpersonal, educational, occupational, physical health, and mental health outcomes for the individual (e.g., Leon, Portera, & Weissman, 1995; Mogotsi, Kaminer, & Stein, 2000). The wide array of negative consequences associated with SAD underscore the importance of research that examines factors implicated in the development and maintenance of symptoms.

Multiple models of SAD have been proposed to explain these development and maintenance factors, including seminal cognitive-behavioral models (e.g., Clark, 2001; Clark & Wells, 1995; Heimberg, Brozovich, & Rapee, 2010; Rapee & Heimberg, 1997) that have generated decades of empirical research. These models stress the interaction of various cognitive processes, including attention, interpretation, memory, and repetitive negative thought (RNT) in the maintenance of social anxiety symptoms.

These models generally suggest several ways in which individuals high in social anxiety

symptoms (HSAs) differ from those low in social anxiety symptoms (LSA) in information processing. First, HSAs tend to believe that others have high standards to which HSAs are held, turning any social interaction into an important evaluative situation. Therefore, as an interaction begins, HSAs become hypervigilant for threat information, including internal (i.e., physiological indices of anxiety; Clark & Wells, 1995; Rapee & Heimberg, 1997) and external (i.e., negative facial expressions; Rapee & Heimberg, 1997) stimuli, which increases their awareness of these stimuli. This biased attention is proposed to reduce resources and increase anxiety, perhaps resulting in actual social impairment. These models also suggest that HSAs negatively interpret ambiguous social stimuli and have overly pessimistic beliefs about the probability and consequences of negative social events. Their negative interpretations maintain their beliefs about their social inadequacy and therefore maintain their anxiety for future interactions (Clark & Wells, 1995; Rapee & Heimberg, 1997).

Attention. Researchers have used several cognitive tasks in order to evaluate attentional processing in SAD. For example, the emotional Stroop task (e.g., Williams, Mathews, & MacLeod, 1996) instructs participants to name color words while ignoring the content of the word, and researchers have found that socially-anxious participants respond more slowly to social threat-related words (e.g., sweating; blushing) compared to neutral words (Grant & Beck, 2006; Mattia, Heimberg, & Hope, 1993), but nonanxious controls (Mattia et al., 1993) and participants with other anxiety disorders (Hope, Rapee, Heimberg, & Dombeck, 1990) do not demonstrate this slower response. Face-in-the-crowd paradigms (e.g., Gilboa-Schechtman, Foa, & Amir, 1999) have been used to examine participants' ability to detect target faces among large numbers of distractor

stimuli, and have found HSAs (relative to LSAs) have enhanced ability to identify angry faces among neutral distractors, but difficulty ignoring emotional distractors when searching for a neutral face (Gilboa-Schechtman et al., 1999).

Most recently, researchers have used variations of dot-probe tasks (MacLeod, Mathews, & Tata, 1986), which can provide information about initial orientation, disengagement, and avoidance of threat stimuli. Typical dot-probe tasks present threat (e.g., a disgust or angry face) and neutral (e.g., a neutral face) stimuli simultaneously on either side of a screen, followed by a target probe (e.g., the letter "E") behind one of the two stimuli. Participants are instructed to respond to the target stimulus. Studies have found that socially-anxious participants respond more quickly to the probe when it is preceded by a threat face compared to a neutral face (see Schultz & Heimberg, 2008). This faster response time is hypothesized to occur because HSAs are immediately drawn to the threatening face, so when the target probe appears behind it, they are already looking in that general area. However, when the probe appears behind the neutral face, participants have to direct their attention to the other side of the screen, resulting in a longer response time (MacLeod et al., 1986).

Studies using dot-probe methodology have generally suggested HSAs initially (e.g., within 300ms) experience biased attention toward threatening stimuli followed by avoidance after later latencies (e.g., after 500ms) (Cisler & Koster, 2010; Garner, Mogg, & Bradley, 2006; Mogg, Bradley, Miles, & Dixon, 2004; Vassilopoulos, 2005a). Several studies have suggested that initial vigilance to threat is followed by avoidance (e.g., Mogg et al., 2004; Vassilopoulos, 2005). For example, Vassilopoulos (2005) had participants high and low in negative evaluation fear complete a modified dot-probe task

with social threat (e.g., "foolish," "incompetent," "weird,") and neutral (e.g., "north," "expensive," "green,") words. A pair of words (one neutral and one threat) was presented for either 200ms or 500ms and were then replaced by a probe that required a response from the participant. Participants high in evaluation fear demonstrated an attention bias *toward* threat words when they were presented for 200ms, but at 500ms they were biased *away* from threat words, suggesting avoidance. Although additional studies also support the vigilance-avoidance hypothesis (e.g., Mogg et al., 2004; Garner et al., 2006), Judah and colleagues (Judah, Grant, Lechner, & Mills, 2013) found that under high working memory load, HSAs demonstrate difficulty disengaging attention from threat instead of avoidance. This study underscored the importance of continuing to examine moderators of attention biases.

Additional moderators of attention bias were demonstrated by studies attempting to determine whether HSAs were predominately biased toward internal (e.g., physiological) or external (e.g., faces) stimuli. Four studies (Deiters, Stevens, Hermann, & Gerlach, 2013; Mansell, Clark, & Ehlers, 2003; Mills, Grant, Judah & White, 2014; Pineles & Mineka, 2005) examined internal and external attention biases simultaneously using varying stimulus modalities (i.e., images, tactile feedback, live interactions). In each study, results suggested that HSAs only demonstrated internal attention biases under conditions of social threat, suggesting that these biases are activated by anxiety related to an upcoming social task. Biases were not observed for external stimuli.

This research has demonstrated importance in SAD, as attention biases have been proposed to be a causal mechanism in the maintenance of social anxiety (Van Bockstaele et al., 2014) and treatment efforts aimed at cognitive bias modification have shown

promise (Beard, Weisberg, & Amir, 2011). Taken together, the attention literature has been advanced by research efforts devoted to identifying moderators of attention biases (e.g., Cisler & Koster, 2010; Schultz & Heimberg, 2008). Trait anxiety level, stimulus presentation time, stimulus type, and working memory load have all been identified as influential moderators and have increased researchers' understanding of attentional processes in social anxiety. However, reviews of attention bias still report equivocal results (Cisler & Koster, 2010; Schultz & Heimberg, 2008), suggesting that more research is needed on the interaction of attentional processes.

Interpretations. Research on interpretation biases have generally found that HSAs interpret ambiguous social information as negative (Amir & Bomyea, 2010). Interpretation biases are specific to social stimuli (Amir et al., 1998) and have been found using event-related brain potentials (Moser, Hajcak, Huppert, Foa, & Simons, 2008), reaction time on cognitive tasks (Amir, Prouvost, & Kuckertz, 2012), self-report (Huppert, Pasupuleti, Foa, & Mathews, 2007; Mills, Grant, Judah, & Lechner, 2014; Stopa & Clark, 2000), and behavioral interactions (Kanai, Sasagawa, Chen, Shimada, & Sakano, 2010). For example, Kanai and colleagues (2010) had confederates engage in common and neutral behaviors (e.g., scratching head, clearing throat) during a social interaction with participants high and low in social anxiety symptoms. As expected, HSAs rated those behaviors more negatively than control participants. However, the research is mixed in terms of the nature of these biases. For example, some studies suggest SAD is characterized by the tendency for HSAs to endorse negative interpretations (Huppert et al., 2007; Kanai et al., 2010; Mills et al., 2014a; Stopa & Clark, 2000), whereas others have found that HSAs do not disproportionately endorse

negative interpretations, but instead are less likely than nonanxious individuals to endorse positive interpretations (Amir et al., 2012; Hirsch & Mathews, 2008; Moser et al., 2008).

It also is likely that interpretations may be a function of attention bias. Mills and colleagues (2014a) found that HSAs who were more focused on internal stimuli also were more likely to endorse negative interpretations. This is consistent with Clark and Wells (1995), who suggested that self-focused attention increases anxiety and reduces attention on the interaction, leaving the socially anxious individual with ambiguous information to evaluate while in a state of increased anxiety.

