ANXIETY'S EFFECT ON DIRECT ATTENTION FATIGUE

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ABSTRACT

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Research has suggested that the use of sustained direct attention can result in a fatiguing effect. It is believed that this attention fatigue is specific to direct attention, which is an intentional cognitive process. Direct attention serves to focus a person's cognition on selected information so that the targeted information may be processed. If common activities fatigue attention then it is possible that these important processes may be less efficient. A common daily experience is social evaluation. For many people, perhaps most people, social evaluation evokes anxiety. It is possible that the feeling of anxiety can act as a powerful distractor requiring you to use intentional direct attention. Thus, performing while feeling anxiety may result in attention fatigue. To test whether anxiety could cause attention fatigue, 54 undergraduates performed a modified TSST task, during which heart rate and the STAI-Y-6 were collected as measures of state anxiety and the reversible figure test was used as a measure of attention. Results were unable to establish a link between attention fatigue and anxiety.

CHAPTER ONE: LITERATURE REVIEW

Attention as a Whole

Attention consists of three elements or processes: sensory selection, attentional capacity, and response intention/selection (Cohen, 2014). It is through a combination of these processes that attention can be sustained (Cohen, 2014). Sensory selection occurs when the attention is directed to a specific sensory channel or a segment of the sensory input in one channel. This process can be either intentional and active or automatic. Selection can be affected by several factors, such as interest, priming, orienting, or past experiences (Cohen & O'Donell, 1993; Kundsen, 2007). For instance, an individual may "choose" to focus on something and orient his or her attention accordingly. For example, in a loud, confusing social setting he or she may select just a small portion of his or her auditory channel in order to process the name of a stranger he or she just met (Cohen & O'Donell, 1993; Kundsen, 2007).

Response intention/selection is the process of reacting appropriately given the context of a situation (Cohen & O'Donell, 1993). When an environment presents many stimuli each stimulus may suggest a different response, an individual takes all the information and develops a response strategy that will be effective in the context (Cohen, 2014; Cohen & O'Donell 1993; Cohen & Sparling-Cohen, 1993; Garforth, McHale, Meehah, 2006). For example, when you are driving on a sunny day an upcoming curve will not call for a change in your response. You can simply maintain your speed. If you are performing the same task during a heavy rain driving requires a much more active approach. You must select new responses based on "rain" cues. There will be more conscious effort to focus and react in the latter case (Cohen & O'Donell, 1993).

Humans have an attentional capacity. We cannot process an infinite amount of information. Our attentional capacity consists of two parts, structural capacity and amount of exerted focus, both of which can vary on an individual basis. Structural capacity includes the individual's more fixed abilities, such as channel capacity or processing speed (Cohen & O'Donell, 1993; Haroz & Whitney, 2012; Huang & Pashler, 2004). Our exerted focus takes into account the generated effort used toward attending to presented information. Unlike structural capacity, focus is affected by more dynamic factors, such as motivation or level of arousal (Cohen, Lohr, Paul, & Boland, 2001; Cohen & O'Donell 1993). Put more simply, our structural capacity is the maximum amount of information we can process. Exerted focus is the amount of effort we are using when we attempt to process information. The resulting interaction between our maximum information capacity and the amount of effort exerted to processes the information presented is our attentional capacity.

Sustained attention is the process of fixating your attention on a selected stimulus for a prolonged amount of time (Cohen & O'Donell, 1993). In order to sustain attention a combination sensory selection, response selection, and focus is used. Returning to the example of driving a car, optimal driving performance requires that you provide preferential treatment to all stimuli that can affect the task, such as weather conditions, other cars, warning lights, etc. Doing so allows you to create and alter reaction strategies as needed. This preferential treatment of stimuli must be maintained for the entire drive or you risk a wreck. In order to ensure that you continue to show preferential treatment to stimuli that are relevant to the task of driving you must maintain a minimal level of focus. The minimal level of focus needed will vary depending on the complexity of the drive. Because sustained attention is the result of the interaction of sensory selection, response selection, and exerted focus; sustained attention can be rather fragile. If a single element of our attention shifts or falters then sustained attention will be broken. (Cohen & O'Donell, 1993).

Selecting Stimuli and Sustaining Attention

Attention is clearly limited and focusing on one stimulus in an incredibly complex world can be challenging (Cohen, Lohr, Paul, & Boland, 2001; Cohen & O'Donell, 1993; Haroz & Whitney, 2012; Huang & Pashler, 2004). This raises the obvious question of what is it that guides attention to one stimulus at any given moment? William James (1892) suggested that your level of "interest" in the stimulus is the key to sensory selection and sustained attention. Further, in an early version of the direct and indirect attention dichotomy mentioned above, James suggested that attention can be either passive and involuntary or active and voluntary and that "interest" in the situation determined which process was engaged.

James (1892) argued that people do not focus on a stimulus, even for a brief amount of time, without some sort of interest in the stimulus. When a person is surrounded by stimuli, the stimulus of greater interest is the stimulus on which the individual focuses. When a stimulus is inherently interesting attention is automatically engaged. In simple terms, this is fascination. In the absence of such fascination a person chooses to attend to a stimulus and generates an interest in the stimuli.

A good example of this is an atypical event or stimulus. For example, an obvious black mark on a white wall. The mark is in such contrast to it surrounding that it may engage your attention automatically. Your focus will immediately be drawn to the black mark because clear contrast makes it fascinating. On the other hand, voluntary attention is engaged when the individual chooses to make the stimulus interesting (James 1892). Voluntary attention requires effort to assign the stimulus importance. For example, the black mark on a white wall initially draws involuntary attention but quickly becomes unimportant. To remain focused on the black mark you must assign it significance. As you adapt to the contrast between the mark and the wall to remain focused you must assign the mark importance. The assigned importance can seem similar to the mark's original intriguing character but it is fundamentally different. In other words, you are still focused on the black mark not because the mark looks out of place in the white room, but because you are now consciously assigning the mark's significance.

Further, when you are directing your attention you actually perform two tasks simultaneously. You assign importance to the target stimulus, as mentioned above, and at the same time you try to reduce the importance of non-target stimuli. Whenever you lose focus on an object you must exert renewed effort to resume both of these tasks (Kaplan, 1995). Returning a final time to the black mark on a white wall, if you are to focus your attention on the mark for a long period then you must repeatedly assign the mark a high level of importance. At the same time you must ensure that no other stimulus appears more important than the mark.

While James' theory of attention was entirely theoretical key components of James's theory have been validated in contemporary empirical work. For example, Jonides (1981) demonstrated that attention can be engaged either automatically or voluntarily and that actively engaging attention is much more difficult. Jonides reported three experiments relating direct and indirect attention to the location of a visual cue that appeared suddenly.

The first experiment asked participant to fixate on the center of a computer screen and respond when either the letter L or R appeared somewhere on the screen (Jonides, 1981). The target letter was presented amid a random array of seven distractor letters. Before the appearance of the target letter an arrow would appear momentarily. The arrow was at either the center of the screen or the edge of the screen. The arrow acted as a reliable but not perfect cue to the location of the next target letter. Participants were asked to respond as quickly as possible and their accuracy and reaction times were measured. Participants benefited by attending to the arrow cues. Lastly, the participants were asked to memorize a series of digits before the task and repeat the digits after the task.

This experiment showed that when the cue was in the center of the screen the reactions were slower, the discrimination was performed with less accuracy and digits were recalled with less accuracy (Jonides, 1981). Jonides proposed that centered cues were processed deliberately and thus activated direct attention. On the other hand, peripheral cues activated automatic or indirect attention. Because direct attention requires more cognitive effort than indirect attention, centered cues interfered more with recall in the digit span task.

