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Assessing attentional bias and cerebral laterality in specific phobia using a dichotic listening paradigm

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ASSESSING ATTENTIONAL BIAS AND CEREBRAL LATERALITY IN SPECIFIC PHOBIA USING A DICHOTIC LISTENING PARADIGM

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Researchers have found fear to impact a variety of cognitive variables in individuals with specific phobia. Attentional bias is a cognitive variable that has received considerable attention in the specific phobia literature; however, the existing literature follows only one line of attentional bias—bias as encoded through images, words, or other content presented visually. This study aimed to expand on this area by assessing attention and cerebral laterality in individuals with specific phobia using a dichotic listening paradigm (i.e., via auditory means). Results indicated that participants with specific phobias do not significantly differ from controls in terms of the number of threat-related words endorsed overall; however, groups did differ on channel (i.e., left vs. right ear) used. Participants with specific phobias were more likely to select stimuli corresponding to the left channel than control participants. This difference was due to their increased recognition of threat-related stimuli through the left channel. Implications and limitations of this study are also discussed.

CHAPTER 1. INTRODUCTION

Anxiety disorders are frequently occurring problems in the United States with a lifetime prevalence of approximately 28.8% of the population (Kessler, Berglund, et al., 2005). While anxiety itself is a prominent problem, impairments and deficits associated with it can cause additional difficulties. One such potential impairment is the presence of attentional bias. For instance, it has been postulated that the cognitive vulnerability to anxiety results in part from an automatic tendency for anxious individuals to selectively encode emotionally threatening information (MacLeod, 1991). Further, anxious individuals are more likely than nonanxious individuals to direct their attentional resources toward threatening stimuli (Mathews & MacLeod, 2005; Williams, Watts, MacLeod, & Mathews, 1988). They are also more likely to direct these resources toward threatening stimuli as opposed to neutral stimuli (see MacLeod, Mathews, & Tata, 1986 for a review). Such conclusions have been reached for individuals with specific phobias and phobia-related fears using several different methodologies (e.g. the Stroop task or visual search tasks) and provide evidence that these individuals are hypervigilant for threat and danger (Beck & Emery, 1985). Given these findings, the current study extends the literature by examining auditory attentional bias in adults who have specific phobias via a dichotic listening paradigm. Studies to date have only examined attentional biases using visual tasks, so this method is novel in the specific phobia literature.

1.1 Specific Phobia

Specific Phobia is an anxiety disorder that involves excessive fear provoked by exposure to a specific stimulus, often resulting in panic and avoidance of the feared stimulus. Individuals with this disorder typically experience anxiety as soon as they encounter the feared stimulus or when anticipating an encounter. Generally, these individuals recognize the excessiveness of their fear (American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders, 4th ed., text revision, 2000; DSM-IV-TR*). Specific phobias are broken down into five subtypes: animal type, natural environment type, blood-injection-injury type, situational type, and other type (e.g. choking or vomiting; *DSM-IV-TR*). The prevalence of these subtypes vary depending on the sample while the overall lifetime prevalence of specific phobia is 12.5% (Kessler, Berglund et al., 2005) and the 12-month prevalence is 8.7% (Kessler, Chiu, Demler, & Walters, 2005). Comorbid psychopathology is also a common occurrence within the phobic population with rates of comorbidity with other disorders ranging from 50% to 80% in community samples, (American Psychiatric Association, 2000).

1.2 Information Processing Theory

Information processing theory is a prominent theory of how attentional biases are formed and maintained. It is especially relevant to the fear and avoidance that phobic individuals experience when presented with a threatening stimulus. Information processing theory posits that threatening stimuli are processed differently than non-threatening stimuli; threatening stimuli are processed preconsciously, at an automatic level. Numerous operations are performed in the brain that must occur prior to incoming information reaching the conscious level, including "sensory registration, semantic labeling, associative spread, and disambiguation of a stimulus" (Williams at al., 1988, p. 171). Subsequently, all meanings of a specific stimulus or situation are activated which in turn interact with the previously cited operations and the context meaning (i.e. the meaning most relevant to the individual at hand). This produces ambiguity that results in the emergence of a predominant meaning and the rejection of other viable interpretations of the situation. Thus, an individual with a phobia of dogs will preconsciously process many meanings of what a dog is, but the predominant meaning that arises will likely be distorted and pertain to fear of dogs. Williams et al. (1988) further suggests that a preconscious decision mechanism exists that decides the emotional importance of a stimulus based on an individual's predominant meaning of it, thus determining whether to orient attention toward or away from the stimulus. As a result, anxious individuals selectively attend to threatening stimuli. However, if the stimulus is too emotionally arousing and/or anxiety-inducing, the processing of this information may be disrupted. Foa and Kozak (1986) posit that such distraction is caused by cognitive avoidance and the use of distraction strategies when one is confronted by a threatening stimulus. In phobic individuals, processing resources are directed away from the threatening stimulus, making the threat information less retrievable. Thus, due to selective attention and cognitive avoidance, phobic individuals demonstrate impaired memory for threat-related material. Accordingly, this theory posits that anxious individuals are inclined to direct their attention toward threatening stimuli during automatic/early stages of processing; however, they are inclined to direct their attention away from such stimuli during later, more strategic stages of processing (Williams et al., 1988).

1.3 Specific Phobia and Phobia-Related Fears in Relation to Attention

Much of the evidence that indicates phobic and fearful individuals possess attentional biases comes from the modified Stroop task. While the traditional Stroop task (Stroop, 1935) requires participants to name the color or ink that a word of a conflicting color is printed in (i.e. color-name color words), the modified Stroop task presents phobia-related stimuli in the form of words. Participants view emotionally laden words (e.g. snake) that are presented in different colors. They are instructed to name the color of the word while attempting to ignore the semantic content of the word. The rationale behind this task is that participants will find it difficult to avoid processing particular word contents resulting in a longer latency in color-naming. Thus, an individual with a specific phobia of bees would take longer to name the color of words associated with bees (e.g. "sting" or "hive").

Watts et al. (1986) were one of the first research groups to test for attentional bias using the modified Stroop task in a sample of individuals with specific phobia. In order to determine whether anxious individuals responded specifically to threat or to the emotional content of the words used in the Stroop task, these authors employed a set of highly emotive words (e.g. "disaster") as a control for the task. Results indicated that phobic individuals showed longer latencies in the naming of spider-related words compared to both neutral and emotional words (Watts et al., 1986), indicative of attentional bias for spider-related words. Similar results were found using the modified Stroop task in a sample of spider-phobic children aged seven to thirteen (Martin, Horder, & Jones, 1992) and with individuals high in dental anxiety for dental words (Muris, Merckelbach, & De Jongh, 1995).

Other studies have employed variants of the Stroop task to further examine attentional biases in individuals with specific phobia. Three such studies have utilized the Stroop in order to compare selective attention evidenced by pictorial and linguistic tasks. These studies included a pictorial variant of the Stroop task on the basis that it may be a more appropriate test of attentional bias in terms of ecological validity and accessibility of affective information (Lavy & Van Den Hout, 1993). Additionally, pictorial stimuli may be more capable of activating the fear network, resulting in more processing resources being allocated to the network and strengthening the bias (Lang, 1979). Both Lavy and Van Den Hout (1993) and Kindt and Brosschot (1997) found that spider-phobic individuals exhibited an attentional bias for pictorial and linguistic spider-related stimuli; however, the former posited that linguistic stimuli resulted in a significantly greater attentional bias while the latter did not find differences between the types of stimuli. Kindt and Brosschot (1999) conducted a follow-up study with spider-phobic children and found no evidence of attentional bias for pictorial stimuli and a moderate bias for linguistic stimuli. Results from these studies suggest spider-phobic adults do exhibit attentional bias for spider-related words and pictures; however, children appear to exhibit attentional bias for linguistic stimuli only.

Another variant of the Stroop task entails the use of masked (i.e., allows for little stimulus recognition) and unmasked conditions. This type of paradigm serves to differentiate between automatic and strategic allocation of attention toward threat. Indication of bias on a masked task shows automatic allocation of attention whereas bias on an unmasked task demonstrates strategic allocation. Thorpe and Salkovskis (1997) and Wikstrom, Lundh, Westerlund, and Hogman (2004) conducted studies with this type of methodology, in which spider and snake-phobic individuals showed attentional bias to threat only in the unmasked condition of the Stroop task. Conversely, Van Den Hout, Tenney, Huygens, and De Jong (1997) found attentional biases using both the masked and unmasked versions of the Stroop task with spider-phobic individuals, though there was only a small masked Stroop effect. Taken together, it appears that attentional bias in individuals with specific phobia is better explained by strategic allocation of attention rather than automatic allocation of attention.