Memory. Cognitive models also proposed that HSAs would disproportionately remember negative social stimuli relative to neutral or positive stimuli. However, results have been inconclusive to date (Amir & Bomyea, 2010; Coles & Heimberg, 2002; Foa, Gilboa-Schechtman, Amir, & Freshman, 2000; Mitte, 2008; Morgan, 2010; Rapee, McCallum, Melville, Ravenscroft, & Rodney, 1994). Rapee and colleagues (1994) examined recall and recognition memory performance between HSAs and LSAs using words, personal memories, and negative feedback and failed to find differences between HSAs and LSAs. However, Foa and colleagues (2000) found that HSAs had better memory (recall and recognition) of facial expressions than LSAs, and this effect was enhanced for negative faces.

Several review articles have attempted to summarize the memory literature in order to explain inconsistent results. Coles and Heimberg (2002) suggested that there was little evidence to support that HSAs have a bias for explicit (i.e. conscious) memories, but some evidence suggests that implicit biases exist. However, a meta-analysis by Mitte (2008) suggested that there was little overall evidence across anxiety

disorders that anxiety is associated with an implicit memory bias. Mitte (2008) suggested that recognition memory bias for threat stimuli is more consistently demonstrated with threat images than threat words, and those high in anxiety tended to explicitly recall more threat-related information than nonanxious individuals. Mitte (2008) described these contradictory findings in terms of methodological differences and emphasized the importance of using more consistent and valid methodology.

Morgan (2010) suggested that examining memory biases for lists of threatening words or emotional faces lacks ecological validity, which may contribute to inconsistent findings. Instead, she suggested research examining autobiographical memories, which are complex, self-relevant episodic memories. HSAs are hypothesized to retain autobiographical memories of past social failures that intrusively arise under conditions of social threat. Therefore, autobiographical memories are an appropriate but infrequent target of research. For example, D'Argembeau and colleagues (2006) asked HSAs to recall social and non-social memories and found that social memories were characterized by increased internal/self-referential details and fewer external sensory (e.g., visual, auditory) details, which is similar to results in the attention literature about internal and external attention biases (e.g., Deiters et al., 2013; Mansell et al., 2003; Mills et al., 2014b; Pineles & Mineka, 2005). Overall, Mitte (2010) concluded that the extant research on autobiographical memories has found that HSAs experience disproportionately enhanced memory for negative emotional autobiographical material, thus proposing that memory research should continue examining autobiographical memories. However, since that review was published, research on autobiographical memories in SAD remains limited. One promising study compared a group of

participants diagnosed with SAD to a control group and found that both experience negative autobiographical memories under social threat. However, SAD patients retrieved a higher proportion of negative memories than controls, and positive memories recalled by SAD patients had significantly fewer details than those of controls (Moscovitch, Gavric, Merrifield, Bielak, & Moscovich, 2011). Furthermore, these memories resulted in more negative affective and cognitive consequences for SAD participants relative to controls.

Together, many studies have demonstrated memory bias for threat in SAD, but several other studies have failed to demonstrate a bias (Amir & Bomyea, 2010). It is possible that increased research on autobiographical memory can improve consistency of these results; however, researchers also should consider including potential interactive processes (e.g., information processing biases and RNT) into this literature in order to assist in the explanation of equivocal results.

Integration. Despite decades of promising findings in clinical research, only recently have researchers begun to examine the interaction among cognitive processes (Hirsch Clark, & Mathews, 2006). The limited body of literature has suggested that cognitive processes interact in depression (e.g., Everaert, Koster, & Derakshan, 2012) and social anxiety (Hirsch et al., 2006; Mills, Grant, Judah, & Lechner, 2014). As individual cognitive processes do not occur in isolation, this line of literature is vital to understanding the role of cognition in symptoms of psychopathology, including SAD.

The integration of these components is described in cognitive models, but remains generally untested. Hirsch and colleagues (2006) reviewed attention and interpretation research and proposed a combined cognitive bias model. Under social threat, HSAs

experience negative memories and imagery (Moscovitch et al., 2011; Heimberg et al., 2010), and the processing of negative self-imagery (and increase in self-focused attention; Mills et al., 2014b) prevents the generation of positive interpretations (Hirsch, Clark, Mathews, & Williams, 2003) that nonanxious individuals typically experience. With few resources to devote to the interaction and the inability to generate positive interpretations, HSAs are unable to gather evidence that contradicts their negative beliefs, resulting in the maintenance of social anxiety in evaluative situations. The maladaptive cycle will continue at the next social interaction, because HSAs under social threat demonstrate self-focused attention (Deiters et al., 2013; Mansell et al., 2003; Mills et al., 2014a; 2014b; Pineles & Mineka, 2005), which promotes negative self-imagery (Clark & Wells, 1995; Hirsch et al., 2006).

The promising results of studies that have evaluated combined cognitive models have emphasized the need to continue examining how cognitive processes influence each other. Therefore, the purpose of this study was to add to the limited but growing body of literature that examines the integration of multiple cognitive processes that are independently hypothesized to maintain social anxiety symptoms. This was done by examining the relationship between anticipatory processing and working memory. Working memory has been a recent target of psychopathology researchers, as it can explain mechanisms associated with symptom maintenance. Anticipatory processing is an anxious form of RNT proposed by Clark and Wells (1995) that has been rarely studied but consistently implicated with SAD symptoms. Both will be discussed below.

Working Memory

Anxiety researchers have shown growing interest in working memory, which is responsible for the short-term storage and manipulation of information (e.g., Baddeley & Hitch, 1974) and acts as a bridge between perception and long-term memory (Baddeley, 2003). Several models of working memory have been proposed in the cognitive literature. Some models (e.g., Baddeley & Hitch, 1974) describe the function and integration of various subsystems of working memory, whereas others (e.g. Cowan, 1999) are concerned with general characteristics and functions of the working memory system.

Baddeley & Hitch. Baddeley and Hitch (1974) provided a significant advancement in theories of information processing with their model of working memory, which differed from existing theories by describing multiple components and functions of the short-term memory (STM) system (Baddeley, 2003). The most significant addition to existing models was the description of the interaction between several components within the working memory system. Their working memory model consists of two storage systems, the phonological loop and visuospatial sketchpad, and a control system called the central executive. These systems interact in order to process incoming perceptual stimuli, to rehearse and manipulate information, and to encode information into long-term memory (LTM) for future retrieval.

Phonological Loop. The phonological loop includes a component for short-term echoic memory storage and a component that is responsible for articulatory rehearsal (e.g., subvocal speech). Specifically, the storage system holds fast-decaying auditory information while the articulatory system rehearses this information in a loop in order to prevent decay. This system is responsible for processing and storage of verbal material,

and has been proposed to be a mechanism that evolved in order to acquire language (Baddeley, 2003). Therefore, the phonological loop is believed to be responsible for verbal working memory capacity, and research supports that phonological task performance is impaired upon the introduction of concurrent verbal information (Baddeley & Hitch, 1974).

The phonological loop was originally proposed to be completely distinct from LTM, as Baddeley and Hitch (1974) described individuals with phonological impairments but sufficient LTM. However, follow-up research suggested that phonological difficulties are associated with impaired language acquisition and lower vocabulary (Baddeley, Papagno, & Vallar, 1988). This suggests some independence of the phonological subsystem from long-term functioning, but these processes also appear related.

Several characteristics of verbal short term memory are supported by the theory of the phonological loop. Intuitively, longer words or longer lists of words are harder to remember than shorter words or lists (Baddeley, Thomson, & Buchanan, 1975). Lists of similar stimuli (e.g., *c*, *g*, *d*, *e*) are more difficult to remember than distinct stimuli (e.g., *x*, *t*, *y*, *f*) (Baddeley, 1966). Finally, engaging in concurrent verbal tasks (e.g., articulatory suppression), such as repeating a word or number, interferes with verbal memory performance (Baddeley et al., 1975) and prevents coding visual information verbally (Murray, 1968). Thus, the phonological loop, as with working memory and short-term memory in general, is a system of limited capacity. For example, Richardson and Baddeley (1975) had participants memorize lists of 16 words each while repeating "hi-ya" out loud or remaining silent, and found decreased recall performance in the speaking

condition, demonstrating that articulatory suppression results in interference in the phonological loop.

Visuospatial Sketchpad. As the phonological loop is responsible for verbal working memory, the visuospatial sketchpad is a limited-capacity system responsible for visual working memory, including shapes, spatial locations, and colors. Research has demonstrated that introducing a concurrent visuospatial task can interfere with recall for visuospatial but not verbal information, supporting the dissociation between these two systems. For example, Sims and Hegarty (1997) had participants engage in a visuospatial task that involved examining images of a pulley system and deciding whether the diagram was showing the correct direction of motion. They also engaged in secondary visuospatial and verbal tasks, and more interference occurred on the visual compared to the verbal task.