Jonides explanation is supported by Eimer (2000) and Doallo et al. (2004). Eimer and Doallo et al. found that a peripheral cue is processed much more quickly than a central cue. When a peripheral cue appeared for 100 milliseconds reaction times to the cue were faster. This effect disappeared when the peripheral cue appeared for a longer period (700 milliseconds). With longer presentations subjects shift their attention to actively process the cue. Essentially, with longer presentations the peripheral cue became the center of the subject's attention. This interpretation matches the findings that when cues were presented centrally reaction time increased regardless of how long the cue was present.

For his second experiment Jonides (1981) hypothesized that if peripheral cues automatically engaged attention, they should be harder to ignore than central cues. In order to test this, Jonides conducted the same stimulus response task but removed the digit span recall task and reduced predictable validity of the arrow cue from 70% to 12.5%. He informed the participants that the arrow cues appeared at random and that it was unlikely that the arrows would predict the location of the L or R in the letter array and that it was in the participant's best interest to ignore the cues. Unreliable peripheral cues slowed reaction times and reduced response accuracy.

Jonides (1981) argues that this difference appeared because the participants were unable to ignore the peripheral arrow cues. Despite the fact the participants had been advised to ignore the cues, the cues in the peripheral condition automatically engaged the participant's attention and created a response tendency. Responding based on the unreliable cue was often incorrect producing lower accuracy or inhibiting the incorrect response slowed reaction time.

Eimer (2000) and Doallo et al. (2004) also replicated this effect. Unreliable peripheral cues increased reaction time. These studies suggest that when peripheral information is noticed it is processed automatically. Thus, inaccurate or misleading peripheral cues slow responding or reduce accuracy in fast responses.

For the final experiment Jonides (1981) used a reliable cue presented one of two ways. In one condition the arrow cue appeared 80 times in a central location and 20 times in the periphery. In the alternative conditions these rates of appearance were reversed. Further, there were two groups in each condition. One group was given a 25 millisecond delay between the appearance of the arrow cue and target letter while the other was given a 100 millisecond delay between the appearance of the cue and target. The results of this experiment showed that when central cues are expected, because they are appearing much more often, they improve performance if they are accurate and reduce performance if they are inaccurate. However if the central cue is unexpected, because it is appearing infrequently, the cue has no effect on reaction time and error rate unless there is a delay between the cue and the target stimulus.

This finding requires some explanation. We process the center of our perceptual field intentionally using direct attention. Direct attention demands time. However, we can be primed to process the arrow cue if it is appearing consistently. Thus, when we expect the appearance of a cue we are primed to engage direct attention and can do so more effectively. Accurate arrows then help and inaccurate arrows hurt. However, when we do not expect the appearance of a cue that requires direct attention, there is a delay in the process of engaging our attention. Thus, in the unexpected central presentation with a short delay direct attention never engaged, the information represented by the arrow isn't processed and the arrow has no effect on reaction time or accuracy. When there is an unexpected arrow and a long delay, which gives the subject time to engage direct attention and process the arrow, accurate arrows help and inaccurate arrows hurt performance.

This effect of delay should not appear when the arrow cues are presented in the periphery because those cues would be always processed using automatic indirect attention. The data show that regardless of the rate at which peripheral arrow cues appeared, they still resulted in faster reaction times and more accurate discriminations when they were valid, and the opposite when they were not valid. Peripheral cues engage indirect attention and do not benefit from or depend upon priming through expectation.

Jonides' (1981) work provides evidence that two forms of attention operate in human cognition. Peripheral cues engage indirect attention automatically and central cues engage effortful direct attention. The key point to take forward from this work is that the direct attention is effortful while indirect attention is automatically and effortlessly engaged.

Jonides (1981) conclusions in experiments 2 and 3 have been replicated and extended by Rees, Frith and Lavie (1997) who showed that participants were less able to detect words that were printed in all capital letters when the detection task was presented with peripheral distractors. Peripheral cues engaged indirect attention and actively distracted the subjects from completing the primary task. However, Rees, Frith and Lavie's (1997) extended Jonides' result by showing that direct attention can resist disruption if the central task is more completely engaging. Specifically, the negative effects of peripheral distractors were significantly reduced when subjects were asked to find a bisyllabic word within a list of monosyllabic words. This is a very demanding central task. The outside cues were more easily ignored when direct attention was fully engaged in the central task.

Direct Attention versus Indirect Attention

The studies cited above suggest that attention is dichotomous. Events in our primary perceptual field are typically subject to voluntary or direct attention and events in our periphery are processed automatically using indirect attention. Further, it seems that engaging direct attention is more cognitively demanding. One final line of evidence for both the dichotomy of attention and the effortful nature of direct attention is found in the phenomena of direct attention fatigue.

When a long duration task demands direct attention performance will drop over time (Halliday & Gordon 2012; Macemore, Hurlbut & Gordon, 2011; McGathy, Hesselbirg, & Gordon, 2014; Shemery, McConnell, Halliday, & Gordon 2012). The argument is that the effort of exerting direct attention drains some finite cognitive resource. Thus continued use of direct attention causes a fatigue effect, making it more difficult to maintain or engage direct attention (Kaplan, 1995; Kaplan & Berman, 2010).

Current research suggests that the finite cognitive resource behind directed attention fatigue could be part of the central executive function of cognition (Kaplan & Berman 2010).

The central executive is known to play a role in cueing, directing, and coordinating many of our mental processes, including perception, emotion, and response selection (McCloskey & Perkins 2012). It is reasonable to suppose that the stimulus selection we know as attention is managed by the central executive.

The idea that resources used by the central executive functions are finite is still theoretical, but support for this idea does exist. For example, Schmeichel et al. (2003) has shown that ignoring outside stimuli or suppressing responses to emotional distress results in a significant drop in other executive functions, as measured by performance on intellectual aptitude tests. Baumeister et al. (1998) has shown that when a subject makes a great effort to show self-control, or is forced to suppress emotional responses, that subject's ability to solve puzzles is significantly reduced. Baumeister, Vohs and Tice (2007) found a link between direct attention and emotional regulation, and impulse control, all of which seem to suffer as we self-regulate. This evidence strongly suggests that exertion of our executive functions seems to harm our performance in any other task that involves our executive functions.

The Reversible Figures Test as a Measure of Attention

Based on what is known about direct and indirect attention an effective measure of attention fatigue should achieve three goals. First, the measure must vary reliably and systematically after operations that should fatigue direct attention. Second, the measure should be brief and minimally invasive. An ideal measure of direct attention fatigue would be brief because a brief measure is less likely to cause attention fatigue. If the measure were extended and fatigued attention this would confound any study. A brief non-fatiguing measure would give a more accurate measurement of a subject's level of fatigue and allow multiple tests within a subject (Baumeister et al., 1998; Baumeister, Vohs and Tice, 2007; Kaplan & Berman, 2010;

Schmeichel et al., 2003). Finally, the measure must be compatible with other operations that will fatigue direct attention. For example, an ideal measure of attention fatigue could be used directly before and after a task such as mental math. This would allow for the most accurate within-subject pre and post fatigue measures.

Recent evidence suggests that the perceived reversal rate of an ambiguous or reversible figure can be a measure of direct attention fatigue (Cimprich, 1992; Macemore, Hurlbut & Gordon, 2011; Tennessen & Cimprich, 1995). The reversible figure test (RFT) is an experimental behavioral measure. In this sense it is like other behavioral measures used to assess cognitive functions such as number of items recalled in a list. The RFT is not a clinical measure of direct attention and it has not been normed for any population. The RFT is a new measure that is still in development. This research is both part of that ongoing development of the measure and an experimental application of the measure.

An ambiguous or reversible figure is an image that remains physically constant while a subject's perception of the image changes (Pitts, Gavin, & Nerger 2007).