Several studies have found no attentional bias in phobic participants when using the modified Stroop task. First, Mathews and Sebastian (1993) found that highly snake-fearful individuals do not exhibit an attentional bias to threat words on the Stroop task when exposed to the feared stimulus, even though Stroop interference existed when the feared stimulus was absent. Numerous explanations are offered for this phenomenon. For instance, exposure to a live stimulus may increase emotional interference effects and deter attentional interference.

However, it may also be that individuals allocate priority to the real, threatening stimulus at the expense of attention to threatening words. Second, Sawchuk, Lohr, Lee, and Tolin (1999) failed to find an attentional bias toward medical and disgust words in a sample of individuals with blood-injection-injury (BII) phobia. This finding may be due to the emotional reaction of disgust rather than fear in individuals with BII phobia. Third, Olatunji, Sawchuk, Lee, Lohr, and Tolin (2008) found no group differences between spider-phobic individuals and controls on the Stroop task after adjusting for individual differences in color-naming speed. Lastly, Kindt, Bierman, and Brosschot (1997) found that spider-fearful children did not demonstrate a stronger processing bias for spider-related information than controls on two different versions of the Stroop task. This suggests that attentional bias may not be associated with anxiety in children. Further, this finding is discrepant with Martin et al. (1992) who found that only spider-fearful children showed bias for spider words when compared to controls.

Visual search tasks, such as the odd-one-out search task, are alternatives to the Stroop task. In the odd-one-out task, introduced by Hansen and Hansen (1988), participants are shown a group of stimuli simultaneously and are then asked to indicate whether one of the stimuli is different from the others on a pre-determined dimension. Ohman, Flykt, and Esteves (2001) used this paradigm by presenting fear-relevant target stimuli (e.g. snake or spider) among fear-irrelevant distractors (e.g. flowers or mushrooms). Findings indicated that spider pictures among neutral distractors were most quickly detected by spider-fearful individuals, with the same true of snake pictures for snake-fearful individuals.

A similar study was carried out by Rinck et al. (2005) who added eye-tracking during the experimental trials. Spider-fearful and control participants completed a target search task (i.e. participants were shown a target picture which disappeared after two seconds and were then presented with a matrix of 20 pictures that they were to choose the original picture from) and an odd-one-out search in the first experiment, and new spider fearful and control participants completed a category search task (i.e. participants were shown a word which disappeared after two seconds and were then presented with a matrix of 20 pictures which they were to choose a picture that fit the category of the presented word) in the second experiment. Evidence of increased distraction (i.e. longer fixations) from threat was found in all tasks for the spider fearful groups, whereas speeded threat detection (i.e. faster detection) occurred in both the odd-one-out search task and the category search task but not in the target search task. This suggests that clinically fearful individuals show attentional bias in both the shift (i.e. orienting attention to a stimulus) and disengage (i.e. removal of attention from a stimulus) components of attention. Thus, the spider fearful individuals were more distracted by the spider pictures and showed enhanced detection of the spider stimuli when compared to controls.

Miltner, Krieschel, Hecht, Trippe, and Weiss (2004) found contrary results using a visual search task and eye-tracking. They presented spider phobic and nonphobic controls with matrices of neutral targets (mushrooms) paired with a spider distracter stimulus and spider targets with a neutral distracter. Both groups responded faster to the neutral target than spider target (via key presses). Eye movement data demonstrated that the saccades of both groups were significantly faster toward neutral than spider stimuli. Notably, when a spider distracter was presented with a neutral target, phobics displayed delayed reaction times and saccades directed toward the neutral stimulus. Further, the phobics appeared to first fixate on the spider stimuli than the neutral stimuli. The authors posit that threat captured the attention of spider phobic participants only when such threat was part of a background (i.e. distracter stimulus) that participants were to ignore. They emphasize the notion that attentional bias to visual threat primarily occurs when individuals are presented with stimuli of discrepant emotional valence that compete for attention (Miltner et al., 2004).

Rinck and Becker (2006) conducted a study to further examine eye-tracking in spider-fearful individuals to determine the course of attentional vigilance and avoidance. They found that the spider-fearful group first fixated on spider pictures in a free-viewing task; however, these individuals quickly moved their eyes away from such pictures resulting in shorter gaze durations than controls. These findings demonstrate reflexive attentional bias toward threat that is immediately followed by avoidance. Hermans, Vansteenwegen, and Eelen (1999) found similar results in their eye-tracking study with participants fixating more on threat-related stimuli when the stimulus was first presented and subsequently displaying viewing patterns that shift away from the stimuli as time progressed. These studies posit that such behaviors contribute to the maintenance of phobic anxiety as attentional bias increases the likelihood of threat perception, which increases anxiety and distraction and often results in avoidance. While this avoidance may initially reduce fear and anxiety, it is typically short-lived and maladaptive (Rinck & Becker, 2006).

Other eye-tracking studies found discrepant results. For instance, Gerdes, Alpers, and Pauli (2008) found that spider phobic individuals' initial eye movements were on any kind of small picture, not just on spider pictures. However, phobic individuals' reaction times were longer with those trials utilizing spider distracter stimuli suggesting enhanced distraction by threatening stimuli and slowed disengagement. Therefore, the results of this study do not support the notion of automatic capture of attention by phobic stimuli as found in previously documented studies, instead suggesting that phobic individuals fail to disengage attention from phobic stimuli. Gerdes et al. (2008) finding of initial eye movements on any kind of small picture is interesting as it bolsters claims made by Becker and Rinck (2004) in which they found that highly fearful participants were not better than nonfearful controls at detecting fear-relevant stimuli using a signal detection paradigm. They concluded that highly fearful individuals may have a lower criterion for what they label as fearful, suggesting these individuals may exhibit an interpretation bias rather than facilitated detection of threat.

In another study, Gerdes, Pauli, and Alpers (2009) used eye-tracking to determine how quickly spider-fearful individuals identified fear-relevant pictures and whether these individuals distract their attention to neutral or fear-relevant targets. Findings revealed that all participants (both spider-fearfuls and nonanxious controls) were faster to look toward spider stimuli compared to neutral stimuli; however, spider-fearful participants' eye movements slowed when they had to look away from the spider stimuli. The authors contended that this slowing of eye movements could not be explained by initial allocation of attention toward spider stimuli, but rather by slowed attentional disengagement from such stimuli.

Several other studies examined attentional biases in spider-fearful individuals by testing for biases in visual working memory (VWM). VWM is the hypothetical mechanism that holds visually presented items most recently attended to at conscious levels of processing. It is limited to approximately three to four items (Luck & Vogel, 1997; Wheeler & Treisman, 2002). Reinecke, Rinck, and Becker (2006) conducted a study in which spider-fearful individuals and non-fearful controls completed a computer task testing for VWM bias. Participants first viewed a fixation cross on the screen and were then presented with 16 pleasant, neutral, and negative images (e.g. a spider). Five of these images were cued with a white frame. After a very short amount of time, these items disappeared and returned with one item masked, and the participants were asked to identify which of the images was previously masked. Results indicated that spider-fearful individuals showed improved VWM for uncued spider images when compared to non-fearful controls. However, this relationship did not exist for cued spider images. Reinecke, Rinck, and Becker (2008) followed the previous study up by assessing VWM biases using the Attentional Blink paradigm. In this paradigm, participants are asked to attend to a series of rapidly presented stimuli (e.g. pictures) and focus on two designated targets. Unique visual features (e.g. a brighter background) designate these targets and the time between the presentation of targets is varied. The goal is for the participants to name/select what the first or second target was. Reinecke et al. (2008) tested spider-fearful individuals and non-fearful controls using two negative targets (i.e. disorder-related spiders and disorder-irrelevant snakes). Their results indicated that spiders were preferentially recalled by spider-fearful individuals compared to non-fearful controls, suggesting a temporal VWM bias. Congruent findings from these two studies tentatively suggest that spider-fearful individuals do exhibit VWM biases. However, VWM studies are relatively new and need corroboration and replication with a clinical sample.

Thorpe and Salkovskis (1998) took yet another approach to investigate attentional bias in spider-phobic individuals. These researchers suggested that anxious persons divide their attention between threat and safety when real threat stimuli are used as opposed to semantic stimuli (as in the Stroop). To test their hypothesis, they conducted a reaction time study in which spider-phobic individuals and controls pressed a button as soon as they detected a light. This light randomly flashed either by the door in the room or by the wall opposite the door. A tarantula was placed next to the door for half of the participants and next to the wall for the other half. Results indicated that spider-phobic individuals were faster to respond to the light when the spider was next to the door rather than when it was next to the wall. Thus, they were quicker to respond when threat and escape coincided, suggesting phobic individuals may divide attention to both threat and safety. The authors concluded that phobic individuals divide their attention between threat and safety when confronted by a real threat stimulus, which leads to a division of processing resources once the threat is detected (Thorpe & Salkovskis, 1998).

