**Visual Attention Bias: Delayed Disengagement of Phobic-related
Stimuli Presented in a Flicker Task.**

by

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A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
May 14, 2010

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Abstract

The flicker task, a change detection paradigm, has been used to present phobic-related stimuli to snake-tolerant and snake-fearful participants. The current experiment arranged a stimulus set into three blocks of image-pairs (neutral, snake, and neutral) in an effort to demonstrate slowed disengagement in the third block. The hypothesis was not supported; however, the change detection may still be a viable method for measuring visual attention biases among snake fearful persons.

Acknowledgments

I have greatly appreciated my family, friends, and faculty who have provided beneficial support and guidance.

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INTRODUCTION

Anxiety disorders are among the most commonly diagnosed psychiatric disorders in the United States today. During a given 12-month time period, 12.6% of the United States' population likely suffers from at least one of the diagnosable anxiety disorder (Maxmen, 1995). Most of those who suffer from anxiety experience symptoms such as a racing heart, dizziness, stomach discomfort, consider their symptoms serious, and often seek the aid of their primary care physician. The high prevalence rate and the severity of these symptoms make anxiety disorders a significant mental health concern; consequently an extensive literature is available. Numerous theories from various areas within psychology have attempted to account for the causal factors, maintenance, and the treatment of anxiety.

The roles of both attention and perception, two components of information-processing, have relevance to research with populations that have elevated levels of anxiety. Early writings provide theoretical accounts of attentional biases in anxious persons. Beck's cognitive theory (1976), for example, suggests people who have anxiety disorders have a tendency to distort perceptions of stimuli in their environment. Experimental data followed and provided useful support for Beck's theoretical accounts of how the anxious person's attentional processes differ from those of non-anxious persons.

One area of anxiety research that has received extensive interest is responsivity to threatening stimuli. Studies of response to threat generally agree on the *theory of distorted perceptions* among people suffering from anxiety disorders indicating that they

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are more likely than other people to perceive ambiguous stimuli as threatening stimuli (Butler & Mathews, 1983; Foa, 1988). Beck (1976) has suggested also that people with high levels of anxiety tend to selectively attend to feared stimuli. In the face of countless numbers of visual stimuli, a person with an anxiety disorder is likely to attend to a potentially fear invoking stimulus over all others. Numerous theories, laboratory tasks, and data, although at times discrepant, have been published in an effort to elucidate the nature of anxious persons' attentional biases. The different theories of attention bias are discussed below with a focus of a phobic person's fear.

Cognitive psychology, in particular, has made significant contributions in both theory and methods for studying anxiety and its related symptoms. Two decades ago, McNally (1990) outlined some of the concepts that information-processing theory and research have offered to the understanding of panic disorder and other anxiety disorders. In this article, McNally reviewed research involving cognitive tasks that have been adapted for use with clinical populations. Further, McNally summarized the gains made in the understanding of cognitive biases that are often present in those who suffer from anxiety disorders. Experimental tasks given attention by McNally include a dichotomous listening task and the well-known Stroop color-naming task. Research using these two experimental tasks suggests that the information-processing of those with an anxiety disorder is biased toward detecting threatening stimuli.

Research in the field of cognitive psychology has progressed since 1990 resulting in significant refinements to the literature over the past two decades (Goldstein, 1999; Solso, 2001; & Wenzel & Rubin, 2004). In the late 1990's, research centering on visual attention and the visual search capabilities of humans lead to the identification of a

phenomenon labeled *change blindness* and to the development of associated *change detection* tasks. Change blindness occurs when significant changes in environmental stimuli are not recognized after a brief visual disruption, for example, disruption by an eye movement (O'Regan, Rensink, & Clark, 1999). Overlooked or unrecognized changes can include, but are not limited to, the omission of objects, the addition of objects, deletion of parts of an object, or changes in color. The change detection literature has produced several useful and interesting laboratory methods for studying change blindness (Rensink, 2002). A discussion of the change detection literature follows below. Additionally, the theories currently used to explain the phenomenon of change blindness are reviewed in an attempt to conceptualize how change detection tasks can aid in the evaluation of attentional bias among phobic persons.