When you look at these drawings you see two or more versions of the image in irregular alternation. Individuals can stabilize the figure, or reduce the frequency of perceptual shifts, by attending to cues that favor one form of the figure. This focus on one cue is intentional and uses direct attention. Thus, stabilizing an ambiguous figure demands direct attention. If the figure is changing appearance frequently then the individual is not using direct attention to stabilize the image. Over time or across tasks an increase in the frequency with which the figure changes is an indication of reduced direct attention. In simple terms, direct attention stabilizes a reversible figure. The less often the image changes the more effectively attention is stabilizing the image (Cimprich, 1992; Macemore, Hurlbut & Gordon, 2011; Tennessen & Cimprich, 1995).

There is a dispute about whether the reversal of an ambiguous figure arises from a "top-down" or "bottom-up" process (Kornmeier, Hein, & Bach, 2008). Recent research has found evidence for both sides of this dispute. Top-down processing, which is intentional and effortful, seem consistent with exerting control over the perceived reversals of an ambiguous figure. A top-down model suggests that we can see a reversible figure in whatever form we wish to see. If we want stability then the image is stable and if we want a reversal to occur, it will occur. (Kornmeier & Bach, 2004; Kornmeier & Bach 2006; Kornmeier, Hein, & Bach, 2008; Pitts, Gavin, & Nerger 2007; Theeuwes, 2009).

In contrast, the automatic mechanisms of bottom-up processing also seem to play a role in figure reversals. Whenever you reorient to a reversible figure, the appearance of the reversible figure often changes automatically. This occurs even if you are making a conscious effort to hold the figure stable. (Kornmeier & Bach, 2004; Kornmeier & Bach 2006; Kornmeier, Hein, & Bach, 2008; Pitts, Gavin, & Nerger 2007; Theeuwes, 2009). From a bottom-up perspective some element in the reversible figure triggers an automatic perception of one form of the figure. This automatic, bottom-up process can occur even when you are attempting to hold a figure stable. Thus, the bottom-up shift can overwhelm the top-down attempt to maintain stability. This dominance of the bottom-up process may increase as the intentional top-down process is fatigued.

The RFT has been shown to be an experimentally useful measure of attention. From an empirical perspective ambiguous figure reversals have yielded consistent experimental findings in measuring sustained attention. Cimprich (1992) and Tennessen and Cimprich (1995) used the Necker cube as part of a test battery to asses attention in cancer patients. They found that as the disease affected the patients their ability to stabilize the Necker cube's appearance was reduced.

The conclusion was that the illness reduced the patients' direct attention. Macemore, Hurlbut and Gordon (2011) found that reported changes in the appearance of the Necker cube increased when observing the cube alternated with a reverse digit span task that demanded direct attention. Further, the frequency of change increased as the reverse digit span task was increased in duration. When the reverse digit span task increased in duration it should have demanded increasing attention and, theoretically, generated greater levels of fatigue.

This effect has been replicated and extended in several subsequent tests. Shemery, McConnell, Halliday, and Gordon, (2012) showed results similar to Macemore, Hurlbut and Gordon (2011) using a letter search task rather than reverse digit span to fatigue participant attention. Halliday and Gordon (2012) worked with several reversible figures (see Appendix A) and used letter search as a fatiguing operation and produced results like the earlier studies and results that were similar across all the figures. Finally, McGathy, Hesselbirg, and Gordon (2014) showed that the RFT shows the same results regardless of whether or not the figure is presented in a digital or paper and pencil format.

The RFT fits all of the criteria for a good experimental measure of attention. First, changes in the reversal rate have been attributed to changes in subjects' attentional processes. A momentary loss of sustained attention can result in an image reversal (Intaite, Koivisto, Rukše, & Revonsuo 2010; Kornmeier & Bach 2004; Kornmeier & Bach 2006). Second, the measure is complete in one minute thus the RFT is minimally fatiguing. And finally, the measure seems to work well with other tasks that are used to fatigue attention (Cimprich, 1992; Halliday & Gordon 2012; Hesselbirg, McGathy, & Gordon 2014; Macemore, Hurlbut & Gordon, 2011; McGathy, Hesselbirg, & Gordon, 2014; Shemery, McConnell, Halliday, & Gordon 2012; Tennessen & Cimprich, 1995).

The Importance of Direct Attention Fatigue

If direct attention is fatigued whenever someone uses it to maintain focus in a complex world, then it is possible everyone's direct attention is often fatigued. If direct attention is central to effective cognitive function then living in a constant state of fatigue is of some concern. At very least you would have a reduced attention and miss valuable information.

There is also another more serious implication. Returning to the suggestion that sustained attention is drawing upon finite executive functions then sustained attention could reduce other executive functions (Baumeister et al., 1998; Baumeister, Vohs & Tice, 2007; Kaplan & Berman, 2010; Schmeichel et al., 2003). Fatigued executive functions would result in decreased performance in many tasks. In other words, whenever you are suffering from direct attention fatigue, your central executive functioning and response regulation are also likely to suffer. Though this interaction between cognitive functions is theoretical, the negative implications of direct attention fatigue make it important to test the idea.

If attention fatigue may reduce our day-to-day performance, the next logical question may be whether direct attention fatigue really occurs in day-to-day activity and whether this fatigue is significant. If direct attention fatigue is a narrow experimental phenomenon then it would be of little significance in day to day function. However, if the fatigue is a general effect then many people may be performing well below their peak ability. If direct attention fatigue proves to be a broad general phenomenon then research into how to restore direct attention would be important.

Direct attention fatigue has consistently occurred in some specific experimental circumstances. For example, in the ambiguous figure experiments the participant's attention was intentionally fatigued by either reverse digit span or letter search, both of which are mentally strenuous activities (Halliday & Gordon, 2012; Shemery, McConnell, Halliday, & Gordon, 2012). Though the results were significant and reliable, both reverse digit span and letter search are narrow experimental tasks. While it is good to see that fatigue is predictable, does this evidence suggest that direct attention fatigue is a general problem? If it were shown that significant levels of direct attention fatigue follows day to day tasks then the phenomenon is more problematic.

Direct Attention Fatigue in a Daily Task

Since people are constantly surrounded by many stimuli yet they seem to function well, perhaps direct attention fatigue isn't really an issue? However, you do not need to be in a constant state of fatigue for the fatigue to be a problem. You only have to be fatigued at a critical moment when attention is absolutely necessary. To test whether specific momentary fatigue is a problem you could test the fatiguing impact of a typical daily activity. To have the best measure of this impact a controlled experimental procedure could test simulations of such activities.

The present experiment is designed to test whether attention fatigue appears after a more common event. This event is experiencing social evaluation. Some common examples of this would be public speaking, public performance, or job interviews. Scenarios involving social evaluation are rather frequent in day-to-day life. (Baumeister & Leary, 1995) When we are subjected to social evaluation we actively attend, often intensely, to both the judges who are evaluating us and to the affective arousal that accompanies the evaluation (Baumeister & Leary, 1995). This intense focus would depend upon and possibly fatigue direct attention.

It is easy to see the external judges in a social evaluation scenario. However, how does affective arousal appear as a distracting event? One expression of the arousal is anxiety.

Anxiety is an unpleasant affective state that includes the feelings of nervousness, worry, tension, and apprehension (Weegar, 1993). Anxiety also activates the autonomic nervous system producing broad physiological reactions including tachycardia, palpitations, nausea, dizziness, a dry mouth, difficulty breathing, feelings of weakness, restlessness, and tremors (Weegar, 1993). These physiological elements of anxiety could be very distracting.