Three studies, however, did not find attentional biases in phobic individuals when using Stroop task alternatives. The first study examined whether fear-relevant pictures elicited attentional bias in spider-fearful individuals completing a reaction time task (Merckelbach, Kenemans, Dijkstra, & Schouten, 1993). Spider-fearful participants and non-fearful controls were presented with neutral patterns (i.e. horizontal and vertical bars), half of which served as the target and the other half as nontargets. The targets and nontargets were accompanied by a picture of a spider or a flower. Results indicated that fear-relevant pictures (i.e. spider pictures) did not slow reaction times for spider-fearful individuals, suggesting spider-fearful individuals do not exhibit an attentional bias for fear-relevant pictorial stimuli (Merckelbach et al., 1993). Similarly, Lipp, Derakshan, Waters, and Logies (2004) found no pre-attentive processing advantage of snakes and spiders for individuals high in snake or spider fear relative to other nonthreatening animal stimuli. This study is in direct opposition of the Ohman et al. (2001) study that found pre-attentive processing advantage for threatening stimuli. The last study applied the dot probe paradigm to individuals with spider and BII phobias and non-phobic controls (Wenzel & Holt, 1999). The dot probe task involves participants pressing a key as soon as they detect a dot that appears in the location of one of two previously presented words (i.e. spider-related, blood-related, positive, and negative words). Faster reaction time to the dot when it occurs in the previous location of a threatening stimulus is interpreted as attentional bias to threat (MacLeod et al., 1986). Using this methodology, it was found that phobic individuals did not differ from controls on the dot probe task, failing to demonstrate an attentional bias toward phobia-related words. The authors further suggest that semantic paradigms may be insufficient to demonstrate biased performance toward threatening stimuli (Wenzel & Holt, 1999), consistent with the view of Thorpe and Salkovskis (1998).

The literature on attentional biases, though encouraging, has provided a mixed and inconclusive pattern of results. There is relatively strong evidence that specific phobia is associated with attentional bias for linguistic phobia-related stimuli (e.g. Kindt & Brosschot, 1997; Lavy & Van Den Hout, 1993; Watts et al., 1986) and unmasked stimuli (e.g. Thorpe & Salkovskis, 1997; Van Den Hout et al., 1997; Wikstrom et al., 2004). However, studies assessing attentional bias in children are few and inconsistent, with some studies finding that phobic and fearful children do exhibit attentional biases comparable to that of adults (e.g. Kindt & Brosschot, 1997; Martin et al., 1992) while others find no evidence of attentional bias (e.g. Kindt & Brosschot, 1997). The use of visual search tasks (i.e. the odd-one-out paradigm) has produced consistent reports of attentional bias in snake- and spider-fearful individuals (e.g. Ohman et al., 2001; Rinck et al., 2005); however, this methodology is seldom tested in a sample of clinically diagnosed phobics. Similarly, VWM studies demonstrate promising findings of attentional bias, though such studies have yet to utilize a phobic sample (e.g. Reinecke et al., 2006; Reinecke et al., 2008). While there are some studies that failed to find evidence of attentional bias in phobic and fearful individuals (e.g. Olatunji et al., 2008; Sawchuk et al., 1999), the majority of the literature documents such bias. In addition, this literature only follows one line of attentional bias—bias as encoded through images, words, or other content presented visually.

1.4 Dichotic Listening and Psychopathology

Dichotic listening paradigms are employed in many different contexts and with numerous forms of psychopathology. During a dichotic listening task (Broadbent, 1958), participants are simultaneously presented with two separate messages, one presented to each ear. They are instructed to "shadow" (i.e. attend to) the message in only one ear. Subsequently, participants are typically asked about the content of one or both messages. Such tasks yield valuable information regarding both attention and cerebral lateralization in different populations. Past research on attention has shown that when participants are presented with two different auditory messages from two different sources, they can repeat back one message very efficiently. They are unable, however, to report verbal content from the unattended message (Cherry, 1953), apart from highly important or relevant words on an infrequent basis (Moray, 1959; Treisman, 1960). When asked to recall specific target words presented to one ear, the ability to repeat the words on the unattended ear is typically disrupted during times when the target word occurs (Mowbray, 1964).

There is no set methodology when employing dichotic listening tasks. This is apparent when examining the body of literature employing this type of task in clinical populations. To demonstrate, Burgess, Jones, Robertson, Radcliffe, and Emerson (1981) used a dichotic listening paradigm in a sample of clinical patients who were diagnosed with either agoraphobia or social phobia, analogue participants who were identified as extraverted or introverted, and controls. Participants listened to two separate messages presented dichotically to each ear. Participants were instructed to shadow only one channel but tap a ruler to indicate when they heard the target (i.e., phobia-related) word regardless of which channel it was presented in (i.e., right or left ear). Results indicated that the clinical group recognized significantly more target words than the other groups, and this difference was due to their increased recognition of phobia-relevant targets from the rejected channel (Burgess et al., 1981).

Manassis, Tannock, and Masellis (1996) utilized a similar dichotic listening task with anxious, attention-deficit/hyperactivity disorder (ADHD), and typical children. These participants were tested for their detection of words and emotions. Results indicated that anxious children showed increased sensitivity in detecting emotions when compared to controls, while the controls showed increased sensitivity when compared to children with ADHD. In a follow-up to this study, Manassis, Tannock, and Barbosa (2000) used dichotic listening to discriminate biases between children with anxiety, ADHD, comorbid anxiety and ADHD, and controls with neither anxiety disorders nor ADHD. This time, anxious children did not differ from controls while children with ADHD performed more poorly than controls for words but not for emotions. Those children with comorbid anxiety and ADHD performed more poorly than controls on emotional targets. Further findings suggest left hemispheric deficit in emotion recognition of children with comorbid anxiety and ADHD as this group demonstrated very poor right ear emotion recognition (Manassis et al., 2000).

Numerous other studies have utilized dichotic listening paradigms to assess cerebral laterality and perceptual asymmetry in those with psychopathology. A dichotic listening performance advantage for one ear is interpreted as indicating a processing advantage in the contralateral hemisphere. Kimura (1961) found that verbal stimuli presented dichotically were associated with a right ear advantage (REA) and interpreted this finding as an indication of left-hemispheric dominance for language processing. In contrast, typical participants showed right-hemisphere dominance on non-verbal tests (Levy, 1983; Kim & Levine, 1992). Similarly, several researchers have found that depressed adults show evidence of reduced left ear, right hemisphere advantage on non-verbal dichotic listening tests (Bruder et al., 1989; Johnson & Crockett, 1982) and have shown evidence of enhanced right ear, left hemisphere advantage for verbal dichotic listening tasks (Bruder et al., 1989). However, it is important to note that findings on dichotic listening tasks and depression tend to be inconsistent and vary with depressive subtype (Bruder, 1995), reflecting the clinical heterogeneity of depression.

Discrepant results were found by Wale and Carr (1990) who compared individuals with major depressive disorder (17 individuals without melancholia, three with melancholia, and four with psychotic features), diagnosed using *DSM-III* criteria, to controls using both the Fused Rhymed Words Test (FRW; Wexler & Hawles, 1983) and the Dichotic Monitoring (DM) task (Geffen, Traub, & Stierman, 1978). The former is a language-processing task using phonemic discrimination of rhyming words. The latter, however, requires ongoing attention to a stream of information, rapidly presented, with the items of each dichotic pairing being spatially separate. No differences were found between depressed participants and controls or within depressed participants according to presenting symptomatology on the FRW. Conversely, the DM revealed significant differences in both diagnosis and symptomatology with depressed participants detecting fewer targets than controls. As the DM has more of an attentional component than the FRW, it can be concluded that the depressed participants exhibited attentional deficits. Further, depressed participants did not show a significant REA, which was seen in the control group (Wale & Carr, 1990). The authors proposed an interaction between attention and affect as the basis for the performance asymmetries found in their study. The depressed participants showed a reciprocal relationship between anxiety and psychomotor retardation as there was an inverse correlation between these two symptom dimensions. These findings implicate right hemisphere processes in depression, which is inconsistent with more recent research (e.g. Bruder et al., 1999; Pine et al., 2000).