Attentional Biases

Prior to McNally's 1990 paper, researchers theorized that phobic persons often had distorted information-processing with regard to feared stimuli. Several experiments provided evidence of distorted perceptions of relevant stimuli among those with anxiety disorders. In general, anxious persons were said to have a tendency to perceive threat in otherwise neutral or ambiguous stimuli (Butler & Mathews, 1983; Foa, 1988). Recent research has begun dismantling the perceptual effort of the anxious person with regard to speed, latency, and duration of attention towards or away from relevant stimuli. Measurable differences of attention among anxious persons, when compared to non-anxious persons, have been referred to as an *attentional bias*. Attentional biases, at times, are referenced in terms of when the bias takes place with regards to awareness of the phobic-threat. An automatic attentional bias is said to occur prior to one having full

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awareness to a threat, and a strategic attentional bias occurs while one has full awareness of a threat (Cisler, Bacon, and Williams, 2007). The literature is not always consistent with the labeling of attentional biases. Below is a description of the major theoretical accounts of attentional bias and the relevant experimental tasks associated with each theory.

Perceptual Bias

Öhman, Flykt, and Esteves (2001) report a common clinical observation of a spider-phobic individual, for example, as the first of a group of people to notice a spider crawling across the floor. This clinical observation suggests that a phobic person has an attentional, or information-processing, bias for the detection of threatening stimuli. In other words, a phobic person is faster than a non-phobic person at attending to threatening stimuli. It is seemingly commonplace for authors to allude to the notion of an evolutionary influence on phobias. With regard to attention, life-threatening stimuli are identified as dangerous and in need of attention regardless of a mammal's current activity. Attentional resources need to be shifted towards potentially threatening objects quickly. Along with receiving the full attentional resources of a mammal, these dangerous objects should receive attention automatically (Öhman et al.). The rapid attention shift towards threats may be evolution's lesson for how one should process dangerous situations or stimuli (Carpenter, 2001). This process of attending to dangerous objects allows for mammals to then escape or avoid potential harm quickly (Mineka & Öhman, 2002). Specific phobia may be a modern legacy of attentional processing once helpful for early man's survival.

Research on information-processing biases among phobics has entailed measures of latency of attention and of orientation towards threat-relevant stimuli. Öhman et al. (2001) offer experimental support for the notion that phobics attend to fear-relevant material faster than controls. Öhman et al. made use of matrices depicting images of non-feared and feared objects that were presented to control and phobic groups. The results indicate that phobics were faster at locating the feared objects when compared to the control group. According to Öhman et al., this suggests that the fear-relevant stimuli were prioritized to receive attention by the perceptual and arousal systems of phobics. The use of the complex visual displays of the matrices and the rapid processing speed demonstrated by phobic participants suggest that fear-relevant information was processed quickly and automatically. These results suggest that the threat-relevant stimuli were given top priority by the visual attention system of phobic participants. In other words, the attentional system of a phobic person renders threat-relevant stimuli as more salient. It would seem that threat-relevant information has been prioritized in people's attentional systems in order to avoid and escape danger; phobic persons apparently prioritize threat-relevant stimuli as more important than other objects (Öhman et al.)

Preattentive Awareness

There is support for the idea that those with an anxiety disorder actually experience a *preattentive* awareness of threat-relevant information. One who has a preattentive awareness for threat-relevant stimuli experiences autonomic responses to such stimuli before full awareness that the stimuli are present (Mogg & Bradley, 1998). Following autonomic arousal, the anxious person then initiates a search to locate the source of the arousal in order to engage in appropriate avoidant and escape behaviors.

Preattentive awareness is also referred to as an *automatic attentional bias*, as the visual attention bias occurs prior to full explicit awareness. In comparison, *strategic biases* occur after one has full explicit awareness of a phobic threat (Cisler et al., 2007).

According to Mogg and Bradley (1998), attentional biases occur early in the processing of information for the anxious person. Due to the preattentive awareness of threat-relevant information that is followed by avoidance of the perceived threat, there is little opportunity for much further processing to occur (Mogg & Bradley). Because a phobic person makes efforts to escape or avoid the accompanied discomfort before being fully aware of a threat, there is little naturally occurring exposure to a threat that would perhaps lead to an overall reduction in fear to the stimuli.