Measuring State Anxiety during Social Evaluation

Anxiety can be reliably triggered, and anxiety can be reliably measured (Dawans, Kirschbaumb, & Heinrichs 2011; Dickerson & Kemeny, 2004; Spielberger, 1989; Speilberger, Gorsuch, & Luchene, 1970; Spielberger et al., 1983). It has been shown that any task which combines social evaluation with a level of uncontrollability will reliably trigger anxiety seen as a psychological and biological stress responses (Dawans, Kirschbaumb, & Heinrichs 2011; Dickerson & Kemeny, 2004). In other words, when you are placed in a situation in which you face impending social judgment and you do not feel that you will be able to avoid this judgment, you will dread the possibility of negative social judgment and show physiological changes. Baumeister and Leary (1995) suggest that this occurs because humans have a fundamental desire to form positive social relationships. Negative social judgment threatens these relationships.

Anxiety can be reliably measured (Spielberger, 1989; Speilberger, Gorsuch, & Luchene, 1970; Spielberger et al., 1983). There are well-established, reliable psychological measures such as the State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1983; Spielberger, 1989). The STAI includes two 20 question forms, one measures trait anxiety while the other measures state anxiety (Speilberger, Gorsuch, & Luchene, 1970). In the context of social judgment only the state portion of the measure would be required. The variable of interest is the momentary anxiety that accompanies social judgment. It is not critical whether you are generally prone to being anxious, trait anxiety, it is critical whether your anxiety increases at the time of social judgment. Therefore the state portion of the STAI could be used to accurately measure the emergent anxiety in an individual experiencing social evaluation.

There is a short from of the STAI anxiety questionnaire (STAI-Y-6) created to measure state anxiety in situations where the full form may not be appropriate. Though the STAI-Y-6 has lower reliability, Cronbach's alpha drops from .91 to a .82 with the shorter form (Marteau & Bekker, 1992), the short form is less likely to confound the test of attention by causing direct attention fatigue in and of itself. Thus, the STAI-Y-6 is a good measure for measuring anxiety due to social evaluation. Then the level of anxiety can be related to direct attention fatigue.

A non-invasive measure of physiological stress, such as heart rate, can also be used to complement the psychological measure of state anxiety. Elevated heart rate beyond one's baseline measure is a physiological symptom of stress which has been shown to have a high positive correlation with anxiety (Cannon, 1929). Higher scores on the STAI-Y-6 questionnaire should show a positive correlation with elevated heart rate. Heart rate can be measured in a non-invasive manner that is minimally distracting and therefore minimally fatiguing.

Why Does Social Evaluation Demand Attention?

Research has shown that an anxious individual is more likely to pay attention to a stimulus that is deemed threatening and more likely to interpret a stimulus as threatening (Barlow, 1988; Eysenck, Derakshan, Santos, & Calvo, 2007; Reinholdt-Dunne, Mogg, & Bradley, 2008). When threatening stimuli reach some threshold they seem to demand our attention (Koster, et al., 2006; LeDoux, 1995; Mueller, et al, 2012; Pessoa & Adolphs, 2010; Shechner et al, 2012). This response to threat creates a challenge for direct attention. When task irrelevant stimuli are perceived as threatening it is harder to ignore them (Barlow, 1988;

Eysenck, Derakshan, Santos, & Calvo, 2007; Reinholdt-Dunne, Mogg, and Bradley, 2008) than when they are not perceived as threatening (Koster, et al., 2006; LeDoux, 1995; Mueller, et al, 2012; Pessoa & Adolphs, 2010; Shechner et al, 2012). Thus, when an individual is anxious sustaining attention on task relevant stimuli requires effortful direct attention (Cohen & O'Donell 1993; Jonides 1981; Rees, Frith & Lavie 1997.) Exerting more effort towards sustaining attention while in a state of anxiety should result in higher levels of attention fatigue.

Hypothesis

Anxiety is both a very salient and very common event or state. An anxious individual will have to engage direct attention to focus on task relevant stimuli to the exclusion of task irrelevant anxiety producing stimuli. Therefore, if an individual is placed in a situation that will induce higher levels of state anxiety, that individual's direct attention will become significantly fatigued.

CHAPTER TWO: STATEMENT OF THE PROBLEM

Attention can be broadly defined as the selective processing of information during which some information is encoded while other information is relatively neglected (Young, 2014). Research on attention, both past and current, has suggested that attention can be directed to information either automatically or intentionally. Automatic attention is indirect attention while voluntary, intentional focus is direct attention (Cohen & O'Donell 1993; James, 1892; Jonides 1981; Kundsen, 2007; Rees, Frith & Lavie 1997). Direct attention draws on and expends cognitive resources. These are resources that are also needed for other central executive functions, such as response inhibition and stimulus selection. Extended periods of attention deplete these executive function resources and results in attention fatigue (Baumeister, Vohs & Tice 2007; Kaplan & Berman 2010; Schmeichel et al. 2003).

Attention fatigue is both theoretically and practically interesting. Operations that are fatiguing may tell us something about how human cognition functions. Further, in a complex world full of competing demands there are practical negative implications of suffering from fatigued attention (Baumeister et al., 1998; Baumeister, Vohs & Tice, 2007; Kaplan & Berman, 2010; Schmeichel et al., 2003). However, it is not known how much of a problem attention fatigue may pose in day-to-day life. While it seems that the environment would demand direct attention the existence of a common fatiguing daily task remains to be demonstrated.

Social evaluation is a rather common experience that often results in social anxiety (Baumeister & Leary 1995). When someone feels anxiety that person is more likely to interpret surrounding stimuli as threatening (Barlow, 1988; Eysenck, Derakshan, Santos, & Calvo, 2007; Reinholdt-Dunne, Mogg, & Bradley, 2008). When a stimulus is deemed threatening it becomes very difficult to ignore (Koster, et al., 2006; LeDoux, 1995; Mueller, et al, 2012; Pessoa & Adolphs, 2010; Shechner et al, 2012). Because voluntarily focusing and sustaining our attention requires that we ignore task irrelevant stimuli, even if they may appear to be threatening, anxiety should create competition for attention and the effort of directing attention to relevant cues could cause attention fatigue.

CHAPTER THREE: METHOD

Participants

The participants in this experiment consisted of 54 (28 female, 26 male; mean age = 20.22 ± 1.65 years) undergraduates, participating in partial fulfillment of a course requirement or serving as volunteers. No significant difference was found between gender and age. The participants were informed that the purpose of the experiment was to measure impromptu performance in stressful situations.

Materials

For the purposes of this experiment, a modified version of the Trier Social Stress Test (TSST) was used. The TSST is a standardized performance task that uses a combination of social evaluation and uncontrollability to produce high levels of stress within participants. The TSST task consists of three phases: (1) An introduction, preparation, and anticipation phase of 300 seconds, (2) a public speaking task (mock job interview) of 120 seconds, and (3) a mental arithmetic task (serial subtraction) of 80 seconds (Dawans Kirschbaumb & Heinrichs 2011; Kirschbaum, Pirke, & Hellhammer, 1993). Previous lit (e.g., Dawans Kirschbaumb & Heinrichs 2011, Dickerson & Kemeny, 2004; Kirschbaum, Pirke, & Hellhammer, 1993) that has used the TSST provides no formal info concerning reliability, such as Cronbach's alpha (Cronbach, 1951)". Thought the TSST is widely used and is a standard protocol for evoking anxiety responses, formal validity evidence was not provided in the literature.

For this experiment, each phase of the TSST was set to 120 seconds. Unlike the original TSST in which each phase was performed in front of a panel of confederates, in this experiment each phase was performed in front of a conspicuous video camera and one experimenter. The camera was a Flip Video™ Model F260W digital video camera. The participants were told that at a later date the recordings would be evaluated by expert judges. This was intended to create a stronger feeling of social evaluation. In addition to this, rather than performing a mock job interview, the participants were asked to provide a persuasive argument either for or against one of five controversial topics. The five topics were abortion, gay marriage, welfare, euthanasia, and the Patient Protection and Affordable Care Act (ACA; 2010), colloquially known as "Obamacare". Finally, for the serial subtraction task participants were presented with the number 1379 an asked to continually subtract 16 as quickly as possible. If a participant made a mistake the experimenter interrupted the participant saying "Stop. Please start again with 1379."