Although less studied than the phonological loop (Baddeley, 2012), evidence suggests that the visuospatial sketchpad includes at least two distinct nonverbal components (spatial and visual STM), as well as potentially kinesthetic and tactile components (Baddeley, 2012). Hecker and Mapperson (1997) had participants complete spatial sequence and color matching tasks under conditions of spatial and color interference, and found that only spatial interference impaired spatial task performance, whereas only color interference impaired color matching performance. Many other studies have replicated this distinction (see Klauer & Zhao, 2004 for a review).

Central Executive. The central executive is the control system of working memory that is involved with focusing, shifting, and dividing attention. It also is thought to be responsible for orchestrating (and switching between) storage and retrieval

processes (Baddeley, 2003; 2012; Baddeley & Hitch, 1974). Baddeley (2003) describes this system as the "most important but least understood component of working memory" (p. 835). The central executive is thought to be responsible for several attentional functions, including shifting (e.g., shifting among multiple tasks), inhibition (e.g., inhibiting automatic responses), and updating (e.g., monitoring and updating representations in working memory; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; Smith & Jonides, 1999). Miyake and colleagues (2000) demonstrated support for these three functions of the central executive by performing a confirmatory factor analysis on several commonly used tasks of executive functioning. Their three-factor model demonstrated excellent fit. These three components were moderately correlated (*r*s ranged from .42 to .63) but distinct from each other. They also noted that they only examined three basic functions of the central executive that have been proposed in previous research, and central executive functioning is likely not limited to these three functions. They suggested that more complex functions, such as planning and engaging in multiple tasks simultaneously could be studied as combinations of the three basic functions.

Because the central executive has been linked to performance in many domains, difficulties in executive functioning have been linked to almost every form of psychopathology, including attention-deficit/hyperactivity disorder (Alderson et al., 2010; Pennington & Ozonoff, 1996; Poletti, 2009), autism spectrum disorder (Pennington & Ozonoff, 1996), depression (Poletti, 2009), anxiety (Hosenbocus & Chahal, 2012), and schizophrenia (Hosenbocus & Chahal, 2012). Executive functioning deficits also have

been found in various medical patients, including chronic pain (Nes, Roach, & Segerstrom, 2009), epilepsy (Braakman et al., 2011).

Studies have attempted to examine the relationship between the central executive and the verbal and visual subsystems. Miyake and colleagues (2001) suggested that visuospatial working memory and STM tasks place equal demands on the central executive, making them difficult to distinguish from each other, which is in direct contrast to studies that have found differences between verbal STM and verbal working memory tasks (e.g., Engle. Tuholski, Laughlin, & Conway, 1999). Studies such as these demonstrated the limits of the original description of the central executive system and prompted further research, which resulted in the addition of the episodic buffer to Baddeley's model.

Episodic Buffer. The description of the central executive in the Baddeley and Hitch (1974) model was specific to attention and did not account for the transfer of information from STM to LTM (Baddeley, 2003). Additionally, the central executive was assumed to have no storage capacity, which did not explain how the slave systems integrated with each other and/or the central executive (Baddeley, 2012). Therefore, Baddeley (2000) added a new component to the model called the episodic buffer, which is another limited-capacity storage system that integrates information from various domains simultaneously. Thus, the episodic buffer serves as an integrative storage system for the phonological loop, visuospatial sketchpad, central executive, and LTM (Baddeley, 2000; 2003). Baddeley (2003; 2012) suggests that the episodic buffer could be conceptualized as a storage component of the central executive system, whereas the original description of the central executive (i.e., focusing, shifting, dividing attention) is

primarily responsible for attentional awareness and attentional processes. Baddeley and colleagues (2011) suggest that the episodic buffer serves passively (e.g., unconsciously) as the "heart" (p. 1399) of the working memory system, in order to integrate multimodal sensory information into LTM.

Cognitive and neurological research has generally found support for the proposed function and integration between these subsystems (e.g., Baddeley, 2003; 2012). For example, research has suggested that attaching verbal labels to visual stimuli enhances recall of the visual stimuli (Brown, Forbes, & McConnell, 2006; Verhaegen, Palfai, & Johnson, 2006). In order to identify the mechanisms responsible for this enhancement, Wesley and Brown (2013) examined the role of the phonological loop and central executive in the enhancement of visuospatial working memory performance. Participants completed a modified version of the Visual Patterns Task (VPT; Brown et al., 2006), which asks participants to reproduce grids of black and white squares after a 10 second delay. Some grids were designed such that the black cells appeared like common shapes (e.g., square) or letters, so participants could recruit verbal resources in order to remember the pattern (high verbal). Other grids formed abstract patterns that could not benefit from the use of verbal strategies (low verbal). Articulatory suppression did not interact with the type of grid, suggesting that taxing the phonological loop did not impair performance on the task. Therefore, the phonological loop may not be involved in the enhancement of visual memory when using verbal strategies. However, taxing the central executive did prevent participants from benefitting from verbal strategies, suggesting that the resources of the central executive assist in multimodal (e.g., verbal and visual) encoding.

Cowan's Embedded Processes Model. An alternate, but not incompatible (Baddeley, 2003) approach to working memory was provided by Cowan (1999; 2005). This model is seemingly more focused on what occurs in the systems that Baddeley called the central executive and episodic buffer. In other words, this model is less concerned with specific domains of the working memory system, but instead is more focused on describing the nature of awareness and capacity. The principles of Cowan's model suggest that 1) working memory consists of a hierarchy of information that includes LTM, currently-activated LTM, and the subset of currently-activated LTM that is under attentional focus at any given moment; 2) attention is limited by capacity and awareness is limited by time; 3) attentional focus is controlled by both voluntary (i.e., central executive) and involuntary (i.e., attentional orienting) processes; 4) orientation to stimuli can be habituated; and 5) increased awareness results in increased encoding of information and therefore increased recall.

Levels of Activation. Cowan (1999) suggested that memory is organized hierarchically in terms of three levels of activation. Long-term storage is the largest process in this model, as it consists of seemingly infinite storage, but the majority of it remains inactive. At any given time, a subset of our long-term store can be activated into short-term memory. This subset is called the activated memory, and Cowan argues that Baddeley's visuospatial sketchpad and phonological loop are two of several domains of activated memory. Within activated memory is a narrower subset of activation that Cowan described as our focus of attention and awareness. This latter process is the information of which we are consciously aware at any given moment, and Cowan suggests that this system is limited in capacity to only a few items at a time. Cowan

(1999) also noted that effort can be directed away from specific information instead of toward it, which is referred to as inhibition. While attention is consciously focused on a narrow subset of stimuli, automatic processes continue to simultaneously run in the background in order to efficiently recruit attention for highly noticeable events, such as personally-relevant (e.g., your name being spoken) or salient sensory (e.g., loud noises or bright lights) information.

Cowan's research also has suggested that the conscious focus of attention has a capacity of approximately four chunks of information (Cowan, 2005) challenging the longstanding acceptance of Miller's 'magical number' of seven (Miller, 1956). Cowan and other researchers (e.g., Oberauer and Bialkova, 2009) are therefore suggesting that attentional focus is much more limited than previously thought, and may be limited to as few as one or two chunks (Oberauer & Bialkova, 2009).

Bell and colleagues (2012) tested aspects of Cowan's model by presenting verbal auditory distractions to participants during number recall tasks. Cowan's model suggests that these distractions serve as novel stimuli that should pull the focus of attention away from the task, but as the distractions are repeated and lose novelty, individuals should be able to maintain focus of attention on the serial recall task. This is precisely what Bell and colleagues (2012) found in a series of five experiments. Participants experienced initial interference in recall performance that attenuated over time, suggesting that the orienting response described by Cowan (1999) attenuated after habituation. However, if distractor stimuli were varied in any way during the task, the orienting response re-emerged. Similarly, distractor stimuli that are relevant to the individual have been found to be more distracting than irrelevant stimuli (Bell, Mund, & Buchner, 2011).

Additional research evaluating specific predictions of the Embedded Processes Model is limited. Chein and colleagues (2003) suggest that this model may map onto verbal-linguistic processing neuroimaging data more accurately than Baddeley's model (Chein, Ravizza, & Fiez, 2003). However, this study is currently one of the only available studies to compare the two models by examining existing empirical results.