The study of a phobic person's memory for threat-relevant stimuli has provided support for the theory of preattentive awareness. Mogg, Mathews, and Weinman (1989) conclude that people with anxiety disorders often lack a memory bias for threat-relevant information. The lack of a memory bias is thought to result from the quick avoidance of threatening stimuli. Even though anxious persons search vigilantly for threat-relevant stimuli, such phobic-threatening information is not processed after the initial awareness due to the frequent escape of the perceived threat (Mogg et al.). Hence, the later stages of information-processing, at which point memories would be established, do not take place for threat-relevant information. It is the function of the phobic person's attention system to detect threats so as to avoid them; thus, threat related stimuli, once detected by a phobic person, are avoided (Mogg et al.). Consequently, there is negligible memory bias for threatening stimuli among phobic people.

Amir, Foa, and Coles (1998) also failed to find a memory bias for threat-relevant information among those who have an anxiety disorder. Similar to conclusions offered by Mogg et al. (1989), Amir et al. suggested that the lack of processing of threatening stimuli does not allow for deep processing (i.e., ongoing exposure, stored as a memory) to take place. The avoidance of the threatening stimuli not only prevents memory bias, but it also helps maintain the fear of the threat-relevant information.

Misperception of Stimuli (Selective Interpretation)

The visual-perception system of people is part of the attentional system and is responsible for quickly discriminating among stimuli in the environment. As noted earlier, there is an information-processing bias in the phobic's visual-perception system; threat-relevant information is attended to more quickly than other present information. These "threatening" stimuli often are ambiguous or otherwise considered affectively neutral stimuli. When a phobic person misperceives neutral or ambiguous stimuli as threatening, this is called an *interpretation bias* (Mathews & MacLeod, 1994). Interpretation biases are likely not vacuous misperceptions of neutral stimuli; however, such misperceptions may results in false-positive identifications of threats.

An interesting laboratory task involving ambiguous stimuli is the *masking* procedure. Öhman (1994) presented *masked* pictures of threat-relevant information to a phobic group. The masking procedure involves randomly cutting a picture of a phobic stimulus into several smaller square pieces. These small pieces of a spider picture, for example, are then randomly reassembled back into a whole image again. The reconfigured spider picture is then considered to be masked. Once masked, no readily identifiable object can be recognized. Similar colors and visual textures remained from

the original pictures; however, the reassembled picture would not be recognizable as a spider as the cut pieces are no longer in the original position from the original image.

When these masked pictures were rapidly presented to phobic persons, they demonstrated significant elevations in skin conductance and self-reported fear compared to non-phobic persons. These results were considered further support for the argument that phobic persons process threat-relevant information quickly. These data also suggest that phobics may misinterpret affectively neutral environmental cues resulting in false-positive perception of threats (Öhman, 1994).

Kindt (1997) proposed that equally fast processing of different forms of threat-relevant information is controlled by an internal binary system. Via this internal binary system, stimuli either elicit a threat response or do not. When presented with stimuli that are perceived as threatening, a person either experiences fear or does not. The results of Kindt's study indicate that the degree, level, or medium by which threat-relevant material was presented was not important. Instead, merely the presentation of such stimuli, regardless of other factors, was enough to elicit a fear response in phobics. Kindt suggests that phobics do not distinguish between weak and strong fear signals; instead, any threat-related stimulus, regardless of intensity, might trigger an attentional focus. It would seem then that such a binary system would allow for false positives to occur when searching for threat-relevant material. For example, a snake phobic might have a fear response triggered by a rope lying on the floor of a woodshed. Hence, phobics are more likely to misinterpret environmental stimuli as threatening.

<u>Disengagement</u>

　　As noted earlier, there are data that indicate phobic persons are faster to detect threatening stimuli as well as misinterpret neutral stimuli as threatening when compared to non-phobics. Research of phobic persons' measured disengagement of attention away from threatening stimuli offers data that suggest that a phobic person also has difficulty disengaging attention and orientation away from threat-relevant information. Disengagement of attention, in general, refers to withdrawing attention from a stimulus. According to Fox, Russo, Bowles, and Dutton (2001), phobic persons have difficulty disengaging attentional resources away from a locale where a threat has been identified. Implications of the difficulty phobic persons have with disengagement are discussed below.