The Reversible Figure Test (RFT) was used to measure the participant's level of direct attention fatigue. In the RFT, as the participant's direct attention fatigues, the rate at which the ambiguous image reverses increases. Because individual levels of ambiguous figure reversals can vary RFT scores are always within-subject comparisons to baseline rather than comparison to group norms. Increasing reversal rates represent a greater level of fatigue. Participants were asked perform the RFT four times, once before the experiment began and once after each phase of the experiment. For the purposes of this experiment the reversible figure was the duck-rabbit (see appendix A). The figure was presented as a black and white image on a standard 4th-generation Apple® iPad®. Each RFT was timed for 60s and participants were asked to indicate a reversal by touching the iPad® screen. This digital version of the RFT has been used successfully in previous studies (Hesselbirg, McGathy, & Gordon, 2014; McGathy, Hesselbirg, & Gordon, 2014). As previously mentioned the RFT is an experimental behavioral measure of direct attention and is still in development. The RFT has not been normed for any population and as such lacks psychometric data.

The State-Trait Anxiety Inventory six-item short-form (STAI-Y-6) (see Appendix B) is a 6 item questionnaire derived from the State-Trait Anxiety Inventory form Y (STAI-Y) (Spielberger, Gorsuch, & Lushene, 1970). The questionnaire was used to obtain a self-report measure of the participant's current state of anxiety. The STAI-Y-6 was created by Marteau and Bekker (1992) for the purpose acquiring reliable measures of acute anxiety in situations where the 20-item anxiety measure is inappropriate. STAI-Y-6 has shown a strong positive correlation with the results of its 20-item counterpart ($r = .95$) and thought the STAI-Y-6 does suffer a drop in reliability ($\alpha = .82$; as compared to $\alpha = .91$) its level of reliability is still within an acceptable range (Scales, 2013). The STAI-Y-6 is has a minimum score of 6 and a maximum score of 24 with higher scores indicating a stronger feeling of anxiety.

Participants were asked to fill out the STAI-Y-6 four times throughout the experiment, once before the procedure began and once after each phase of the procedure. The STAI-Y-6 questions were presented on the iPad® and the response to each item was recorded by touching the screen.

A Polar® T31 coded transmitter chest strap heart rate monitor was also used. The measured heart rate was displayed on a wrist monitor and participants were asked to read the monitor and report their current heart rate seven times throughout the procedure, once before the experiment and once before and after each phase of the experiment.

Procedure

Upon arrival each participant read and signed a consent form (see Appendix C). Each participant was then excused to the bathroom and asked to attach the chest strap heart rate monitor. The participants were then placed in individual observation rooms in front of a conspicuous video-camera and an experimenter. At this time the experimenter asked the participant to fill out a basic demographic form presented on the iPad®. The experimenter also confirmed that the heart rate monitor was working correctly. Next, each participant received written instructions for the modified TSST task and for the RFT presented on the iPad®. After reading these instructions, the participants were asked to report their current heart rate. The participant then completed the first RFT and the first STAI-Y-6 form.

After the participant completed the first RFT and STAI-Y-6 form, the participant was told that he or she was about to enter the preparation phase for the presentation of a persuasive argument and the participant's heart rate was recorded. The participant was presented with the five controversial topics, asked to choose one topic, and then indicate whether he or she would argue for or against the chosen topic. After selection, each participant was given 120 seconds for preparation. During the preparation phase, the participant was given paper and pencil to plan an argument. The paper was then taken away after the planning phase ended. After this phase, the participant's heart rate was recorded again and the participant completed another RFT and STAI-Y-6 form.

After the participant completed the second RFT and STAI-Y-6 form, the experimenter told the participant that it was time to present the persuasive argument. The experimenter recorded the participant's heart rate, told the participant to look at the camera, and the experimenter activated the camera. Once it was clear to the participant that the camera was recording, he or she was told to begin speaking. If the participant finished his or her speech in less than 120 seconds the experimenter prompted the participant to continue by saying "You still have some time left, please continue." If the participant finished a second time before the 120 seconds is over, the experimenter would wait quietly for 10 seconds stop the camera then move on to the next phase.

After the 120-second presentation the participant's heart-rate was again and the participant completed another RFT and STAI-Y-6 form. Once these tasks had been completed the experimenter told the participant that it was time to start the serial subtraction task. The experimenter recorded the participant's heart rate, told the participant to look into the camera, and the experimenter activated the camera. Once it was clear to the participant that the camera was recording he or she was told to begin the task.

After a participant finished the 120-second subtraction task the participant's heart-rate was recorded for the final time and the participant completed the final RFT and STAI-Y-6 form. Once the participant completed these final tasks the experimenter thanked him or her for participating. The experimenter then debriefed the participant, explaining that the videos were in fact being deleted. The entire procedure took an average of approximately 16 minutes per subject.

CHAPTER FOUR: RESULTS

The dependent measures in this study were the number of figure reversals reported (Duck Rabbit Reversal, DRR), heart-beats per minute (BPM), and the subjects self-reported anxiety (SR Anxiety) at each observation point. There was no upper limit on the reversal measure. BPM was limited physiologically. The STAI-Y-6 has a maximum of 24 and a minimum of 6. The average reported measurement of each dependent variable and the standard errors at each observation period were calculated in Microsoft® Excel® and are listed below in Table 1 and plotted in Figures 1, 2 and 3.

Table 1:

Average measurement of each variable at each observation point.

	DR Reversal Rates	Recorded BPM	Self-Reported Anxiety
Baseline	22.28 ± 2.28	88.91 ± 2.09	10.85 ± .364
Pre-speech Preparation	—	84.3 ± 2.04	—
Post-speech Preparation	27.46 ± 2.62	90.78 ± 1.85	11.39 ± .409
Pre-speech Preparation	—	97.78 ± 2.08	—
Post-speech Preparation	27.5 ± 2.84	89.7 ± 2.06	10.59 ± .405
Pre-mental Math	—	90.76 ± 1.88	—
Post-mental Math	29 ± 2.93	86.89 ± 1.76	10.59 ± .491

Figure 1:

Average number of figure reversals at each measurement point.

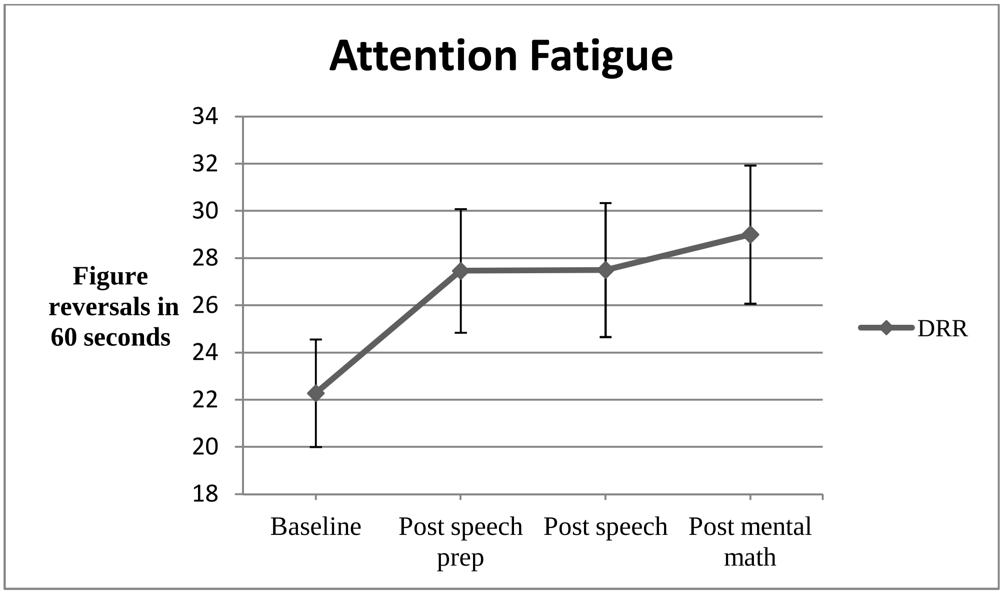


Figure 2:

Average heart-rate of participants throughout the procedure.