Anxiety and Attention – Attentional Control Theory

Researchers have frequently examined the effects of anxiety on attentional processes. Eysenck and colleagues (2007) provided a framework for studying this interaction by proposing predictions about how anxiety could influence three major functions of the central executive: inhibition, shifting, and updating (e.g., Miyake et al., 2000). This framework was called Attentional Control Theory.

Eyesenck and colleagues (2007) identified a distinction between performance effectiveness, which is concerned with accuracy, and processing efficiency, which is concerned with the interaction between accuracy and the amount of effort needed for task performance. When challenged with concurrent tasks or limited resources, individuals can increase their effort to maintain performance effectiveness; therefore, concurrent tasks are likely to impair efficiency but not necessarily effectiveness. They also describe how anxiety can impair attentional control, which is one's ability to consciously direct attentional processes, by inhibiting certain information processing functions of the central executive (Eysenck, Derakshan, Santos, & Calvo, 2007). Specifically, the introduction of anxiety into the environment enhances stimulus-driven attention (e.g., bottom-up processing; Corbetta & Shulman, 2002) in order to improve vigilance to threat. This utilizes attentional resources, thus reducing the individuals' ability to engage in goal-

directed (e.g., top-down; Corbetta & Shulman, 2002) executive processes, such as being able to consciously inhibit task-irrelevant stimuli. To compensate for this, more resources are recruited in order to maintain performance effectiveness, and this increase in effort results in the maintenance of observable performance. The lack of noticeable differences in performance may lead to conclusions that anxiety is not influencing attentional processes, but the increase of cognitive resources that is necessary in order to maintain performance has been found to be influential (Eysenck et al., 2007).

Research has supported that anxiety impairs processing efficiency but not effectiveness (e.g., Derakshan, Ansari, Hansard, Shoker, & Eysenck, 2009). This theory has been tested using an antisaccade task, which is a measure of inhibition. Derakshan and colleagues (2009) instructed participants high and low in trait anxiety to direct attention toward (prosaccade) and away (antisaccade) from a prepotent stimulus, the latter of which is difficult considering the reflexive tendency to orient to novel stimuli. As predicted by attentional control theory, there were no differences in the number of errors made by participants high and low in anxiety. Because the antisaccade task is more difficult than a prosaccade task, all participants took longer to correctly look away from the stimulus during the antisaccade task. However, highly-anxious participants demonstrated longer response times than control participants, suggesting increased effort and reduced efficiency, especially during the presentation of negative emotional stimuli (angry faces; Study 2), supporting several predictions of attentional control theory.

Using a similar saccade task, Ansari and colleagues (2008) examined the effects of anxiety on attentional shifting. A fixation cross was followed by a stimulus on one side of the screen, and participants were instructed to look toward or away from the

stimulus. They also completed blocks with mixed instructions, during which the color of the fixation cross indicated whether participants were to look toward or away from the stimulus. During the mixed block, a trial was defined as a "shifting" trial if it had different instructions than the previous trial. They found that low anxious participants had faster reaction times during mixed trials because they were receiving reminders of the task instructions during each trial, as indicated by the color of the fixation cross. However, high anxious participants did not experience this improvement. They suggested that switching requires attentional resources and efficient top-down processing, and while low-anxiety participants were able to benefit from the task cue at every trial, high-anxiety participants' difficulty with efficient top-down processing prevented the same facilitated processing that low-anxiety participants experienced.

Finally, attentional control theory proposed that anxiety interferes with updating and monitoring mental representations. Behavioral research examining the effects of anxiety on updating have been equivocal (Berggren & Derakshan, 2013; Eysenck et al., 2007), but updating does not require attentional control, and therefore the effects of anxiety on updating are hypothesized to be more limited compared to inhibition and shifting (Eysenck et al., 2007). However, some impairment in updating is expected due to stress making significant demands on the central executive overall (Eysenck et al., 2007).

In a review of attentional control theory, Berggren and Derakshan (2013) concluded that the literature supports the main hypotheses regarding the effect of anxiety on attentional control. They also suggested that research supports that anxious individuals can compensate for the effects of anxiety by recruiting additional resources;

however, they noted influential moderators that can interfere with this compensatory behavior, including motivation and cognitive load. Specifically, anxious participants with low motivation demonstrate efficiency deficits predicted by attentional control theory, but with sufficient motivation, those deficits appear to attenuate (Hayes, MacLeod, & Hammond, 2009). Anxious participants under cognitive load (e.g., engaging in a concurrent counting task) demonstrated slower visual search and increased fixation on distracting stimuli, neither of which were experienced by low-anxious participants under cognitive load (Berggren, Koster, & Derakshan, 2012). This suggests that cognitive load may be disproportionately disruptive to high-anxious individuals' ability to engage in attentional control compared to low-anxious individuals.

Effects of Social Anxiety on Attentional Control. The extent to which these results generalize to social anxiety has been tested in only six available studies. Judah and colleagues (Judah, Grant, Mills, & Lechner, 2013a) used event-related potentials to examine processing efficiency in shifting and inhibition with participants high (HSA) and low (LSA) in social anxiety symptoms. This was done with a mixed antisaccade task that included a threat manipulation on 20% of the trials using false heart rate feedback. HSAs demonstrated longer saccade onset and greater amplitudes of the CNV negativity for both shifting and inhibition trials, which indicated an increased recruitment of effort. For social threat inhibition trials, HSAs had delayed onset of the P3b component, suggesting a delay in their ability to categorize stimuli. They also had reduced P3b amplitude throughout the entire task, suggesting that they had fewer resources with which to engage in stimulus categorization. Taken together, these results supported aspects of attentional control theory and cognitive theories of social anxiety, as HSAs demonstrated a reduction

of attentional resources and increased interference under social threat. Wieser and colleagues (2009) found that HSAs demonstrated difficulty with antisaccade tasks, but not prosaccade tasks, with emotional face stimuli, suggesting that the presence of threatening faces impaired HSAs' inhibition ability.

Amir and Bomyea (2011) found that nonanxious participants demonstrated better working memory control than participants with SAD with neutral stimuli, suggesting that attentional control is impaired in those with anxiety. They suggested that this difference may be the result of SAD participants engaging in concurrent tasks, such as RNT processes, throughout the study. However, there was no difference between groups on performance with social threat stimuli, and SAD patients demonstrated *enhanced* working memory performance for social words compared to neutral words, suggesting that processing of salient threat words is more automatic for those with symptoms of SAD than it is for nonanxious individuals.

Other studies have found that attentional control 1) is negatively associated with social anxiety, even after controlling for trait anxiety and depression (Moriya & Tanno, 2008), 2) longitudinally mediates the relationship between social anxiety symptoms and positive affect (Morrison & Heimberg, 2013) and 3) improves after cognitive behavioral treatment for social anxiety (Bowler et al., 2012). Thus, the important tenets of attentional control theory, including decreased efficiency and difficulties with inhibition and shifting, likely generalize to social anxiety as well.

Anticipatory Processing

Clark and Wells (1995) proposed a model of SAD that described cognitive processes that interact to maintain symptoms. Specifically, they noted that HSAs engage

in a process of RNT prior to a social interaction that they called anticipatory processing. During anticipatory processing, HSAs imagine past social failures, generate worst-case predictions about the upcoming interaction, think of ways to escape or avoid the upcoming interaction, and imagine their appearance from a third-person perspective (Clark & Wells, 1995; Hinrichsen & Clark, 2003). Clark and Wells (1995) suggest that anticipatory processing results in a shift of attention inward, and as such, HSAs have reduced attention to their interaction partner and likely do not notice any information that could disconfirm their negative hypotheses (e.g., signs of acceptance from others). HSAs are left with ambiguous information with which to evaluate the quality of the social interaction and will default to a negative interpretation, leaving them with an additional piece of evidence in favor of their social ineptitude.