　　Based on data from an adapted dot-probe task, Fox et al. (2001) hypothesized that differences may exist in terms of the ability to disengage from threatening stimuli between groups of people with and without sub-clinical anxiety. Fox et al. presented both anxious and non-anxious participants with a dot-probe task. Participants were instructed to depress a button indicating where a target circle was presented on a computer screen. Visual cues preceded the presentation of the target circles and cues were assigned an emotional valence, as some cues were threatening, some neutral, and some positive. Cues, regardless of emotional valence, were either valid or invalid. Valid cues preceded the target circle to be located on the same side of the computer screen, and invalid cues preceded the target on the opposite side of the computer screen. Data presented indicated that anxious persons were slower at detecting targets that were preceded by invalid threatening cues when compared to non anxious persons. Persons in

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the anxious group were slow to disengage their attention away from the invalid threatening cue, even though the cue was discontinued, compared to persons in the non-anxious group (Fox et al.).

Fox, Russo, and Dutton (2002) suggest that people with high levels of anxiety, not necessarily phobic persons, exhibit prolonged *dwell* times to emotionally ambiguous and emotionally threatening stimuli. Dwell time refers to a phobic person's increased visual attention, or gaze, towards perceived threats. The visual attention of a phobic person, for example, may be narrowed to a specific area where a threat was, or is currently, present. Fox et al. modified an inhibition of return (IOR) paradigm based on Posner and Cohen (1984). Posner and Cohen's IOR paradigm cues a participant with either a valid or invalid cue prior to presentation of targets. In general, a control participant shifts attention towards a cue, then shifts attention back to a central location during the relatively lengthy time between cue and target set. A phobic person's attention is often inhibited from returning to the previous location. Posner and Cohen argue that a person conducting a visual search seeks new and novel information; hence, returning to a previously scanned location will be inhibited. Fox et al. found that high anxious persons had a disrupted IOR response when cued with angry or emotionally ambiguous stimuli. Inferentially, the highly anxious group continued to dwell or allocate attention towards to the location of the angry stimuli when used as invalid cues. Thus, the anxious persons did not disengage their attention away from a threat during the relatively prolonged dwell time in the modified IOR.

The experimental tasks used by Fox et al. (2001) and Fox et al. (2002) measure one's dwell time and problematic disengagement that occurs in experimental tasks using

words or angry faces. Cueing tasks such as the IOR paradigm yield results suggesting

that phobics and highly anxious persons have an increased dwell time for threat, and such

people then have difficulty with disengaging their attention away from threats. The slow

disengagement of attention away from threatening cues occurs after the discontinued

presentation of a threat in the tasks discussed above, which resulted in the anxious

persons being slower to detect targets compared to non-anxious (Fox et al., 2001; Fox et

al., 2002). Both an increased dwell time of visible threats and a slowed disengagement

away from areas where threats were once present are not necessarily competing biases

and can co-occur, according to Cisler et al. (2007).

<div align="center">Change Blindness</div>

Recent research focusing on visual attention and the visual search capabilities of

humans has lead to the identification of a phenomenon referred to as *change blindness*

(Rensink, O'Reagan, & Clark, 1997). As stated above, change blindness occurs when

changes in one's environment are not recognized after a brief visual disruption. For

example, visual disruption may occur during by an eye movement (O'Regan et al., 1999).

The available literature provides examples of numerous changes types of changes to

stimuli often go unnoticed following a brief disruption of visual attention (Rensink,

2002).

Perception of changing stimuli in an environment is moderated by one's visual

attention to specific details in the environment (Rensink et al., 1997). In other words, the

ability to perceive change in one's environment requires one's attention to that area of the

environment. A person must put forth effort and attention to perceive when changes take

place in the environment, and changes are often unnoticed (Simons, 1996). A person's

ability to detect change in an environment is limited by which specific stimuli receive visual attention at any moment.