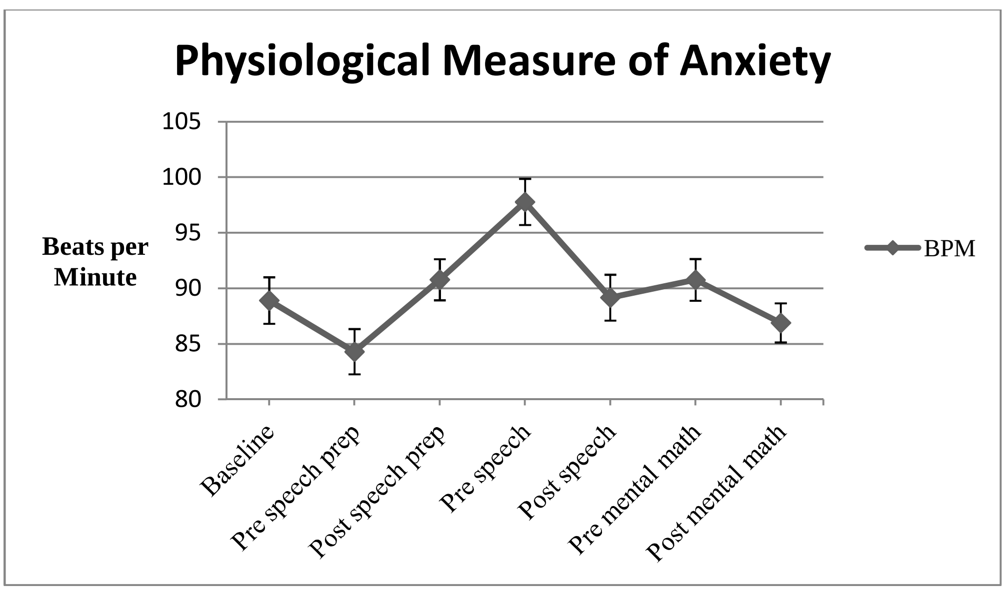
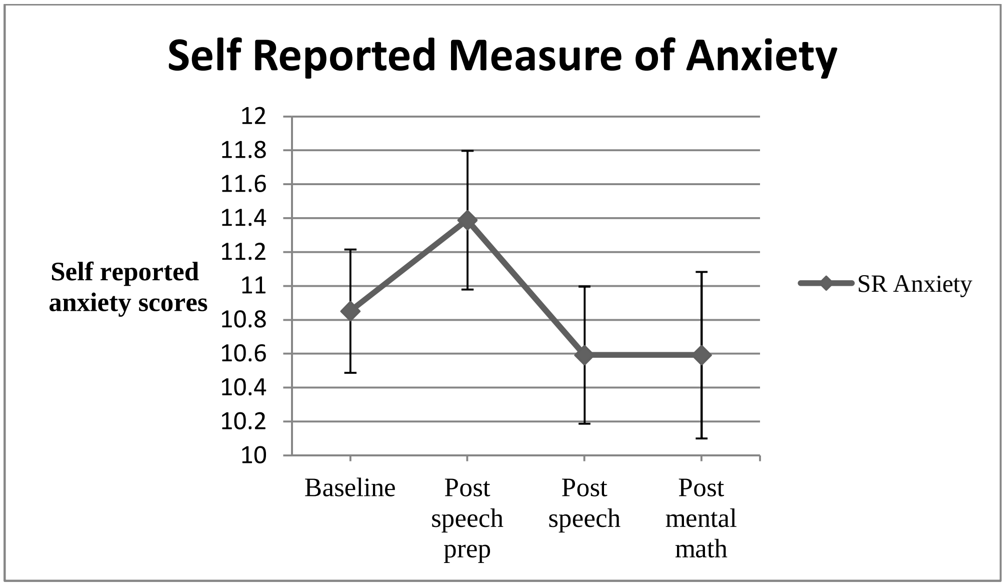


Figure 3:

Average state anxiety self-reported by participants.



Results were compared using a series of repeated-measures ANOVAs (RM ANOVA) and multiple regressions while effect sizes we measured using values of partial eta squared (η^2_p). Though there are not hard rules concerning interpretation of eta squared or partial eta squared, Cohen (1988) established that values of eta squared close to .10 signify a small practical effect, values around .25 signify a moderate effect, and values around .40 or larger demonstrate a large practical effect. Sphericity for all RM ANOVAs was measured using Mauchly's *W* (Mauchly, 1940) statistic. Because the assumption of sphericity was violated for all RM ANOVAs, all statistically significant results below were reported using the Greenhouse-Geisser (1959) adjusted values.

The first research question addressed was whether or not attention fatigue was evident. A RM ANOVA, using observation period of figure reversal rates (DRR) (four levels) as a within-subject variable revealed a significant increase in reversible figure reversals across observation periods ($F(3,112.04) = 6.768$, $p = .001$, $\eta^2_p = .113$, $1\text{-}\beta = .92$). *Post hoc* comparisons between individual observation periods found four significant differences. Baseline DRR was significantly lower than post-speech preparation DRR (22.28 ± 2.28 versus 27.46 ± 2.62; $F(1,53) = 10.902$, $p = .002$, $\eta^2_p = .171$, $1\text{-}\beta = .90$), post-speech DRR (22.28 ± 2.28 versus 27.5 ± 2.84; $F(1,53) = 8.361$, $p = .006$, $\eta^2_p = .136$, $1\text{-}\beta = .81$), and post-mental math DRR (22.28 ± 2.28 versus 29 ± 2.93; $F(1,53) = 9.926$, $p = .003$, $\eta^2_p = .158$, $1\text{-}\beta = .87$). Finally, post-speech DRR was lower than post-mental math DRR (27.5 ± 2.84 versus 29 ± 2.93; $F(1,53) = 5.475$, $p = .023$, $\eta^2_p = .094$, $1\text{-}\beta = .632$). These results suggest that the participants' direct attention was fatigued by the procedure.

The second research question addressed whether or not participants felt anxious due to the procedure. A RM ANOVA, using observation periods of participant's heart rates BPM (seven levels) as a within-subject variable, revealed a significant change within the participant's heart rate's throughout the procedure ($F(6, 243.17) = 23.495$, $p < .001$, $\eta^2_p = .307$ $1\text{-}\beta = 1.0$). *Post hoc* comparisons between individual observation levels indicated individual significant differences between 6 different observation levels. Baseline BPM report and pre-speech prep BPM (88.91 ± 2.09 versus 84.296 ± 2.040; $F(1,53) = 35.569$, $p < .001$, $\eta^2_p = .402, 1\text{-}\beta = 1.0$), Baseline BPM report and pre-speech BPM (88.91 ± 2.09 versus 97.78 ± 2.08; $F(1,53) = 47.110$, $p < .001$, $\eta^2_p = .471, 1\text{-}\beta = 1.0$), Pre-speech prep BPM and post-speech prep BPM (84.3 ± 2.04 versus 90.78 ± 1.85; $F(1,53) = 35.981$, $p < .001$, $\eta^2_p = .404, 1\text{-}\beta = 1.0$), post-speech prep BPM and pre-speech BPM (90.78 ± 1.85 versus 97.78 ± 2.081; $F(1,53) = 33.841$, $p < .001$, $\eta^2_p = .390, 1\text{-}\beta =$

1.0), pre-speech BPM and post-speech BPM (97.78 ± 2.08 versus 89.17 ± 2.05; $F(1,53)= 31.832$, $p < .001$, $\eta^2_p= .375$,$1-\beta = 1.0$), pre-mental math BPM and post-mental math BPM (90.76 ± 1.88 versus 86.89 ± 1.76; $F(1,53) = 10.734$, $p < .002$, $\eta^2_p= .168$,$1-\beta = .896$). Additionally, an RM ANOVA using observation period of participant's self-reported anxiety (SR Anxiety) (four levels) as a within-subjects variable, showed no significant change in subjects self-reported anxiety throughout the procedure.