Some aspects of Clark and Wells' (1995) model have been tested thoroughly (e.g., attention, as discussed above), but currently, only about fifteen studies have examined anticipatory processing. Hinrichsen and Clark (2003) identified several specific cognitions that discriminate HSAs from LSAs and used those to construct the Anticipatory Social Behaviours Questionnaire (ASBQ). They also instructed HSAs and LSAs to engage in anticipatory processing or a distraction task for twenty minutes prior to an upcoming speech task. Those who engaged in anticipation, regardless of social anxiety status, had higher self-reported anxiety during a speech task, suggesting that anticipatory processing heightened and maintained state anxiety related to a social task. Anticipatory processing has been found to be negative, distracting, and intrusive (Vassilopoulos, 2004). Five studies have found that it increases self-reported and physiological indices of anxiety (Vassilopoulos, 2004; 2005a; Schulz, Alpers, &

Hofmann, 2008; Wong & Moulds, 2011; 2012), and three have found that it results in negative beliefs and interpretations (Mills et al., 2014a; Wong & Moulds, 2011; 2012), as well as increases in self-focused attention (Mills et al., 2014a; Mills et al., 2014b), imagery (Vassilopoulos, 2005a), and prolongs the experience of rumination (Grant & Beck, 2010).

Anticipatory Processing and Physiological Responding. It is important to examine the effects of anticipatory processing on psychophysiology, because physiology is particularly important in SAD (Clark & Wells, 1995) and physiological arousal can serve as an indicator of cognitive activity (Muth, Moss, Rosopa, Salley, & Walker, 2012) and anxiety (Schulz et al., 2008). Only two studies have evaluated physiological responding during anticipatory processing, despite the potential importance of physiology in social anxiety disorder. Schulz and colleagues (2008) found that HSAs who engaged in anticipatory processing prior to a speech task experienced significantly decreased respiratory sinus arrhythmia (RSA) compared to those who engaged in a relaxation task. This suggests that HSAs have significant difficulty engaging in parasympathetic regulation and are physiologically inflexible (e.g., Porges, 2007) during anticipatory processing. They did not observe any significant associations between social anxiety symptoms, anticipatory processing, and skin conductance, which is a measure of sympathetic activation. However, in a similar study, Wong and Moulds (2011) found that those who engaged in anticipatory processing had higher skin conductance than those who engaged in a distraction task, suggesting that anticipatory processing did increase sympathetic activation for all participants regardless of social anxiety status. These two studies have provided promising results, but this research is limited and will benefit from

additional studies examining the relationship between anticipatory processing and physiological responding. Research on psychophysiological responding to fearful images has suggested that SAD falls in the middle of the anxiety disorder spectrum, which is characterized by acute, fear-related disorders (e.g., specific phobia) on one end and chronic, general-distress related disorders (e.g., generalized anxiety disorder, posttraumatic stress disorder) on the other (Lang & McTeague, 2009; McTeague & Lang, 2012; McTeague et al., 2009). Therefore, an added benefit of examining physiology during anticipatory processing can be to provide information about the degree of imagery that may be present during anticipation.

Potential Functions of Anticipatory Processing. A psychometric study found that anticipatory processing may consist of both preparatory (e.g., rehearsing conversations, thinking about everything that could happen) and avoidance-based (e.g., planning how to escape or avoid the interaction, thought suppression) cognitions, with only the latter predicting negative outcomes in socially-anxious individuals (Mills, Grant, Lecher, & Judah, 2013). Using these subscales, Mills, Grant, Lechner and Judah (2014) examined the simultaneous roles of worry, rumination (and its subscales), and anticipatory processing in the prediction of symptoms of social anxiety, generalized anxiety disorder, and depressive symptoms. They consistently found that avoidance-related anticipatory processing predicted social anxiety symptoms above and beyond the effects of worry and rumination. Together, both studies (Mills et al., 2013; Mills, Grant, Lechner, & Judah, 2014) underscored the importance of research attempting to evaluate the functions anticipatory processing.

Anticipatory Processing and Clark and Wells (1995). Although interesting, few of these studies tested Clark and Well's (1995) hypothesis that anticipatory processing influenced other cognitive components of their model (i.e., attention and interpretation). Mills and colleagues (2014a) used a methodology similar to Hinrichsen and Clark (2003) in order to address this gap. HSAs and LSAs engaged in either an anticipatory processing (Hinrichsen & Clark, 2003) or distraction (Nolen-Hoeksema & Morrow, 1993) task and assessed the effects of anticipatory processing on self-focused attention and negative interpretations. They found that HSAs who engaged in anticipatory processing reported higher levels of self-focus (e.g., focusing on the sound of one's voice, physiology, thoughts, anxiety, etc.) than any other group, suggesting that anticipatory processing indeed enhanced self-focused attention as Clark and Wells (1995) suggested. Anticipatory processing also resulted in higher endorsement of negative interpretations regardless of social anxiety group, and self-focused attention mediated this relationship for HSAs. Therefore, the direct link between anticipatory processing and self-focused attention has been found, but methods other than self-report are needed in order to better understand the relationship.

Mills, Grant, Judah, and White (2014) conducted a follow-up study that examined the effect of anticipatory processing on attentional bias for internal threat information. This study was based on the methodology of Pineles and Mineka (2005), in which HSAs and LSAs engaged in a modified dot-probe task prior to a social threat or control task. External stimuli consisted of emotional faces, as with prior attention bias studies, and internal stimuli included threat (heart wave) and neutral (sound wave) images. Mills and colleagues (2014b) had participants engage in a baseline attention task followed by an

anticipatory processing or distraction manipulation. Participants then completed a second attention task. Prior to anticipatory processing, HSAs' bias score did not differ from zero; however, after anticipatory processing, they were significantly biased toward the heart rate stimuli. Therefore, results suggested that HSAs who engaged in anticipation experienced an increase in attention bias score for internal information. As with similar studies (Deiters et al., 2013; Mansell et al., 2003; Pineles & Mineka, 2005), attention bias was not observed under the control condition.

This study provided further elaboration of the influence of anticipatory processing on attention. It suggested that anticipatory processing prior to a social interaction may activate biases for internal threat information, which as Clark and Wells (1995) suggest, may prevent individuals from noticing external information. However, the mechanisms responsible for the relationship between anticipatory processing and attention biases are not clear. It is possible that anticipatory processing, which consists of intrusive image-based and verbal stimuli, consumes attentional resources and impairs the ability for concurrent task processing (e.g., Eysenck et al., 2007). Thus, HSAs have fewer resources available in which to process stimuli that could contradict their negative expectations, and information processing becomes automatic and stimulus-driven (e.g., Amir & Bomyea, 2011; Corbetta & Shulman, 2002; Eysenck et al., 2007; Teachman, Joormann, Steinman, & Gotlib, 2012). These automatic processes default to threatening appraisals and negative memories, resulting in the further maintenance of SAD symptoms.

Studies on worry (Hayes, Hirsch, & Mathews, 2008) and rumination (Joormann, Levens, & Gotlib, 2011) have suggested that those styles of RNT can interfere with working memory. Specifically, those high in worry demonstrated impaired working

memory performance when worrying compared to low worriers (Hayes et al., 2008), whereas those with major depressive disorder had greater difficulty manipulating verbal information than nondepressed controls, especially when the verbal information was negative (Joorman et al., 2011). Both studies suggest that trait symptoms and state mental activity interact to disproportionately interfere with working memory capacity in those with symptoms of psychopathology. Although examining similar research questions in anticipatory processing is intuitive, it has only been inferred that anticipatory processing consumes attentional resources.

Current Study

Therefore, one purpose of the current study was to evaluate the degree of working memory impairment that results from engaging in anticipatory processing. Evidence of impairment can provide specific information about how anticipatory processing maintains symptoms of SAD. As predicted by theories of working memory and anxiety, an increase in cognitive load from anticipatory processing may reduce the available resources needed in order to focus on the interaction, inhibit intrusive anxious thoughts, and/or shift attention from internal physiology to other stimuli. With few available cognitive resources, HSAs are left to rely on automatic processes (e.g., Teachman et al., 2012) to process emotional threat information. In other words, there are an abundance of consequences associated with impaired attentional functioning due to anticipatory processing, but no research has taken the first step to determine if this impairment is present.