Inconsistent results were also found by Pine et al. (2000). This research group assessed cerebral laterality in adults and adolescents with major depression using two verbal dichotic listening tasks, the FRW (Wexler & Halwes, 1983) and the Fused Syllable Task (Wexler & Halwes, 1985) and one non-verbal dichotic task, the Complex Tones Test (Sidtis, 1981). Results indicated that major depression in adults and adolescents is associated with an increased REA for perception of dichotic-fused words (i.e. two words that are presented simultaneously one to each ear and fuse so that there is only perception of one word), while depressed adults with comorbid anxiety demonstrated reduced REA. The non-verbal dichotic listening task provided no evidence of reduced left ear advantage (LEA) in either age cohort (Pine et al., 2000). Bruder et al. (1999) obtained similar findings in participants with major depressive disorder with or without a comorbid anxiety disorder. Non-anxious depressed participants showed a larger REA than anxious-depressed or control participants for words; however, the anxious-depressed group had a larger LEA for tones and a smaller REA for words when compared to the non-anxious depressed group. These findings indicate that anxious and non-anxious depressed individuals differ in their pattern of hemispheric activation with the anxious depressed group showing bias for the left ear (right hemisphere) and the non-anxious depressed group showing bias for the right ear (left hemisphere; Bruder et al., 1999).

Outside of depression, dichotic listening paradigms have also been utilized with socially phobic and obsessive-compulsive individuals. Bruder et al. (2004) examined hemispheric asymmetries in those having social phobia with or without comorbid depression. Using the dichotic methods common to depression studies (i.e. FRW, Complex Tone Test), socially phobic participants with or without depression showed smaller left hemisphere advantage for verbal dichotic listening tests compared to controls. These participants did not show increased right hemisphere advantage for non-verbal dichotic material though. Findings from this study implicate dysfunction of left hemisphere regions mediating verbal processing with social phobia as participants with social phobia showed smaller left hemisphere advantage for perceiving dichotic words or consonant-vowel syllables when compared to controls. Given the nature of social interaction and importance of verbal processes, left hemisphere dysfunction may contribute to the stress and anxiety in socially phobic individuals when presented with a social situation (Bruder et al., 2004). Wexler and Goodman (1991) compared cerebral laterality between individuals with obsessive-compulsive disorder (OCD) and controls using verbal dichotic listening tasks. Individuals with OCD showed reduced REA (i.e. reduced left hemisphere processing of verbal stimuli) compared to controls as they heard fewer emotion-related words than controls. Additionally, this abnormality was more pronounced in participants with more severe OCD. Consistent findings from these two studies indicate that anxiety disorders may share left hemisphere dysfunction as a common thread.

Taken together, studies using dichotic listening paradigms tend to be diverse in methodology and inconsistent in findings (e.g. cerebral laterality studies of depressed individuals). Aside from studies assessing cerebral laterality in depression, little research using dichotic listening paradigms has been conducted on any single form of psychopathology. Preliminary findings indicate individuals with social phobia and agoraphobia show attentional bias for phobia-relevant material (Burgess et al., 1981) and adults with anxiety disorders (i.e. social phobia and OCD) exhibit left hemisphere dysfunction (Bruder et al., 2004; Wexler & Goodman, 2004); however, findings are inconsistent in the depression literature (e.g. Bruder et al., 1999; Pine et al., 2000; Wale & Carr, 1990) and ADHD child literature (Manassis et al., 1996; Manassis et al., 2000).

1.5 Cerebral Lateralization and the Neuropsychology of Anxiety

The right and left sides of the brain have been shown to differ not only in their capacity to handle different stimuli, but also in the manner in which they process information. Accordingly, it has been postulated that the left hemisphere functions in verbal processes, while the right hemisphere plays an important role in nonverbal aspects of perception and cognition (Milner, 1967; Morgan, McDonald, & McDonald, 1971). There are also indications that the hemispheres may differ in their involvement with emotion regulation and related behaviors. For instance, the right hemisphere has been implicated in the experience of emotion (Schwartz, Davidson, & Maer, 1975; see Silberman & Weingartner, 1986 for a review). According to the right hemisphere model, one of the more prominent emotion theories, expressive and receptive features of emotion are regulated mainly in the right hemisphere of the brain (Heilman & Gilmore, 1998; Heilman, Scholes, & Watson, 1975). Conversely, the valence model postulates that the right hemisphere is specialized for negative emotions while the left hemisphere is specialized for positive emotions (Silberman & Wiengartner, 1986).

Numerous methodologies have been utilized to test the right hemisphere hypothesis, most of which have found evidence to support right hemisphere involvement in emotion. For instance, early dichotic listening studies showed a left ear advantage (i.e. right hemisphere advantage) in the recognition of emotional aspects of speech (Carmon & Nachshon, 1973; King & Kimura, 1972). Similarly, Safer and Leventhal (1977) found a left ear advantage for emotional judgments when participants were asked to judge the content and tone of a speaker's voice in a monaural task. In another monaural variant, DeWitt (1978) had participants view cartoons and hear spoken captions and laughter in either the left or right ear. The results indicated that the participants found the cartoons funnier when the left ear heard laughter, showing that the emotional aspect was more activated when heard in the left ear (right hemisphere advantage) than the right ear. Other researchers have found left visual field advantage for facial recognition when the faces have emotional rather than neutral expression (Ley & Bryden, 1979; Suberi & McKeever, 1977). Subsequently, it was also found that the degree of left visual field advantage relied upon how highly the participants rated the emotionality of the faces (McKeever & Dixon, 1981). Further evidence of right hemisphere dominance in the experience of emotions comes from Schwartz et al. (1975) who found that emotional questions caused an increase in the frequency of left eye movements. Taken together, these studies suggest that the right hemisphere is superior for recognizing emotional aspects of stimuli.

It is also widely accepted that the perception and experience of negative emotions (e.g. anger, disgust, and fear) are lateralized to the right hemisphere (see Demaree, Everhart, Youngstrom, & Harrison, 2005 for a review). Perhaps the most striking demonstration of right hemisphere laterality of negative emotion comes from participants undergoing the Wada test (Wada, 1949). The Wada test entails participants receiving sodium amytal injections into one hemisphere at a time, via the right or left internal carotid artery, in order to "shut down" the functioning of one hemisphere so the other can be evaluated. Thus, injection into the right carotid artery shuts off the left hemisphere of the brain while injection to the left carotid artery shuts off the right hemisphere. Using this method, researchers found that injections to the right artery (left hemisphere) produced a "catastrophic reaction," while injections to the left artery (right hemisphere) produced euphoric behavior (Alema, Rosadini, & Rossi, 1961; Perria, Rosadini, & Rossi, 1961; Rossi & Rosadini, 1967; Terzian, 1964). Thus, a left-positive, right-negative hemispheric dissociation was found for affect. This finding is corroborated with research employing lateral eye movements as a measure of hemispheric activation. For instance, Tucker, Rother, Arneson, and Buckingham (1977) found that stress resulted in an increase in left eye movements, which suggests right hemisphere activation, when they varied the emotionality of an experiment with stressful and nonstressful instructions. Similarly, Ahern and Schwartz (1979) found more left lateral eye movements during responses that pertained to sad or fearful affects, while right lateral eye movements were found when participants responded to questions that provoked happiness and excitement. These findings are discrepant with the formerly mentioned studies that posited the right hemisphere is dominant in the perception and modulation of emotion. Instead, this line of evidence suggests the right hemisphere is specialized for dealing with negative emotions, while the left hemisphere is specialized for positive emotions, which supports the valence model.

Lateralization has further been investigated in individuals experiencing negative affect, specifically anxiety. Tucker, Antes, Stenslie, and Barnhardt (1978) found evidence of increased right visual field errors on verbal and spatial tasks during periods of increased anxiety (i.e. participants were given the impression that they were the focal point of a high-pressure experiment). Left visual field errors, however, were not affected by anxiety. In the follow-up study, Tucker et al. (1978) found right ear bias in the perception of tones during an auditory attention task in high trait anxiety participants. Similar results were also found during periods of depressed mood (Tucker, Stenslie, Roth, & Shearer, 1981). The authors of these studies posited that the results indicated increased left hemisphere activity during anxiety and depression; however, other researchers suggest poorer left hemisphere performance may result from increased right hemisphere activity (Everhart & Harrison, 2000; Silberman & Weingartner, 1986). In line with the previously mentioned hypothesis and in support of the right hemisphere hypothesis, Everhart and Harrison (2000) found high trait anxiety to be associated with increased accuracy for negative affective faces presented to the left visual field (right hemisphere).