Finally, an increase in participant's state anxiety was hypothesized to result in attention fatigue. Four multiple regression analyses calculated using DRR as the independent variable suggested no significant correlation between DRR and BPM, or DRR and SR anxiety measures at any point during the procedure for these 54 subjects. Results suggest that neither participants' heart-rates nor participants' SR Anxiety was related to the overall increase in DRR. Thus, there is no indication that anxiety is associated with attention fatigue. The unstandardized regression weight (B) and the standard error (SE) of each weight are listed below in Table 2. r-squared values ranged from .006 to .09 and were not reported due to their overall insignificance.

Table 2:

Individual results for each regression, standard errors are reported in parenthesis.

	Baseline Measures		Post-Prep Measures		Post-Speech Measures		Post-Math Measures	
	B	SE	B	SE	B	SE	B	SE
Constant	33.31	(16.56)	36.79	(19.30)	21.77	(20.23)	17.70	(22.81)
HR baseline	-0.315	(0.872)	-.166	(.201)	.003	(.193)	.894	(0.830)
SR baseline	-0.086	(0.151)	.506	(.908)	.520	(.978)	.021	(.232)

CHAPTER FIVE: DISCUSSION

The purpose of this study was to determine whether or not anxiety could result in attention fatigue. Thus, the first question to be addressed is whether or not attention fatigue occurred. The second question to address is whether anxiety was present in the subjects. Finally, the possibility that anxiety may result in attention fatigue will be examined.

Based on previous work with the RFT, a significant increase in figure reversal rate overtime should act as an indicator of attention fatigue (Cimprich, 1992; Halliday & Gordon 2012; Hesselbirg, McGathy, & Gordon 2014; Macemore, Hurlbut & Gordon, 2011; McGathy, Hesselbirg, & Gordon, 2014; Shemery, McConnell, Halliday, & Gordon 2012; Tennessen & Cimprich, 1995). Overall DRR increased significantly during the procedure. Further, baseline DRR was less than DRR at every other point. There was not a significant increase in DRR from post-speech preparation to post-speech but the reversal rate increased again after mental math. Thus, it can be concluded that throughout the procedure attention fatigue occurred in the subjects. Additionally, it can be concluded that the acts of preparing for speech and performing mental math were the most fatiguing parts of the procedure. Given that no significant difference can be seen between post-speech preparation and post-speech measurement points the act of actually giving the speech may not have been fatiguing.

According to the literature, if anxiety was induced results should show both an increase in HR and SR anxiety over time (Spielberger, 1989; Speilberger, Gorsuch, & Luchene, 1970; Spielberger et al., 1983). Due to the non-significant differences in the SR Anxiety measures, an argument can be made that the results of this study do not suggest that the subjects were anxious. However, given that each measure of SR Anxiety occurred during a point at which the subjects'

HR were not significantly different from baseline HR measures, it is also possible that the subjects simply were not anxious at the moment the SR anxiety was measured. The SR anxiety measures took place immediately after each task of the experiment, and occurred immediately after a significant drop in HR. Thus it is a strong possibility that the SR anxiety measures were actually tapping into the relief felt by the participants after each part of the procedure was completed. Therefore, the disagreement between SR Anxiety and HR measures can be seen as reasonable and even expected.

Finally, the literature suggested that ignoring distractor stimuli results in attention fatigue (Baumeister, Vohs & Tice 2007; Cohen & O'Donell 1993; James, 1892; Jonides 1981; Kaplan & Berman 2010; Kundsen, 2007; Rees, Frith & Lavie 1997; Schmeichel et al. 2003). Anxiety provoke stimuli are good a grabbing attention and would need to be ignored to focus on a task (Barlow, 1988; Eysenck, Derakshan, Santos, & Calvo, 2007; Koster, et al., 2006; LeDoux, 1995; Mueller, et al, 2012; Pessoa & Adolphs, 2010; Reinholdt-Dunne, Mogg, & Bradley, 2008; Shechner et al, 2012). Therefore, it is possible that attention fatigue can occur as a result of the presence of anxiety. If this is the case, then a correlation between anxiety and attention fatigue should be visible when both factors are present. Unfortunately, the results of this study make it difficult to conclude that there is a link between anxiety due to social evaluation and attention fatigue. The multiple regressions suggest that no relationship exists between anxiety and attention fatigue as measured by the RFT. However, the multiple regression analyses may be subject to flaws due to the different numbers of measurement points for the three variables. Because DRR and SR anxiety were only measured four times, the three additional measures of HR that were taken could not be used in the regression analysis. The three measurements that could not be used were measures that showed significant changes in BPM, or anxiety. Losing these three important data points may have affected the results of the analyses. Replications of this study may consider including measures DRR and SR anxiety whenever HR is measured to potentially correct this error.

Further, the results suggest that fatigue created during the speech preparation may affect the later measures of DRR. There is a significant increase in DRR from baseline to post-speech preparation. However, the DRR post-speech is unchanged. This may suggest a carryover effect: once attention becomes fatigued, it remains fatigued for some time, perhaps for the rest of the procedure. This possibility has been supported by past research (Hesselbirg, McGathy, & Gordon, 2014). If attention fatigue doesn't drop during non-stressful parts of the procedure, it would be difficult to find a relationship between attention fatigue and HR or SR Anxiety. The generally homogenous levels of the RFT across all subjects through the duration of the tasks precludes the ability to pinpoint the specific source of attention fatigue.

A final noteworthy point about anxiety and attention fatigue is the significant increase of BPM occurring between pre-speech preparation and post-speech preparation. The participants' heart rates had slowed significantly before speech preparation began. With preparation, their heart rates increased dramatically. Though the actual value was simply a return to baseline, this jump in BPM occurs at the point in which DRR greatly increase. One interpretation of these results suggests that the participants felt anxious, as indicated by elevated heart rate, and attention was fatigued. It is also a possibility that due to the argumentative nature of the participant's speech, the participants' elevated BPM was due to participants' strong feelings toward their own arguments. If any participant had strong enough feelings toward their own stance, a heightened level of physiological arousal would make sense during speech preparation. This possibility should be taken into account in future replications.

There is an obvious alternative explanation of the significant increases in DRR. It is possible that the attention could be attributed to the task difficulty rather than anxiety over social evaluation. Certainly there is task demand in rapidly preparing a speech and performing mental math. Past work has shown that cognitive challenge in reverse digit span and letter search fatigues attention (Hesselbirg, McGathy, & Gordon, 2014; Macemore, Hurlbut, & Gordon 2011; Shemery, McConnell, Halliday, & Gordon, 2012). Thus, there is every reason to believe that the cognitive demands of speech preparation and mental math would fatigue attention.