This study also will examine if impairment is primarily related to verbal working memory, visual working memory, or if impairment is equal between the two. There are

significant implications for each potential outcome. An abundance of research has suggested that imagery results in more negative affect compared to verbal stimuli (Brozovich & Heimberg, 2013; Lang & McTeague, 2009; Mathews, Ridgeway, & Holmes, 2013; McTeague & Lang, 2012; McTeague, Lang, Laplante, Cuthbert, & Strauss, 2009; Vassilopoulos, 2005). Other evidence suggests that repetitive verbal thinking (e.g., worry) may serve as a form of avoidance from distressing imagery (e.g., Borcovec, Alcaine, & Behar, 2004) or significant negative changes in affect (Newman & Llera, 2011). It currently is unclear if anticipatory processing is predominately verbal or image-based, as qualitative descriptions of the process (e.g., Clark & Wells, 1995; Hinrichsen & Clark, 2003) provide both image (e.g., "think of how you will appear to others") and verbal (e.g., "rehearse what you are going to say") content. It is possible that anticipatory processing is characterized by both verbal and visual stimuli, which would distinguish it from primarily-verbal (e.g., worry; Langlois, Freeston, & Ladouceur, 2000) and primarily image-based (e.g., obsessions in obsessive-compulsive disorder; Langlois et al., 2000) forms of RNT. In partial support of this, Lang and McTeague (2009) have suggested that SAD falls between the fear/imagery and distress/verbal extremes on the spectrum of anxiety disorders. The current study will help to advance the SAD and RNT literatures by examining the verbal and/or imagery impairment that anticipatory processing produces. It also can provide information about the specific results of anticipatory processing on working memory performance.

In the proposed study, participants who score high (HSA) or low (LSA) on a measure of social anxiety symptoms will be informed that they will be engaging in a social interaction later in the study. Then, they will be instructed to engage in an

anticipatory processing or distraction task (Appendix B), which includes thinking prompts related to the upcoming social interaction (Anticipation task; Hinrichsen & Clark, 2003; Mills et al., 2014a; 2014b) or random visual stimuli (e.g., the shape of Africa; Nolen-Hoeksema & Morrow, 1993). Finally, they completed counterbalanced verbal (e.g., recall a series of words) and visual (e.g., recall a visual pattern) working memory tasks in order to determine if anticipatory processing results in impairment in verbal performance, visual performance, or both.

Hypotheses

Social Anxiety Group Effects. Consistent with predictions of attentional control theory, which suggests anxious participants recruit compensatory resources to complete tasks while anxious, we expect no overall differences between participants high and low in social anxiety symptoms.

Visual Impairment. Because mental imagery appears to be particularly problematic in social anxiety (Heimberg et al., 2010), we expect that visual task performance will be more impaired than verbal task performance for those engaging in anticipatory processing.

SA Group X Condition Interaction. We expect SA group to moderate the condition effects such that HSAs will experience more impairment when engaging in AP than HSAs in the control condition and LSA participants in either condition.

A figure of the hypothesized pattern of results is presented in Figure 1.

APPENDIX B

THINKING PROMPTS FOR BOTH CONDITIONS

Anticipatory Processing Instructions (Hinrichsen & Clark, 2003)

I would like you to prepare for the upcoming interaction by following the steps below. As you read the prompts, use your imagination and concentration to focus your mind on each of the ideas.

- Think about/imagine a social situation in which you felt that others formed an unfavorable impression of you.
- Think about/imagine how you looked to others during that particular situation?
- Think about/imagine how you are going to look during the upcoming interaction.
- Think about/imagine what could go wrong during the interaction.
- Think about/imagine the worst thing that could happen during the interaction.
- Think about/imagine what you would have to do if you made a fool of yourself.

Distraction Instructions (from Nolen-Hoeksema & Morrow, 1993)

I would like you to prepare for the upcoming interaction by following the steps below. As you read the prompts, use your imagination and concentration to focus your mind on each of the ideas.

- Think about/imagine a double-decker bus driving down a street.
- Think about/imagine a boat slowly crossing the Atlantic ocean.
- Think about/imagine the shape of the torch of the Statue of Liberty.
- Think about/imagine the movement of an electric fan on a warm day.
- Think about/imagine a group of polar bears fishing in a stream.
- Think about/imagine a gas station on the side of a highway.

APPENDIX C

ANTICIPATORY SOCIAL BEHAVIOURS QUESTIONNAIRE (HINRICHSEN & CLARK, 2003)

The following items ask you about behaviors, thoughts, and mental images that some people have prior to engaging in a social situation. Read each item below and select the option that best characterizes what you do prior to a social situation.

1	2	3	4
Never			Always

1. I think about similar situations in which I have failed in the past _____
2. I try to think of everything that could happen _____
3. I imagine the worst that could happen _____
4. I go over in detail what might happen _____
5. I try to picture how I will appear to others _____
6. I try to plan what I am going to say _____
7. I rehearse conversations in my mind _____
8. I remind myself of things I should not do _____
9. I think about ways in which I could put things right if I make a fool of myself _____
10. I think about ways in which I could avoid having to face the situation _____
11. I think about ways in which I could escape from the situation if it gets too embarrassing _____
12. I make a conscious effort not to think about the situation _____

APPENDIX D

ATTENTIONAL CONTROL SCALE (ACS; DERRYBERRY & REED, 2002)

Here are some different ways that people can feel about working and concentrating. Please indicate how strongly each statement applies to you.

1 = Almost never 2 = Sometimes 3 = Often 4 = Always

1. It's very hard for me to concentrate on a difficult task when there are noises around.	1	2	3	4
2. When I need to concentrate and solve a problem, I have trouble focusing my attention.	1	2	3	4
3. When I am working hard on something, I still get distracted by events around me.	1	2	3	4
4. My concentration is good even if there is music in the room around me.	1	2	3	4
5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.	1	2	3	4
6. When I am reading or studying, I am easily distracted if there are people talking in the same room.	1	2	3	4
7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.	1	2	3	4
8. I have a hard time concentrating when I'm excited about something.	1	2	3	4
9. When concentrating I ignore feelings of hunger or thirst.	1	2	3	4
10. I can quickly switch from one task to another.	1	2	3	4
11. It takes me a while to get really involved in a new task.	1	2	3	4
12. It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures.	1	2	3	4
13. I can become interested in a new topic very quickly when I need to.	1	2	3	4
14. It is easy for me to read or write while I'm also talking on the phone.	1	2	3	4
15. I have trouble carrying on two conversations at once.	1	2	3	4
16. I have a hard time coming up with new ideas quickly	1	2	3	4
17. After being interrupted or distracted, I can easily shift my attention back to what I was doing before.	1	2	3	4
18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.	1	2	3	4
19. It is easy for me to alternate between two different tasks.	1	2	3	4
20. It is hard for me to break from one way of thinking about something and look at it from another point of view.	1	2	3	4

APPENDIX E

CENTER FOR EPIDEMIOLOGICAL STUDIES - DEPRESSION SCALE (CES-D; RADLOFF, 1977)

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way in the past week.

DURING THE PAST WEEK

Rarely or none of the time (less than 1 day)	Some or a little of the time (1 – 2 days)	Occasionally or a moderate amount of time (3 – 4 days)	Most or all of the time (5 – 7 days)
0	**1**	**2**	**3**

_____ 1. I was bothered by things that usually don't bother me.
_____ 2. I did not feel like eating; my appetite was poor.
_____ 3. I felt that I could not shake off the blues even with help from my family or friends.
_____ 4. I felt I was just as good as other people.
_____ 5. I had trouble keeping my mind on what I was doing.
_____ 6. I felt depressed.
_____ 7. I felt that everything I did was an effort.
_____ 8. I felt hopeful about the future.
_____ 9. I thought my life had been a failure.
_____ 10. I felt fearful.
_____ 11. My sleep was restless.
_____ 12. I was happy.
_____ 13. I talked less than usual.
_____ 14. I felt lonely.
_____ 15. People were unfriendly.
_____ 16. I enjoyed life.
_____ 17. I had crying spells.
_____ 18. I felt sad.
_____ 19. I felt that people dislike me.
_____ 20. I could not get "going."

APPENDIX F

THE COGNITIVE FAILURES QUESTIONNAIRE (BROADBENT, COOPER, FITZGERALD & PARKES, 1982)

The following questions are about minor mistakes which everyone makes from time to time, but some of which happen more often than others. We want to know how often these things have happened to you in the past 6 months. Please circle the appropriate number.