Results from the change blindness literature suggest that people are prone to miss large changes in stimuli under both natural and experimental viewing conditions (O'Regan et al., 1999). The available data are rather robust, i.e. consistent across different tasks. Interestingly, change blindness occurs in laboratory tasks even after a person is forewarned of an upcoming change and is asked to actively search for changes in stimuli (Simons, 2000a; 2000b).

The literature offers unique and creative procedures to produce and measure change blindness experimentally (Simons & Ambinder, 2005). The *flicker paradigm* (Rensink et al, 1997) is one procedure that has been developed that allows subjects to view images of colorful objects, places, and people that are presented on a computer monitor. An image (X) is repeatedly presented and alternated with a modified version of itself (X'). These two images cycle back and forth quickly. A trial ends when the subject detects the change. The dependent measure is the number of cycles or the amount of time needed to detect the change. Between the presentation of X and X', a gray blank image is presented for a specified duration. This blank period, or interstimulus interval (ISI), occurs for less time than the presentation of X or X' and creates a visual disruption. The presentation of the blank image (ISI) causes a flickering to appear on the screen as the images cycle back and forth rapidly. Hence, the terms flicker task and flicker paradigm are used.

The order of presentation is illustrated in Figure 1. The picture X is presented by itself, followed by the blank-gray screen, and finally picture X'. This order is repeated until the participant identifies the difference between X and X'.

Figure 1

Picture X'

ISI

Picture X
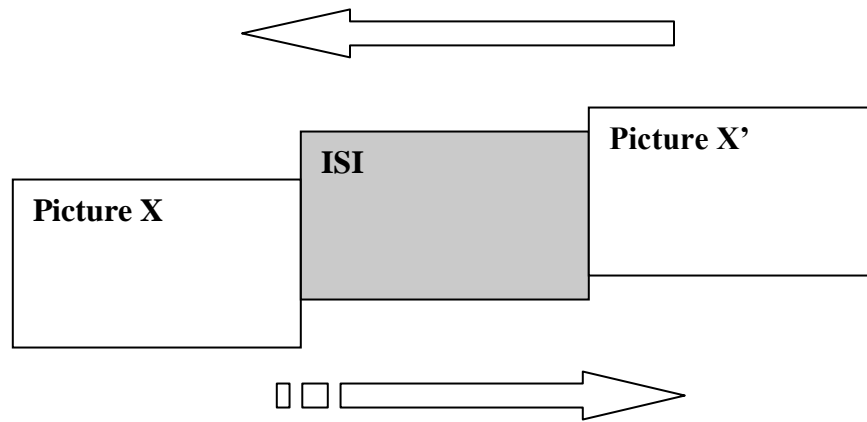
Research with the flicker paradigm suggests that visual attention is necessary for a person to notice changes (Rensink et al, 1997). The flicker paradigm requires that an individual be able to store and retain an image (X) long enough to allow for comparison with the modified image (X'). There can be a countless number of details in image X that will need to be retained and used for comparison to X'. Both explicit attention *and* a briefly stored memory of the changing detail are required in order to make comparisons and accurately identify the modified feature of the two images.

During change detection tasks, not all changes are found at the same rate and some changes are considered to be "easy" or "difficult" to locate. Stimuli that are changed in a scene can be characterized as of *central interest* or a *marginal interest*. Central interest changes are changes to a salient feature and are "easier" to detect than marginal interest changes. Marginal interest changes are changes to less salient features.

Subjects tend to take longer to detect changes to marginal interest features in comparison to changes in central interest features (Rensink et al., 1997). Additionally, the terms central and marginal do not imply location of a change in a given image. Rather, these terms refer to the rated saliency of an area given the context of a picture. Further, these established terms are ultimately based on the behavior of participants. Once a change has been identified, either central or marginal interest, the change is easily detected by observers. In fact, it is difficult to ignore the change in the image after it has been successfully detected (Rensink et al).