Limitations

There are three limitations in this study. First, the TSST may not have been evocative enough. For the purpose of this experiment the TSST was redesigned to use digital camera in place of live spectators. Thought previous research has suggested that recording a performance can elicit an anxiety response; making use of spectators has been show to produce an even larger anxiety response (Dickerson & Kemeny, 2004). Redesigning the experiment so that the TSST is performed in front of spectators would likely produce a stronger anxiety response which could provide a better test of anxiety's effect on attention fatigue. The inconsistent scores on SR Anxiety and heart rate make it difficult to determine whether the TSST was sufficiently anxiety-provoking.

Another potential limitation of this procedure can be found in the lack of trait anxiety measures. While state anxiety was arguably more logically linked to the question of the study, measures of trait anxiety may very well have shown that the study had a range of participants likely to show varying levels of anxiety during the procedure. Variations in this critical variable would most likely have increased the chances of detecting a relationship between anxiety and attention fatigue.

Finally, a limitation can be seen in the lack of a control group. Because each subject experienced both social evaluation and cognitive demand it cannot be determined which part of the procedure produced the observed attention fatigue. The presence of a non-anxious control group would have allowed for a measure of attention fatigue due to task difficulty. While the RFT is typically used as a within-subject measure perhaps significant differences in the RFT between anxious and non-anxious groups would be informative. This is a major limitation and it is highly recommended that a control group be added should this work be replicated.

Though this study did not establish that social anxiety fatigues attention, it does add to the growing body of data related to attention fatigue. Even if the link between social evaluation and attention remains unclear, furthering our understanding of the state of attention fatigue is valuable. The possibility of carry over effects suggests that future analyses of attention fatigue more closely examine the length of time a person remains fatigued, if there a natural recovery function, and what factors increase the persistence of fatigue.

Again, attention fatigue may have serious implications. One only needs to be fatigued at a key point in time for a potential problem to occur. Further research that allows us to predict higher levels of fatigue would provide a useful caution. Developing an attention-restoration process that is both effective and quick would promise help. A combination of both of these additions would be valuable. Either addition could mean that an anxious student passes the GRE, an exhausted truck driver notices brake lights and avoids an accident, or a tired craftsman working with a table saw is able to save a finger. Attention fatigue may not be widespread or even a big inconvenience to the average person in everyday life. However, research strongly suggests that attention fatigue is a real consequence of the continuous use of sustained attention - a consequence that holds the potential for problems.

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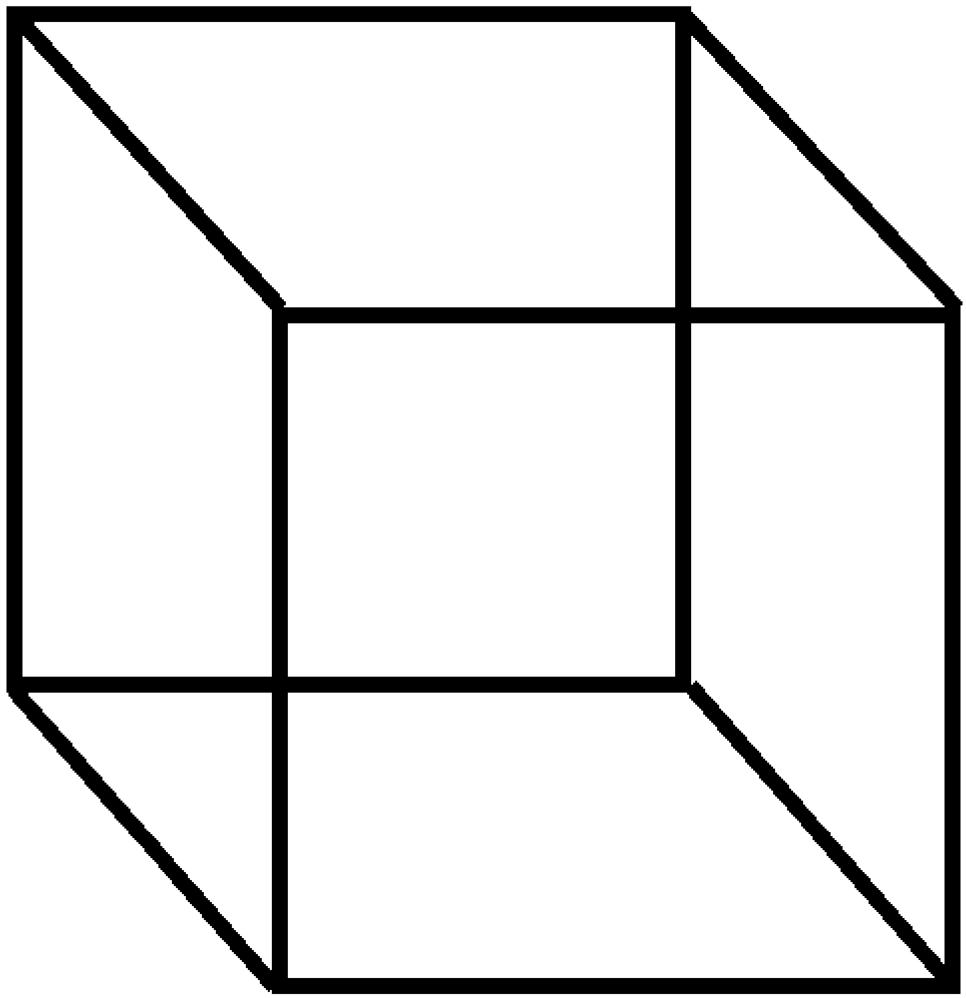
APPENDICES

Appendix A

The Necker Cube



Appendix B

Self-evaluation questionnaire *(Y-6* item)

***Name*___________________________________**
Date____________

A number of statements which people have used to describe themselves are given below. ***Read each statement and then circle the most appropriate number to the right of the statement to indicate how you feel right now, at this moment.*** There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately	Very much
1. I feel calm	1	2	3	4
2. I am tense	1	2	3	4
3. I feel upset	1	2	3	4
4. I am relaxed	1	2	3	4
5. I feel content	1	2	3	4
6. I am worried	1	2	3	4

Please make sure that you have answered ***all*** the questions.

Appendix C

Consent Form

What is the purpose of this research?

Human are often asked to perform to the best of their abilities in unexpected circumstances. This research is studying how well people perform in impromptu situations.

What will be expected of me?

You will be asked to do 4 things. First you will be asked to wear a chest mounted heart rate monitor for the entirety of this procedure. Second, you will be asked to perform an impromptu speech in front of a camera. During this speech you will be asked to select and argue for or against one of the following 5 topics: Welfare, Obamacare, Euthanasia, Abortion, Gay Marriage. After selecting your topic, you will be given two minutes to gather your thoughts and prepare your argument. Third, you will be asked to perform a mental math task. This task will also be performed in front of a camera. Lastly, throughout this exercise there will be 4 instances during which you will be asked to look at a drawing of a duck/rabbit figure and note when the image seems to change its appearance and answer a short questionnaire.

How long will the research take?

The entire testing process will last about 25 minutes.

Will my answers be anonymous?

Yes, your answers are anonymous. Your name will not be used at all in this research. You will be asked not to put your name on the data form and the researcher will in no way connect you and the answers you provide.

Can I withdraw from the study if I decide to?

You may choose to withdraw from the research at any time. You may also decline to respond if you do not wish to answer.

Is there any harm that I might experience from taking part in the study?

There is no foreseeable harm to the participants.

Who should I contact if I have questions or concerns about the research?

If you have questions about the study you may contact Stephen Hesselbirg (smhesselbirg@email.wcu.edu).

If you have any concerns about how you were treated during the experiment, you may contact the office of the IRB, a committee that oversees the ethical dimensions of the research process. The IRB office can be contacted at 227-7212. This research project has been approved by the IRB.

Name: ____ Date: ________________
Participant

Signature: ____
Participant