		Very often	Quite often	Occas ion-ally	Very rarely	Never
1.	Do you read something and find you haven't been thinking about it and must read it again?	4	3	2	1	0
2.	Do you find you forget why you went from one part of the house to the other?	4	3	2	1	0
3.	Do you fail to notice signposts on the road?	4	3	2	1	0
4.	Do you find you confuse right and left when giving directions?	4	3	2	1	0
5.	Do you bump into people?	4	3	2	1	0
6.	Do you find you forget whether you've turned off a light or a fire or locked the door?	4	3	2	1	0
7.	Do you fail to listen to people's names when you are meeting them?	4	3	2	1	0
8.	Do you say something and realize afterwards that it might be taken as insulting?	4	3	2	1	0
9.	Do you fail to hear people speaking to you when you are doing something else?	4	3	2	1	0
10.	Do you lose your temper and regret it?	4	3	2	1	0
11.	Do you leave important letters unanswered for days?	4	3	2	1	0
12.	Do you find you forget which way to turn on a road you know well but rarely use?	4	3	2	1	0

13.	Do you fail to see what you want in a supermarket (although it's there)?	4	3	2	1	0
14.	Do you find yourself suddenly wondering whether you've used a word correctly?	4	3	2	1	0
15.	Do you have trouble making up your mind?	4	3	2	1	0
16.	Do you find you forget appointments?	4	3	2	1	0
17.	Do you forget where you put something like a newspaper or a book?	4	3	2	1	0
18.	Do you find you accidentally throw away the thing you want and keep what you meant to throw away – as in the example of throwing away the matchbox and putting the used match in your pocket?	4	3	2	1	0
19.	Do you daydream when you ought to be listening to something?	4	3	2	1	0
20.	Do you find you forget people's names?	4	3	2	1	0
21.	Do you start doing one thing at home and get distracted into doing something else (unintentionally)?	4	3	2	1	0
22.	Do you find you can't quite remember something although it's "on the tip of your tongue"?	4	3	2	1	0
23.	Do you find you forget what you came to the shops to buy?	4	3	2	1	0
24.	Do you drop things?	4	3	2	1	0
25.	Do you find you can't think of anything to say?	4	3	2	1	0

APPENDIX G

DEMOGRAPHICS FORM

What is your gender identity?:
_____ Female
_____ Female to male transgender
_____ Male
_____ Male to female transgender
_____ Not sure
_____ Other (please specify _____)

Do you identify as LGBT?

_____Yes
_____No

Age: _____

Ethnicity (check all that apply)

_____ Caucasian	_____ Latino/Latina
_____ African American	_____ Chicano/Chicana
_____ Asian	_____ Middle Eastern

_____ Native American/American Indian/Alaskan Native
_____ Pacific Islander
_____ Other (Please specify: _____)

Place of Birth: _____ Primary Language: _____

High School GPA: _____ College GPA: _____

Year in School:
_____ Freshman
_____ Sophomore
_____ Junior
_____ Senior
_____ Graduate student

APPENDIX H

EXTENDED POST-EVENT PROCESSING QUESTIONNAIRE (E-PEPQ; FEHM ET AL., 2008)

We would like you to remember one specific social situation, which has led to unreasonably strong or unrealistic anxiety or discomfort or in which you had a strong feeling of shame. Please let yourself be guided by the situations listed below. The situation should have been of personal relevance to you, and it should have happened during the past six months. If you remember more than one situation, please choose the one that was most relevant for you.

1) Please mark the situation you have chosen and remember to refer to this situation while answering questions 2 – 18.

☐ Talking in front of a group ☐ being at a party ☐ talking to authorities;

☐ participating in group activities ☐ using public restrooms ☐ returning goods to a store

☐ expressing disapproval ☐ talking on the phone ☐ dating someone

☐ formal and informal meetings ☐ oral exams ☐ giving a party

☐ eating/drinking/writing in public ☐ being criticized

☐ initiating a romantic relationship ☐ beginning maintaining a conversation

☐ talking on the phone with others listening

☐ other situation (please describe _____)

Answer the remaining questions on the following scale:

0 (none/never/not at all) ----------100 (very strong always/constantly)

2) After the event was over, how much did you think about it?

3) How much did your memories and thoughts about the event keep coming into your head even when you did not wish to think about it again?

4) How much did the thoughts about the event interfere with your concentration?

5) How difficult was it to forget about the event?

6) How much did you try to resist thinking about the event?

7) If you repeatedly thought about the event, did your feelings about the event worsen?

8) How much have you wondered about whether you could have avoided or prevented your behavior/feelings during the event?

9) How much did you wish that you could turn the clock back and do it again but better this time?

10) As a result of the event, are you now avoiding similar situations?

11) How much did this event reinforce your pre-existing avoidance of similar situations?

12) How much shame do you experience while remembering your behavior during the situation?

13) How much do you think about anxious feelings that you had experienced during the event?

14) When remembering this situation, how much do other past failures that you have experienced in the same way come into your mind?

15) How much do you criticize yourself for your behavior in the situation?

16) To what extent do you think about the event more than you want to?

17) To what extent do you think about bodily sensations you had experienced in the situation?

18) In your memories about the event, how much do you see yourself/your behavior/your attributes in a negative way?

APPENDIX I

PENN STATE WORRY QUESTIONNAIRE (PSWQ; MEYER, MILLER, METZGER, & BORKOVEC, 1990)

Enter the number that best describes how typical or characteristic each item is of you, putting the number next to the item.

1	2	3	4	5
Not at all typical		Somewhat typical		Very typical

_____ 1. If I do not have enough time to do everything, I do not worry about it.
_____ 2. My worries overwhelm me.
_____ 3. I do not tend to worry about things.
_____ 4. Many situations make me worry.
_____ 5. I know I should not worry about things, but I just cannot help it.
_____ 6. When I am under pressure, I worry a lot.
_____ 7. I am always worrying about something.
_____ 8. I find it easy to dismiss worrisome thoughts.
_____ 9. As soon as I finish one task, I start to worry about everything else I have to do.
_____ 10. I never worry about anything.
_____ 11. When there is nothing more I can do about a concern, I do not worry about it anymore.
_____ 12. I have been a worrier all my life.
_____ 13. I notice that I have been worrying about things.
_____ 14. Once I start worrying, I cannot stop.
_____ 15. I worry all the time.
_____ 16. I worry about projects until they are all done.

APPENDIX J

RUMINATIVE RESPONSES SCALE (RRS; NOLEN-HOEKSEMA & MORROW, 1991; TREYNOR, ET AL., 2003)

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

1 2 3 4

Almost Never Sometimes Often Almost Always

1. Think "What am I doing to deserve this?" _____
2. Analyze recent events to try to understand why you are anxious in social situations _____
3. Think "Why do I always react this way?" _____
4. Go away by yourself and think about why you feel this way _____
5. Write down what you are thinking and analyze it _____
6. Think about a recent situation, wishing it had gone better _____
7. Think "Why do I have problems other people don't have?" _____
8. Think "Why can't I handle things better?" _____
9. Analyze your personality to try to understand why you are anxious in social situations _____
10. Go someplace alone to think about your feelings _____

APPENDIX K

SOCIAL INTERACTION ANXIETY SCALE, STRAIGHTFORWARD VERSION (S-SIAS; MATTICK & CLARKE, 1998; RODEBAUGH ET AL., 2007)

For each question, please circle a number to indicate the degree to which you feel the statement is characteristic or true of you. The rating scale is as follows:

0 = Not at all characteristic or true of me
1 = Slightly characteristic or true of me
2 = Moderately characteristic or true of me
3 = Very characteristic or true of me
4 = Extremely characteristic or true of me

1. I get nervous if I have to speak with someone in authority (teacher, boss, etc.)	0	1	2	3	4
2. I have difficulty making eye-contact with others.	0	1	2	3	4
3. I become tense if I have to talk about myself or my feelings.	0	1	2	3	4
4. I find difficulty mixing comfortably with the people I work with.	0	1	2	3	4
5. I tense-up if I meet an acquaintance on the street.	0	1	2	3	4
6. When mixing socially, I am uncomfortable.	0	1	2	3	4
7. I feel tense if I am alone with just one person.	0	1	2	3	4
8. I have difficulty talking with other people.	0	1	2	3	4
9. I worry about expressing myself in case I appear awkward.	0	1	2	3	4
10. I find it difficult to disagree with another's point of view.	0	1	2	3	4
11. I have difficulty talking to an attractive person of the opposite sex.	0	1	2	3	4
12. I find myself worrying that I won't know what to say in social situations.	0	1	2	3	4
13. I am nervous mixing with people I don't know well.	0	1	2	3	4
14. I feel I'll say something embarrassing when talking.	0	1	2	3	4
15. When mixing in a group, I find myself worrying I will be ignored.	0	1	2	3	4
16. I am tense mixing in a group.	0	1	2	3	4
17. I am unsure whether to greet someone I know only slightly.	0	1	2	3	4