Due to inconsistent findings of right and left hemispheric activation during anxiety, types of anxiety (e.g. anxious apprehension and anxious arousal) have been proposed to account for the discrepant findings. Heller, Nitschke, Etienne, and Miller (1997) first tested this hypothesis by manipulating anxious arousal in participants with anxious apprehension. Using electroencephalography (EEG), brain activity was measured during rest and during an emotional narrative task. It was found that anxious participants showed a larger left hemisphere advantage overall, though they showed an increase in right hemisphere activity during the task itself. In a later study, Nitschke, Heller, Palmieri, and Miller (1999) contrasted patterns of brain activity in anxious apprehension and anxious arousal via EEG. They found anxious arousal to be associated with increased right hemispheric activity, while no asymmetry was found for anxious apprehension. Similarly, Mathersul, Williams, Hopkinson, and Kemp (2008) found overall greater right hemisphere lateralization in anxious participants; however, they found evidence of right frontal lateralization in anxious arousal and left frontal and right parietotemporal lateralization in anxious apprehension. Taken together, these studies provide support for the notion that different patterns of brain activity correspond to different types of anxiety (i.e. apprehension vs. arousal), as it appears anxious arousal is associated with greater right hemisphere activity and anxious apprehension is associated with greater left hemisphere activity or perhaps no asymmetry at all.

The evidence provided thus far neither confirms nor disproves the right hemisphere or valence hypotheses. Evidence is also equivocal when it comes to the lateralization of anxiety. Of importance, however, is that most studies assessing anxiety used "high trait" anxiety opposed to clinically diagnosed anxiety disorders. As anxiety is heterogeneous, lateralization may vary according to symptomatology. In one of the few studies assessing laterality in clinically diagnosed individuals, Yeudall et al. (1983) found that panic disorder patients performed worse than normal controls on left but not right hemisphere-specific tasks on a neuropsychological battery. Thus, this study supports the valence model of emotion. Still, one study does not provide enough evidence for researchers to conclude that the valence model is superior to the right hemisphere model. More research is needed to clarify these existing discrepancies in lateralization research.

1.6 Current Study

Overall, the literature on specific phobia indicates that individuals with this disorder appear to experience attentional biases. This bias has been demonstrated with numerous methodologies such as the modified Stroop task (e.g. Lavy & Van Den Hout, 1993; Martin et al., 1992; Watts et al., 1986; Wikstrom et al., 2004), visual search tasks (e.g. Ohman et al., 2001; Rinck et al., 2005), and studies assessing VWM (e.g. Reinecke et al., 2006; Reinecke et al., 2008). Of particular concern, however, is that many of these studies used a sample of individuals without a diagnosis of specific phobia, but rather people endorsing phobia-related fears. This prohibits generalizability of the findings to clinically severe cases, though it adds to the robustness of the literature at the same time by investigating these variables in analogue participants. The current study will attempt to expand such findings using a methodology that has yet to be tested with individuals having specific phobias. Specifically, this study will use a dichotic listening paradigm to test for auditory attentional bias in individuals with specific phobia. The methodology used in the current study was based on Wexler and Halwes' (1983) FRW task; however, participants in this study were chosen based on the presence (or absence) of a specific phobia. Further, this study aimed to extend the current literature citing attentional bias in individuals with specific phobia by assessing cerebral laterality in addition to attention. The existing literature assessing laterality in relation to anxiety is not only equivocal but also sparse. The proposed study will be the first to assess laterality in individuals with diagnosed specific phobias, and one of the few that utilizes clinically diagnosed anxiety disorders.

1.6.1 Hypotheses

Hypothesis 1: In line with information processing theory and literature demonstrating that phobic individuals show attentional bias to threatening stimuli, phobic participants will exhibit attentional bias on the dichotic listening task by recognizing more threat-related target words overall than controls.

Hypothesis 2: Control participants will not show differences in performance between threat-related and neutral words. Hypothetically, these words will not be perceived with the same sense of threat as they will by those with specific phobias.

Hypothesis 3: Phobic participants will show right hemisphere lateralization on the dichotic listening task (i.e., increased recognition of target words played to the left ear) due to increased selection of threat-related words. Thus, phobic participants will recognize significantly more total threat-related words when shadowing the left channel (corresponding to the right hemisphere).

CHAPTER 2. METHOD

2.1 Participants

Twenty-five college undergraduates (seven male and 18 females) participated in this study. The participants ranged in age from 18 to 28 years (M = 20.24, SD = 2.63) and ethnicity was distributed as follows: 72% Caucasian, 20% African American, and 8% Asian. Participants were further placed into either the phobia or control groups (no clinical diagnoses) based on the *ADIS-IV* (14 phobics, 11 controls). Specific phobias were distributed as follows: 60% animal type and 40% blood-injection-injury type. Approximately 25% of the phobic participants had at least one comorbid disorder, most commonly, social phobia, generalized anxiety disorder, or another specific phobia. Those participants with previously diagnosed pervasive developmental delays, intellectual disability, schizophrenia, bipolar disorder, hearing problems, history of traumatic brain injury/stroke/etc., or learning disorders were excluded from participation (n = 1). Participants were also excluded if left-handed. All participants gave written consent prior to initiating the study and received course credit upon completion of this study as incentive for their participation. This study was also approved by the Louisiana State University IRB. See Table 1 for additional participant characteristics by experimental group.

2.2 Measures and Apparatus

Anxiety Disorders Interview Schedule - IV. The Anxiety Disorders Interview Schedule for DSM–IV (*ADIS-IV*; Brown, Barlow, & DiNardo, 1994) is a structured interview designed to assess for current episodes of anxiety disorders and to permit differential diagnosis among the anxiety disorders according to *DSM-IV* criteria. It includes sections to assess current mood, somatoform, and substance use disorders due to their high comorbidity with anxiety disorders. The *ADIS–IV* has been reported to show mostly acceptable levels of test-retest reliability via two

Table 1

Participant Counts By Group

	Phobics	Controls
Gender		
Male	3	3
Female	11	8
Ethnicity		
Caucasian	9	8
African American	4	2
Asian	1	1
Phobia Type		
Animal	9	-
BII	5	-
Mean CSR*	5.25 (1.04)	-

Note: Number of participants per group is presented. Mean CSR is listed with standard deviation in parentheses.
*CSR corresponds to the Clinician Severity Rating obtained from the *ADIS – IV*; 4 and above is considered clinically significant.

separate studies, with kappa coefficients as follows: generalized anxiety disorder = 0.47 and 0.57; OCD = 0.66 and 0.83; panic disorder with agoraphobia = 0.85 and 0.85; panic disorder without agoraphobia = 0.69 and 0.65; social phobia = 0.77 and 0.91, and specific phobia = 0.56 (Barlow, 1985; DiNardo, O'Brien, Barlow, Waddell, & Blanchard, 1983;). Blanchard, Geradi, Kolb, and Barlow (1986) reported the inter-rater agreement for posttraumatic stress disorder as 93% in a separate study.

The *ADIS–IV* was administered to participants individually by trained graduate student clinicians. Diagnoses were made on the basis of a Clinician Severity Rating of four or higher (based on a zero to eight scale with zero being no symptoms, four being the clinical cutoff, and eight being very severe symptoms).

Demographic Questionnaire. The demographic questionnaire is a measure created by Dr. Thompson Davis III (the principal investigator of overarching study) to obtain background information and history from the participant. Items to be included are age, race, gender, marital status, family history of mental illness, income level, medical conditions, and history of therapeutic intervention.

Dichotic Listening Task. The dichotic listening task used in the current study loosely followed the procedures laid out by Wexler and Halwes (1983) for the FRW task. For the FRW task, participants are presented with monosyllabic words in each ear that differ on the initial consonant; however the current study utilized words with either one or two syllables. The words are presented simultaneously to the right and left ears causing the words to fuse to together to form a single auditory image. After hearing each dichotic pair, participants choose the word they heard from the four choices they are presented (the words presented to each ear plus two similar distracters).

The equipment used in the current study included a desktop computer, Adobe Audition 1.5, a set of headphones, and response sheets for participants. The stimulus materials were presented in the form of dichotic recordings (i.e. phobic and neutral dichotic pairs). The words chosen as stimuli for each participant corresponded to their phobia and were obtained using the University of South Florida Word Association Norms (http://w3.usf.edu/FreeAssociation/). Information pertaining to the presence/absence of specific phobia was obtained from the *ADIS–IV* (Brown et al., 1994). Accordingly, a participant with a phobia of bees would be presented with threat-related words such as hive, bug, bumble, etc. in one channel and neutral words simultaneously in the other channel. Threat-related and neutral words were matched on the basis of same number of syllables and ending phonemes. Those participants in the control group were yoked to the phobia group for phobic stimuli (i.e., control participants were matched to phobic participants for word pairs). All participants were permitted to increase or decrease the volume during the practice trial. The volume was kept constant once the experimental trials started. See Appendix A for an example of the dichotic task record sheet (bolded words refer to the presented words).