Although there are other tasks associated with change-detection (Rensink, 2000), the flicker task is considered the most prominent of these tasks (Simons & Ambinder, 2005). A flicker task is relatively easy to develop and can be run with most modern computers, which likely contributes to its popularity. Another laboratory task available makes use of brief motion picture videos (Levin & Simons, 1997). Changes to stimuli occur after a drastic camera angle change, or by other means that cause a visual disruption to the stimuli to be changed. For example, an actor's shirt might be red in an opening scene of the video. Following a brief absence of that actor, the shirt will have a different color. The changes occurring in such clips are still rated as either central or marginal interest changes. All changes follow some form of visual disruption and the use of movie video allows many options for how to create the disruption with the use of zoom and panning of the camera (Levin & Simons).

The change blindness literature presents data that are rather robust and easily replicable. The phenomenon of change blindness occurs for several reasons. The most direct and easily accepted is the requirement of a person to allocate visual attention to the

signal. Regardless of the saliency of a signal, it will go unnoticed without focused visual attention (Rensink et al., 1997).

Assuming a visual signal receives focused attention, a visual representation must be made available in some form of memory in order to make comparisons in a changing image pair. Interestingly, participants have been shown to reproduce visual representations of stimuli even when changes to stimuli have gone unnoticed. Participants who failed to detect a change to an object were later able to visually recognize an object in a memory test (Mitroff, Simons, & Henderson, 2002). In other words, participants failed to accurately attend to the *change* between stimuli even though the requisite memory for details of the image pairs was available.

The two most common explanations of why change blindness occurs involve focused attention towards the signal and visual representations of signals. A visual representation stored in one's memory allows for comparisons between the signal and the signal's visual representation. Signal here refers to the changes occurring between alternating image pairs. A visual representation refers to the brief memory of a stimulus, which is temporarily stored and necessary for comparisons. A person's evaluation the two, the signal and the stored representation, allows for detection of change. However, without focused attention to the signal, a visual representation would never be constructed (Rensink, 2000). In other words, change signals in a change detection task are noticed during periods of explicit attention. The change signals do not automatically draw attention, as people conduct serial searches of stimuli during such tasks (Mitroff, Simons, & Franconeri, 2002).

Change blindness suggests that people sometimes fail to attend to salient and important stimuli. Attention is needed in order to create a visual representation of stimulus in order to make comparisons to the signal stimuli. If attention is limited, or a person is otherwise distracted, an accurate visual representation will not be created (Simons & Ambinder, 2005).

<center>Change Blindness and Phobics</center>

The change detection literature has provided us with technology that can be applied to the study of information-processing biases of those who experience difficulties with anxiety. The tasks made available from this literature offer novel features for stimuli presentation that have not been used in the attentional bias literature. The flicker task, for example, can be used to present colorful, high quality images of any stimuli desired. If using a video-based change detection stimuli package, the threat-stimuli can be depicted moving, produce sound, and be in full color. At the very least, these experimental procedures provide vivid and life-like representations of threatening stimuli.

Change detection tasks can be considered for research on the previously discussed information processing variables: search latency, preattentive awareness, memory biases, selective interpretation biases, and disengagement. Presenting threat-relevant information can be done in seemingly limitless ways given the media available. Computer technology and digital recording devices allow for quick editing and colorful imagery, which afford many forms of phobic-threat to be displayed. As there has only been one published paper using the flicker task with phobic persons (see below), there are many research questions remaining to be asked. In general, it would seem as if these

technologies should be able to provide a much better understanding of attentional biases in phobic persons.

McGlynn, Wheeler, Wilamowska, and Katz (2008) made use of a flicker task that presented snake-image pairs and neutral-image pairs to snake-phobic participants. In each image-pair that presented a snake, the snake was involved as the signal change; changes to snake-image pairs involved features of the snake depicted. For example, a snake's tongue may present and then absent across a pair of images. Neutral-images were of ordinary or mundane stimuli rated to have no snake-relevant stimuli. The participants were asked to search image-pairs for changes that occurred as the images flashed on a computer monitor in a standard flicker task procedure. Equal numbers of snake-image pairs and neutral-image pairs were presented, as were equal numbers of central and marginal interest changes. Phobic participants were slower to detect changes in neutral image-pairs, when compared to control participants. The authors speculated that the phobic persons continued their search for snake-related signals when no such stimuli were present, and that the phobic participants were experiencing a difficulty inhibiting their search for threat-relevant stimuli.