APPENDIX L

POSITIVE AND NEGATIVE AFFECT SCHEDULE (PANAS; WATSON, CLARK, & TELLEGEN, 1988)

PANAS

This scale consists of a number of words that describe different feelings and emotions. Please read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this was **RIGHT NOW,** that is, HOW YOU FEEL **AT THIS MOMENT.** Use the following scale to indicate your answers:

1	**2**	**3**	**4**	**5**
very slightly or not at all	**a little**	**moderately**	**quite a bit**	**extremely**

_____interested	_____irritable
_____distressed	_____alert
_____excited	_____ashamed
_____upset	_____inspired
_____strong	_____nervous
_____guilty	_____determined
_____scared	_____attentive
_____hostile	_____jittery
_____enthusiastic	_____active
_____proud	_____afraid
_____anxious	_____relaxed
_____depressed	

APPENDIX M

STRATEGY USE QUESTIONNAIRE (BROWN & WESLEY, 2013)

STQ - Visual Task Version

1. Please rate the extent to which you relied upon a visual and/or verbal strategy to help you remember the **checkered patterns**. A visual strategy involves concentrating on your mental image of what the pattern looks like. A verbal strategy involves verbalizing the features of the pattern and concentrating on that verbal information.
1) I used a verbal strategy only
2) I used mostly verbal but some visual rehearsal
3) I used verbal and visual strategies equally
4) I used mostly visual but some verbal rehearsal
5) I used a visual strategy only

2. To what extent did you combine visual and verbal strategies to help remember the **patterns**?
1) Always 2) Most of the time 3) Sometimes 4) Rarely 5)Never

3. To what extent did you **count up the number of black cells**?
1) Always 2) Most of the time 3) Sometimes 4) Rarely 5)Never

4. To what extent did you attach verbal labels to some of the individual shapes? (e.g., naming a
collection of black cells the letter L)
1) Always 2) Most of the time 3) Sometimes 4) Rarely 5)Never

5. To what extent did you focus upon refreshing your mental image of the **pattern**?
1) Always 2) Most of the time 3) Sometimes 4) Rarely 5)Never

STQ – Verbal Task Version

1. Please rate the extent to which you relied upon a visual and/or verbal strategy to help you remember the **words**. A visual strategy involves concentrating on your mental image of what the pattern looks like. A verbal strategy involves verbalizing the features of the pattern and concentrating on that verbal information.
1) I used a verbal strategy only
2) I used mostly verbal but some visual rehearsal
3) I used verbal and visual strategies equally
4) I used mostly visual but some verbal rehearsal
5) I used a visual strategy only

2. To what extent did you combine visual and verbal strategies to help remember **the words**?
1) Always 2) Most of the time 3) Sometimes 4) Rarely 5)Never

3. To what extent did you focus upon refreshing your mental image of **the words**?
1) Always 2) Most of the time 3) Sometimes 4) Rarely 5)Never

APPENDIX N

MANIPULATION CHECK QUESTIONNAIRE

During the imagination task, were you asked to think about/imagine:

…raindrops sliding down a windowpane?	**Yes**	**No**
… the layout of a typical classroom?	**Yes**	**No**
…how you are going to appear during the upcoming social interaction?	**Yes**	**No**
… your character and who you strive to be?	**Yes**	**No**
… clouds forming in the sky?	**Yes**	**No**
… a gas station on the side of a highway?	**Yes**	**No**
… a specific social situation that you felt did not go well?	**Yes**	**No**
… a clown putting on his or her make-up?	**Yes**	**No**
… the worst thing that could happen during the social interaction?	**Yes**	**No**
… what you would have to do if you made a fool of yourself?	**Yes**	**No**
… the shape of the continent Africa?	**Yes**	**No**
… the expectations your family has for you?	**Yes**	**No**
… what could go wrong during the social interaction?	**Yes**	**No**
… your appearance during a past social situation?	**Yes**	**No**
… a train stopped at a station?	**Yes**	**No**
… the baggage claim at the airport?	**Yes**	**No**
… objects that are in rooms in your house?	**Yes**	**No**

To what extent did you think about the Thinking Prompts during the pattern or word tasks?

I thought of the prompts the entire time I completed the tasks

10
9
8
7
6

I thought about the prompts about half of the time during the tasks.

5
4
3
2
1

I did not think about the prompts at all during the tasks

0

Please continue to the next page

Throughout the duration of the study, how much did you believe that you would be participating in a social interaction? Using the scale below, please choose one number below and circle it.

10 I was completely convinced there WOULD be an interaction
9
8
7 I was pretty sure there WOULD be an interaction
6
5 I was not sure either way
4
3
2 I was pretty sure there would NOT be an interaction
1
0 I was completely convinced there would NOT be an interaction

APPENDIX O

IRB APPROVAL PAGE

Note: This study was approved as a modification and continuation of a previous study. The original IRB approval (for the previous study is below). The continuation and modification approvals are reproduced on subsequent pages.

Oklahoma State University Institutional Review Board

Date:	Thursday, January 10, 2013
IRB Application No	AS12140
Proposal Title:	Anticipation and Attention
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 1/9/2014

Principal Investigator(s):

Adam Mills
116 N. Murray
Stillwater, OK 74078

DeMond Grant
205 N. Murray
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI, advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Shelia H. Kennison

Shelia Kennison, Chair
Institutional Review Board

This is the continuation approval.

Oklahoma State University Institutional Review Board

Date	Wednesday, December 11, 2013	Protocol Expires:	12/10/2014
IRB Application No:	AS12140		
Proposal Title:	Anticipation and Attention		

Reviewed and Processed as: Expedited
Continuation

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s)

Adam Mills
116 N. Murray
Stillwater, OK 74078

DeMond Grant
205 N. Murray
Stillwater, OK 74078

Approvals are valid until the expiration date, after which time a request for continuation must be submitted. Any modifications to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

- The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

New subject enrollment still in progress. No new changes, risks, reportable events, withdrawals, complaints or funding.

Signature: Shelia K

Shelia Kennison, Chair, Institutional Review Board

Wednesday, December 11, 2013
Date

This is the modification approval.

Oklahoma State University Institutional Review Board

Date:	Tuesday, November 12, 2013	Protocol Expires:	1/9/2014
IRB Application No:	AS12140		
Proposal Title:	Anticipation and Attention		
Reviewed and Processed as:	Expedited **Modification**		

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s):

Adam Mills
116 N. Murray
Stillwater, OK 74078

DeMond Grant
205 N. Murray
Stillwater, OK 74078

The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed. The IRB office MUST be notified in writing when a project is complete. All approved projects are subject to monitoring by the IRB.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

Modification to 1) add 80 participants, 2) modify the Distraction and Attention Tasks, 3) add Strategy Use Questionnaire, and 4) remove the Prediction Questionnaire and remove any questions about the old attention task from the Manipulation Check.

Signature :

Shelia Kennison, Chair, Institutional Review Board

Tuesday, November 12, 2013
Date

VITA

Adam Charles Mills

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE INFLUENCE OF ANTICIPATORY PROCESSING ON VISUAL AND VERBAL WORKING MEMORY TASK PERFORMANCE

Major Field: Clinical Psychology

Biographical:

Education:

- Completed the requirements for the Doctor of Philosophy in Clinical Psychology at Oklahoma State University, Stillwater, Oklahoma in July 2016.

- Completed the requirements for the Master of Sciences in Clinical Psychology at Oklahoma State University, Stillwater, Oklahoma in July 2012.

- Completed the requirements for the Master of Sciences in Clinical Psychology at Minnesota State University, Mankato, Minnesota in May 2010.

- Completed the requirements for the Bachelor of Arts in Psychology at The University of Nebraska – Lincoln, Lincoln, Nebraska in December 2007.

Experience:

- Clinical residency at the Charleston Consortium, Charleston, SC
- 18 publications in peer-reviewed journals
- 51 papers or posters presented at conferences
- Various research laboratory experience (2004 – 2015)
- Various clinical practica (2010 – 2014)
- Various teaching assignments (2009 – 2015)

Professional Memberships:

- Association for Behavioral and Cognitive Therapies (2010-Present)
- American Psychological Association (2011-Present)
- Society for a Science of Clinical Psychology (2014-Present)