2.3 Procedure

The current study was part of a larger, ongoing specific phobia phenomenology and treatment study, which has been reviewed and approved by Louisiana State University's internal review board. Participants attended three sessions; however, data used for the current study was collected from the first and third sessions only. Participants were recruited via psychology experiment sign-ups from various undergraduate classes. Upon signing up for the study, participants were scheduled for an assessment interview that included the *ADIS–IV* and other self-report measures that are unrelated to the current study. Participants were excluded at this stage if they reported a previous diagnosis of pervasive developmental delay, intellectual disability, schizophrenia, learning disorder, or history of traumatic brain injury/stroke/etc, or if they were left-handed. Participants were included in the present study if they received a diagnosis of specific phobia in addition to those with no diagnosable psychopathology and who met no other exclusion criteria. During the third session, participants completed the dichotic listening task as well as other tasks and measures unrelated to the current study.

For the dichotic listening task, participants were tested individually on a desktop computer using the Adobe Audition 1.5 program. Stimuli were presented through headphones.

Accordingly, words corresponding to each participant's phobia were presented to one ear and another unrelated but similar-sounding word (i.e. same number of syllables, rhyming if applicable) was presented simultaneously to the other ear. These dichotic pairs fused into a single auditory image heard by participants. Upon presentation of each dichotic pair, the participants selected the word they heard from four word choices (two of which were presented plus two distracters) printed on an answer sheet (See Appendix A for an example; words presented during the dichotic task are in bold print). When participants chose the word corresponding to their phobia, auditory attentional bias is theoretically exhibited. This procedure was repeated for 30 word pairs (15 phobic word pairs and 15 neutral word pairs). Additionally, the assignment of words was reversed with those words originally presented to the right ear presented to the left and vice-versa so that each participant heard each word pair twice, though in a different ear. Participants were tested for a total of 60 stimulus pairs. The order in which the stimuli were presented was randomized for each participant. Appendix B shows a diagram of the stimulus composition for the dichotic task.

CHAPTER 3. RESULTS

Preliminary chi-square analyses indicated no significant differences between experimental groups due to gender, $\chi^2(2) = 5.60$, *ns,* or ethnicity, $\chi^2(2) = 2.36$, *ns*. An independent samples *t*-test revealed that no differences between phobic participants ($M = 19.86$, $SE = 0.31$) and controls ($M = 20.73$, $SE = 1.14$) existed based on age, $t(23) = 0.81$, *ns*. Accordingly, no significant differences emerged between experimental groups. Due to small sample size, these demographic variables were not tested in relation to the outcomes presented below.

To test the study hypotheses that 1) phobic participants will endorse more threat-related words overall than controls, 2) controls will demonstrate no differences between threat-related and neutral words, and 3) phobic participants will demonstrate left ear bias due to increased detection of threat words, a 2 (Group: phobic, control) x 2 (Channel: left, right) x 2 (Word Type: threat, neutral) repeated-measures analysis of variance (ANOVA), using threat and neutral words and left and right presentation as the repeated measures, was conducted. There was a significant Group x Channel interaction, $F(1, 23) = 4.33$, $p < .05$, partial $\eta^2 = .20$, in addition to a significant Group x Channel x Word Type interaction, $F(1, 23) = 6.64$, $p < .05$, partial $\eta^2 = .16$. In addition to being statistically significant, both interactions indicated large effect sizes, thus accounting for a substantial amount of variance. The lack of a Group x Word Type interaction goes against the first hypothesis, in which phobic participants were hypothesized to detect more threat-related words overall than control participants. The Group x Channel interaction is shown in Figure 1 and the three-way interaction (Group x Channel x Word Type) is shown in Figure 2. Main effects for Group, Channel, and Word Type were nonsignificant (i.e., participants did not differ in threat or neutral responses based solely on each factor), though a main effect for Channel

Figure 1

Number of Right and Left Channel Responses By Group

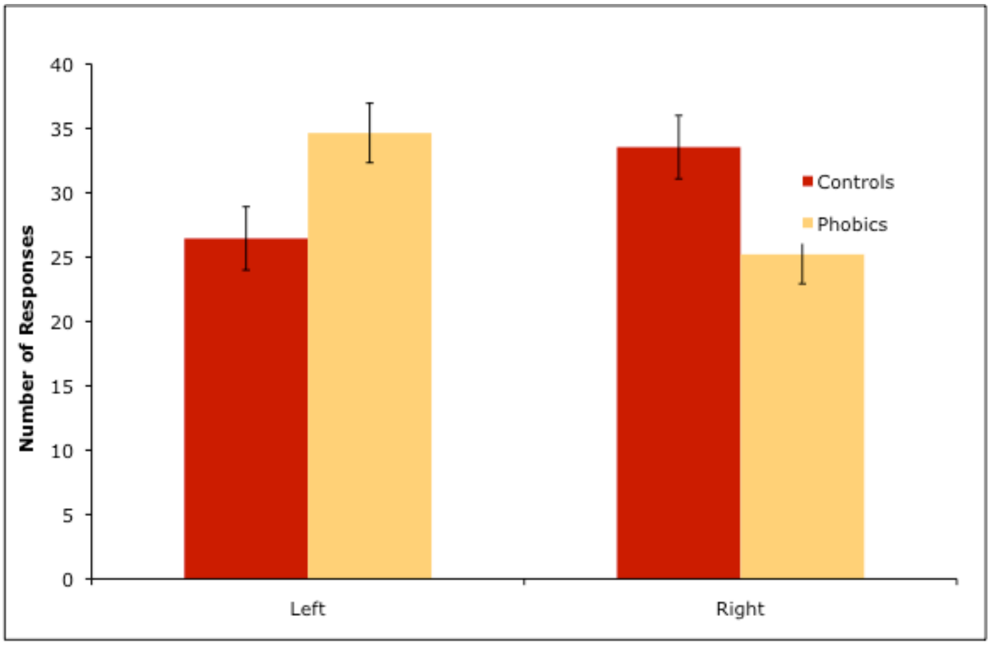

Figure 1. Shows the mean number of responses made in each channel (left versus right) for phobics and controls on the dichotic listening task. This indicates that the Group x Channel interaction is mainly due to phobic participants recognizing significantly more words in the left channel and control participants in the right channel.

approached significance (See Figures 3 and 4). Follow-up analyses revealed that phobic and control participants significantly differed on the number of threat-related words detected with the left channel, $t(23) = -2.19$, $p < .05$, in which phobic participants detected more threat-related words than controls. Follow-up independent *t*-tests also revealed that the groups significantly differed on neutral words detected on the left channel, $t(23) = 2.60$, $p < .05$, with control participants detecting more neutral words than phobic participants. Thus, phobic participants did exhibit a left ear bias in support of the third hypothesis. No differences existed between groups on threat-related word detection on the right channel, $t(23) = 1.50$, *ns*, or on neutral word (i.e., those paired with a threatening word) detection on the right channel, $t(23) = -1.94$. Figure 2 illustrates these group differences.

Figure 2

Number of Fear and Neutral Responses By Participant and Channel

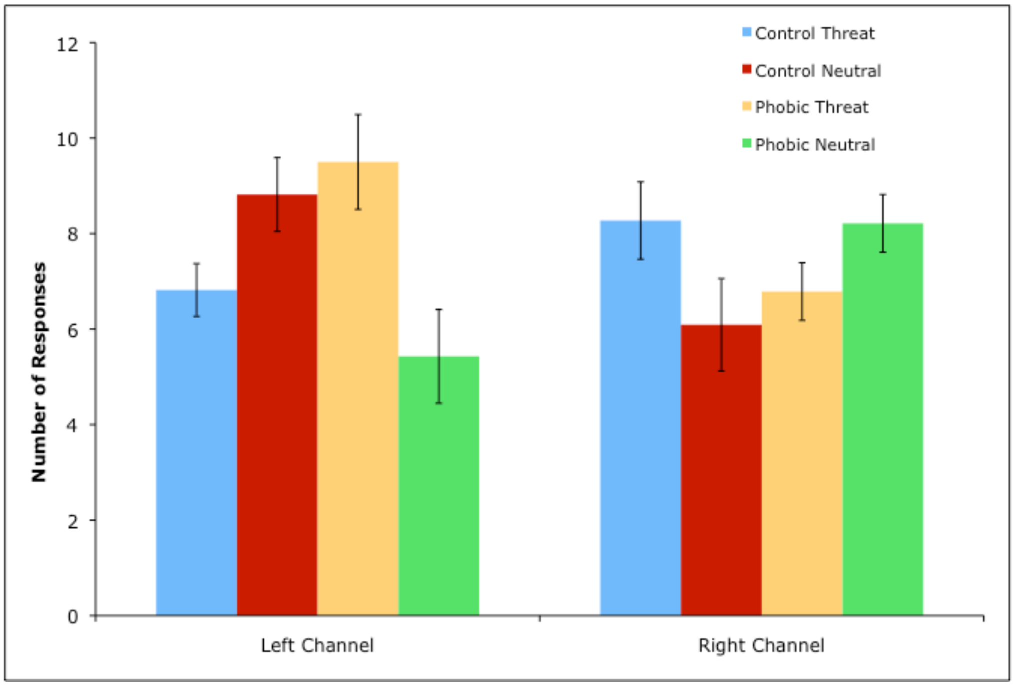

Figure 2. Shows the results of a three-way interaction (Group x Channel x Word Type). Participant group (phobic vs. control) and word type (threat vs. neutral) means are presented by channel. This indicates that the Group x Channel x Word Type interaction is mainly due to phobic participants detecting significantly more threatening words in the left channel and controls detecting more neutral words in the left channel.