<center>Present Experiment</center>

The results of McGlynn et al. (2008) suggest that the flicker task is a laboratory task that can provide further information with regards to the phobic person's inability to disengage attention from phobia-relevant stimuli. The flicker paradigm used as part of McGlynn et al. (2008) was a new experimental method for the study of visual attention in those who report phobic symptoms and the data should be considered exploratory.

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Expanding on the results of McGlynn et al. (2008), presentation of stimuli for the current experiment was organized in a manner to highlight the phobic person's difficulty with disengagement away from threat-relevant stimuli. Two experiments were reported in McGlynn et al., with the first making use of a smaller sample size than the second. For Experiment One, post hoc interpretations of the results concluded that phobics were less able than non-phobics to disengage from searching for previously presented threats when searching for changes in neutral image-pairs; phobic persons required more presentations of neutral image-pairs before detecting changes. For Experiment Two, an interaction was found that indicated snake-fearful participants required more cycles to detect marginal interest changes to neutral image-pairs.

In the current experiment efforts were made to clarify the phobic person's difficulty with discontinuing a visual search for threat. Image-pairs were sorted into three blocks of image-pairs and divided according to the presence or absence of phobic-threat signals (snake-related stimuli). Images lacking snake-related stimuli are referred to here as *neutral* images. Block One presented neutral image-pairs only; some with changes to the central-interest areas and some with changes to the marginal-interest areas. Block Two presented snake-related image-pairs with changes to either central-interest or marginal-interest areas. Block Three again presented only neutral image-pairs with changes to either central-interest or marginal-interest areas. The three Blocks were presented without any temporal gap between each. The third Block was hypothesized to provide data supporting the disengagement theory. It was in this second block of neutral image pairs, which followed the block of viewing only snake images, where phobic persons were hypothesized to slowly disengage from their search for snake-related

images. Hence, it was hypothesized that snake-fearful persons would require more cycles than would snake-tolerant persons to detect changes in the neutral image-pairs of Block Three.

METHOD

<u>Participants</u>

Three hundred and thirty four undergraduate psychology students at Auburn University were recruited for the experiment. Each earned extra course credit for participation. Using procedures described below, eleven participants (five males) were identified and assigned to the snake phobic group and eleven participants (six males) were recruited and allocated to the snake tolerant group.

Psychometric Instruments and Apparatus

The Fear Survey Schedule-II (FSS-II; Wolpe & Lang, 1964) is a self-report measure containing a list of 51 commonly feared situations and objects. Respondents rate their fear (0-6; 0 = None [Fear], 6 = Terror) of each situation and object. An example of an object listed on the FSS-II is "snake."

The Snake Questionnaire (SNAQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974) is a self-report measure that includes 30 true/false statements about fear of snakes. The SNAQ has been shown to have high internal consistency, high test-retest reliability, and is homogeneous in content (see Klorman et al., 1974). According to Anthony (2001), a college student sample who completed the SNAQ obtained mean scores of 5.80 (SD = 3.82) and 9.60 (SD = 6.09) for males and females, respectively. Anthony (2001) also reports that the mean SNAQ score for a sample of snake phobics was 24.44 (SD = 2.95).

Experimental events were controlled by a program written specifically for the data collection in this experiment. A Pentium 4 computer was used for running the

software and data recording. Stimuli were presented on a 17-inch Dell color monitor.

The space bar on a computer keyboard was used to record participants' responses.

Stimuli were generated from digital images and edited using PhotoShop v.6 photo editing

software. Once stimuli were created, four assistants were asked to rate each image pair

independently as showing a marginal or central interest change. The four assistants were

not screened with the phobia measures; however, none reported any significant fear or

disgust of snakes and all were involved in the development of the stimulus set and later

collected data for this experiment. Only image pairs that all four assistants rated as

showing central or marginal interest changes were used.