To further examine response differences, an independent *t*-test was conducted comparing phobic and control participants on the basis Channel using only neutral word trials (i.e., word pairs that contained no threat-related stimulus). This analysis revealed that phobic and control participants do not differ on neutral words presented to the left channel, $t(23) = .26$, *ns*, or to the right channel, $t(23) = .18$, *ns*. Thus, the differences on Channel emerged due to differential performance on trials with threatening stimuli, with phobic participants recognizing more of these words in the left channel. When analyzing non-threatening stimuli, no differences emerged.

Figure 3

Number of Target and Distracter Responses by Group

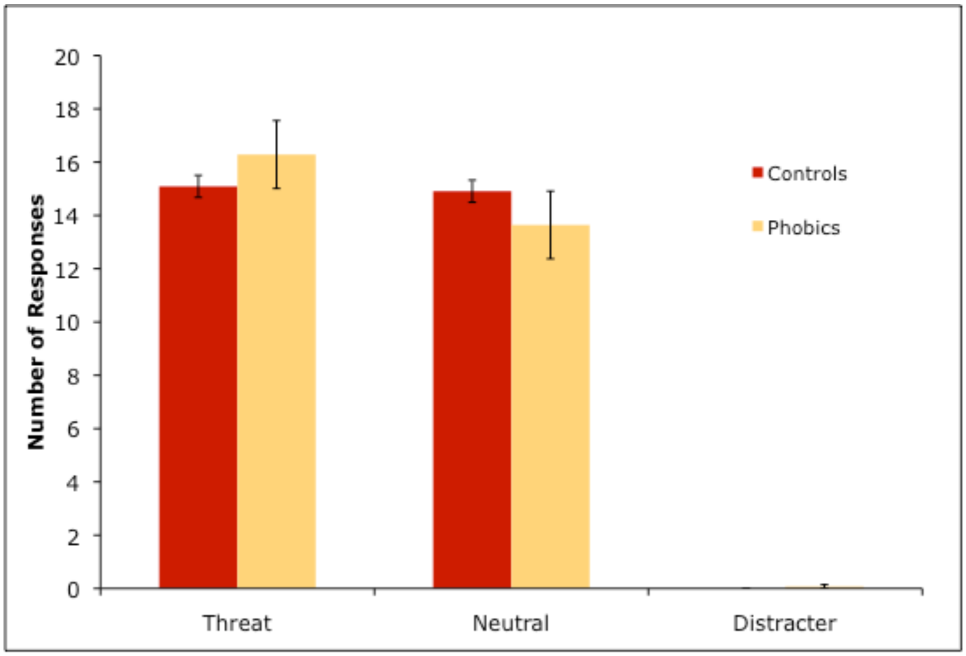

Figure 3. Shows the number of threat, neutral, and distracter (i.e., nonpresented) words for phobics and controls on the dichotic listening task. The figure shows that phobic and control participants did not significantly differ on total amount of threat, neutral, or distracter words.

Refer to Table 2 for means, standard deviations, and effect sizes (i.e., Cohen's *d*) for channel (left vs. right) and word type (fear vs. neutral vs. distracter) detection by group. Note that effect sizes for fear, neutral, and distracters indicated small to medium effects between the phobic and control groups, while channel indicated large effects between groups.

Figure 4

Number of Fear and Distracter Responses By Channel

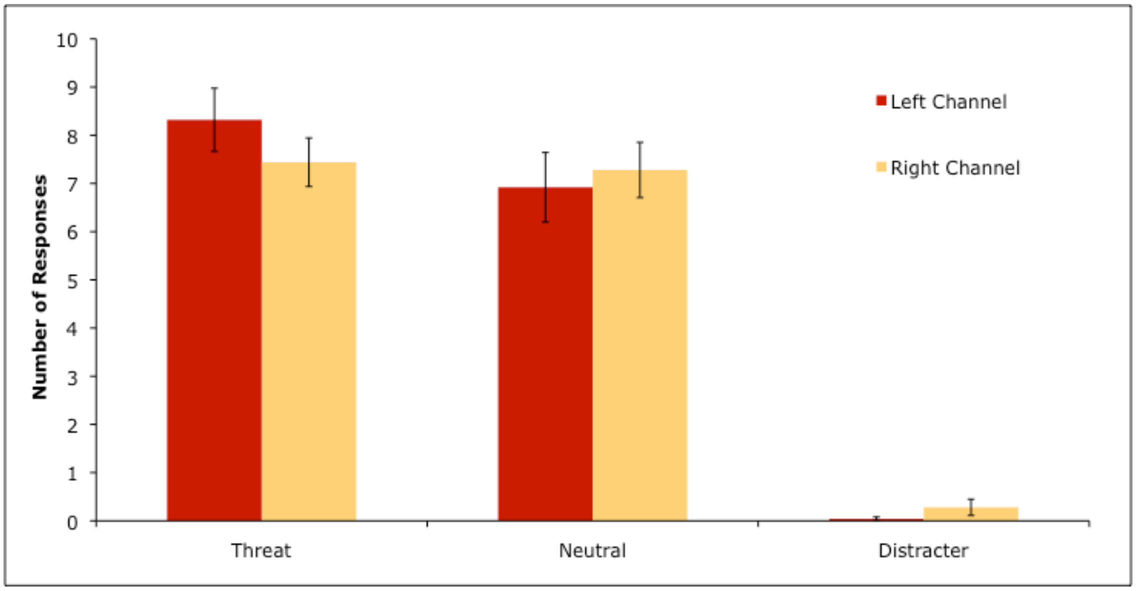

Figure 4. Shows the mean number of responses to each channel for all participants on the dichotic listening task.

CHAPTER 4. DISCUSSION

The aims of the current study were threefold. First, this study sought to test a novel methodology (i.e., dichotic listening paradigm using FRW) in individuals with specific phobias. Second, the study aimed to use dichotic listening to test for attentional bias for threat-related words in those with phobias. The last aim was to assess for cerebral laterality, specifically of fear, in phobic individuals using dichotic listening.

The results of the current study partially supported the study hypotheses. The first hypothesis of this study (i.e., increased threat detection in phobic participants) was disconfirmed. Phobic participants did not detect more threat words overall than controls; however, participants with specific phobias did detect significantly more threatening words than controls in the left channel—a more fine-grained observation. No differences were observed in the right channel. This suggests a left ear and right hemisphere bias for phobic participants. This laterality is further explained below. Despite detecting more threatening words in the left channel, phobic participants did not differ from controls when assessing for total threatening words, thus rejecting the initial hypothesis that phobic participants would show an attentional bias for threat-related stimuli. This is contradictory to findings from various other studies that consistently document attentional biases in individuals with specific phobia; however, these studies utilized visual tasks while the current study examined attention via auditory means. Moreover, this study is novel due to its use of an auditory task to assess attention. This suggests that, perhaps, individuals with specific phobia do not orient their attention to phobic words they hear the same way they do with visually presented words. Specifically, persons with phobias may process fear-relevant, auditory information more through the right hemisphere, whereas those without such fears process the auditory information through the left hemisphere, which is postulated to be the

Table 2

Means and Standard Deviations for the Dichotic Listening Task By Group

	Phobics	**Controls**	**Effect Size (Cohen's *d*)**
Total Fear Words	16.29 (4.76)	15.09 (1.38)	.34
Total Neutral Words	13.64 (4.75)	14.91 (1.38)	.36
Total Distracters	0.07 (0.27)	0.0 (0.0)	.37
Total Left	34.64 (8.63)	26.45 (8.15)	.98
Total Right	25.21 (8.54)	33.55 (8.15)	1.00

Note: Means are presented with standard deviations in parentheses. Fear, neutral, and distracter words refer to word selections made during trials with threat-related stimuli. Total left and total right refer to the channel in which participants chose each word from.

more language-heavy hemisphere. This type of differential processing may have contributed to the results of this study, as there was no difference in total threat detection between phobic and control participants, despite meaningful differences between channels for threat detection (i.e., participants with phobias detected more threatening words in the left channel).

The second hypothesis of this study was confirmed: controls did not show differences between threat-related and neutral stimuli. On average, control participants detected about 15 (out of 30) threatening words and 15 neutral words on trials with threatening stimuli. See Table 2 for a complete list of means and standard deviations by group and stimuli type. This shows that the control participants did not perceive the threat-related stimuli as threatening, rather perceiving them in the same sense as the neutral stimuli. These participants did, however, exhibit a tendency to detect stimuli in the right channel (i.e., left hemisphere), though nonsignificant.

This study found evidence for cerebral laterality in support of the third hypothesis: phobic participants exhibited a left ear, right hemisphere preference for stimuli presented via dichotic means. Accordingly, participants with specific phobias used the left channel more frequently than control participants. Analyses showed that the channel differences were significant for threat-related stimuli presented to the left ear. This finding provides support that the right hemisphere is implicated in cognitive processes such as emotion, especially negative emotion (e.g., fear). The results also provide evidence of both the right hemisphere and valence models. The right hemisphere model posits that the right hemisphere is specialized for both expressive and receptive features of emotion, while the valence model views the right hemisphere as an entity specialized for negative emotion. Current findings give way to these models as the study stimuli were chosen to evoke negative emotion during a task that required them to attend to a threatening message (i.e., receptive task). The results of this study are in support of studies such that by Mathersul et al. (2008), who found anxiety to be associated with right hemisphere lateralization. However, there are some studies, such as Bruder et al. (2004) and Wexler and Goodman (1991) that found participants with social phobia and OCD to exhibit left hemisphere bias. Thus, the literature on cerebral laterality remains equivocal.

As previously cited, the current study used a novel methodology. It used the FRW task employed by Wexler and Halwes (1983), though it employed several deviations from their protocol. The FRW used monosyllabic consonant-vowel-consonant words only while the current study used both monosyllabic and two-syllable words. Additionally, the current study employed emotionally laden words pertinent to certain phobias in order to evoke emotion. These deviations may have impacted the ability to make decisions regarding cerebral laterality.

The results of this study were likely affected by several other limitations. First, the study was under powered due to small sample size ($n = 25$), thus it likely lacked the power to detect some meaningful differences. The experimental groups were also of uneven sample size (14 phobics and 11 controls). Second, the dichotic task itself may not have captured the attention of the participants with phobias. Given the threat-related and neutral words fuse together during simultaneous presentation, the participants may not have been able to clearly and cogently decipher the threat-related words. Lastly, comorbidity may have influenced the results of this study. Almost 25% of the phobic group exhibited at least one other comorbid anxiety disorder while no member of the control group endorsed diagnosable psychopathology. Notably, the phobic group's performance on the dichotic listening task was much more variable than that of the control group. Scores for total number of threat-related words ranged from five to 22 for the phobic group ($M = 16.29$, $SD = 4.76$) and ranged from 13 to 17 for the control group ($M = 15.09$, $SD = 1.38$). Some of the variability in the phobic group's performance may be due to comorbid disorders (i.e., the task itself may have been anxiety-provoking for some due to various issues such as evaluation by the experimenter or other demand characteristics). Alternatively, phobic performance may be more of a bimodal distribution in which some cognitively avoid threat-related stimuli while others show attentional bias and detect high rates of threatening stimuli.

The results of this study may have implications for the degree to which target information (i.e., threatening words) is elaborated upon in individuals with specific phobia. For instance, Foa and Kozak (1986) posited that threat cues tend to be easily and quickly encoded. Thus, individuals may respond to this type of stimuli with cognitive/attentional avoidance, which interferes with elaborative processing of the information. Hypothetically, this interference would lead to poorly differentiated and distorted cognitive representations of phobic stimuli, such as representations that are more harmful or dangerous than they are in actuality or that all things associated with that stimulus is harmful. This incomplete processing may subsequently impair a person's memory for fear-related stimuli (e.g., Watts & Dalgleish, 1991).

Cognitive avoidance may also have implications for psychological treatment for individuals with specific phobia. Given that moderate levels of arousal during exposure are not only necessary but positive indicators (Craske, Street, Jayaraman, & Barlow, 1991), attentional avoidance may lessen the effectiveness of exposure. This would seem to play more of a role for visual stimuli; however, early exposures may entail psycho-education about a particular feared stimulus or sounds associated with stimuli (e.g., hearing a dog bark, thunder, etc.). Depending on the individual, even the noises associated with a feared stimulus may prove to be anxiety provoking.

The current findings should be interpreted with caution and require replication to further support the hypotheses presented. Further research is needed to examine the extent of attentional bias in those with specific phobia. Specifically, do attentional biases extend beyond visual means? There is an abundance of research examining whether or not phobics exhibit attentional bias during visual tasks; however, this is the only study examining attentional bias via auditory means. This topic should be further explored and other paradigms should be tested, including variations of the dichotic listening task.

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APPENDIX A

SAMPLE ANSWER SHEET

Participant #: __________

Date: _________________

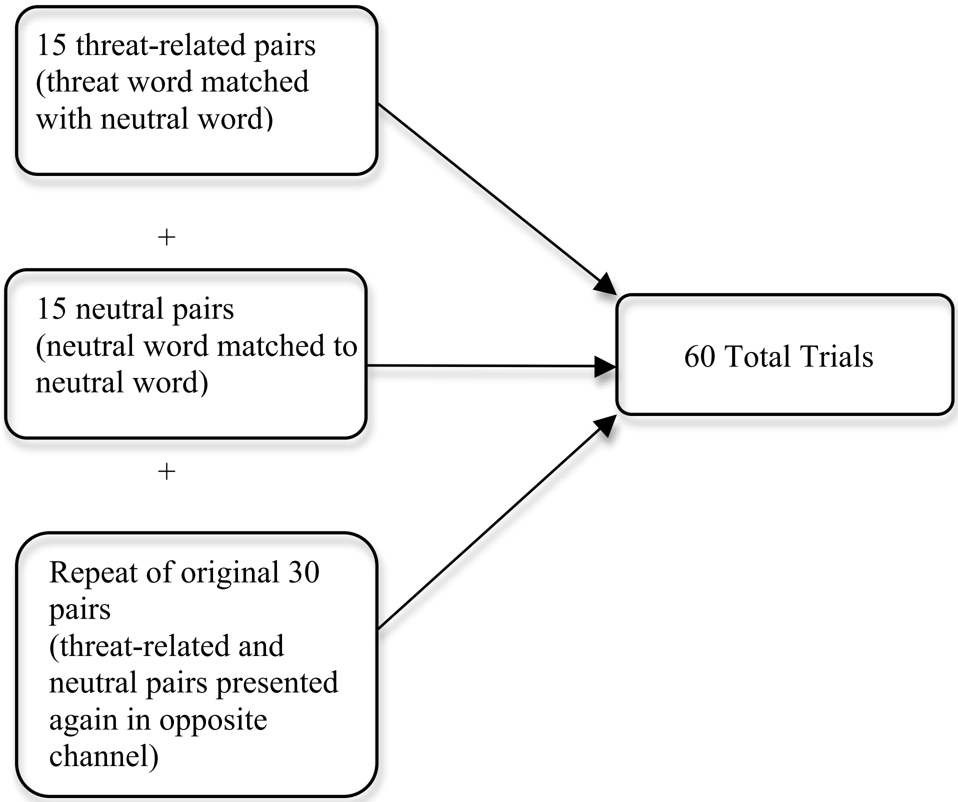
Handedness: Right / Left

Directions: Select the one word that most closely resembles what you heard for each trial.

1	**Plain**	**Vein**	Lane	Mundane
2	**Share**	Glare	Bear	**Chair**
3	Able	**Cable**	**Table**	Capable
4	**Unhinge**	Binge	**Syringe**	Pinch

APPENDIX B

STIMULUS COMPOSITION FOR THE DICHOTIC LISTENING TASK



VITA

Whitney S. Jenkins was born in Ashland, Kentucky on September 16, 1985. She was raised in Ironton, Ohio, where most of her family resides. She and her immediate family moved to Jacksonville, Florida in 1994. Whitney spent most of her childhood engaging in sports (softball and volleyball) and academics. She attended Florida State University for her undergraduate education. She majored in Psychology and graduated Summa Cum Laude in 2007. At Florida State University, Whitney worked in research labs with Roy Baumeister, Ph.D., Joyce Carbonell, Ph.D., and Norman B. Schmidt, Ph.D. Working in these research labs shaped her future interests in addition to her desire to attend graduate school.

After graduating, Whitney worked at Brooks Rehabilitation Hospital in conjunction with the University of Florida. She served as a research associate on projects working with stroke and traumatic brain injury patients. She also worked as a psychometrist on the outpatient neuropsychology team at Brooks Rehabilitation. In the fall of 2008, Whitney started graduate school at Louisiana State University for clinical psychology.