Procedure

Two groups of participants, a snake-phobic and a snake-tolerant group, were

sought. Participants were recruited via the Sona system (an experiment management

system for Auburn University's psychology department); extra course credit was

provided in exchange for participation. Recruitment materials were vague in an effort to

not reveal the nature of the experiment. After an informed consent statement was signed,

potential participants completed the FSS-II. Participants who endorsed a "zero" on the

FSS-II snake item were considered a potential snake-tolerant participant and

subsequently invited to complete the flicker task (described below). Participants who

endorsed scores of 5 or 6 on the snake item on the FSS-II were invited to complete the

flicker task and were considered potential snake-phobic participants. Participants were

not informed of their FSS-II scores or selection criteria prior to completing the flicker

task, which was administered immediately after a participant completed the FSS-II.

Experimenters who administered the flicker task were blind to the FSS-II scores of participants.

Following completion of the flicker task, participants were asked to complete the SNAQ. A participant's SNAQ score determined whether their flicker task data were included in the snake-phobic data set, the snake-tolerant data set, or neither. The participants who scored at least one standard deviation above the normative mean for her/his sex (Anthony, 2001) on the SNAQ comprised the snake-phobic group. Flicker task data of participants who scored at least one standard deviation below the normative mean for his/her sex on the SNAQ comprised the snake-tolerant group. All participants prior to being seated at the computer for the flicker task were read an introduction as well as instructions on how to perform the task.

Flicker Procedure

During the flicker task image-pairs were presented rapidly on a computer screen. In between presentation of the original image and the altered image was a blank gray screen. All images, X and X', were presented for 240 ms; the intervening blank gray screen was presented for 80 ms. Image-pair presentation continued until the spacebar was pressed. These parameters were based on the research of Rensink et al. (1997). The number of image-pair repetitions before the spacebar was pressed was computer-recorded for each participant. After pressing the spacebar, there was a five second delay before the next image-pair was presented.

Two sets of image-pairs were generated. One depicted scenes of snakes in their natural environment (fear-evoking stimuli); and the other illustrated every-day scenes (e.g., parking lot, houses, people) and were classified as neutral stimuli. Fear-evoking

image-pairs had changes to non-feared elements within the image; no area of the snake was changed. The neutral stimuli developed for this research resemble those that have been used in the published literature of change blindness/detection (McGlynn et al. 2008, Rensink et al. 1997). Changes made to image-pairs involved changes of color and deletion of common and routine stimuli, i.e. boxes and desktops.

The stimulus set was organized into three blocks and, as noted earlier, was presented without any temporal gap between the blocks. Sixteen image-pairs were presented in each of the three blocks; however, there were uneven number of central and marginal interest changes presented within each block. Block One presented only *neutral* image-pairs. There were 11 with central interest changes and five marginal interest changes. Block Two depicted only *snake-related* image pairs, seven with central interest changes and nine with marginal interest changes. Block Three again presented only *neutral* image-pairs. There were eight with central interest changes and eight with marginal interest changes.

The order of image-pair presentation was randomized within each block. There was no signal indicating that a participant was nearing completion of any block presented, nor were participants informed that the stimulus set was divided into three blocks.

Participants were instructed to press the space bar on a computer keyboard to stop the cycling of the image pairs once the change was detected. There was a five second delay between the pressing of the space bar and the onset of the next image-pair. To avoid identification errors or guessing, participants were asked to point to or briefly describe the part of the scene where the change had occurred. A researcher, who was

unaware of each participant's potential group assignment, sat behind the participant and

recorded errors.

RESULTS

Two groups of eleven participants, snake fearful and snake-tolerant, provided data

from the flicker task. A three-way repeated measures Analysis of Variance (ANOVA)

was conducted for Group (snake-phobic vs. snake-tolerant), Location of Change (central

interest vs. marginal interest), and Block (neutral, fear-evoking, neutral) on the number of

cycles before detection. There was a significant interaction of Location of change and

Block, F (2, 40) = 28.12, MSe = 5928.14, $p < .001$, η^2 = .584. Specifically, for central-

interest changes, there were significantly greater number of cycles before detection in

Block Three (M = 48.69, SD = 16.04) when compared to Block One (M = 17.10, SD =

9.50), (LSD < .001) and Block Two (M = 11.80, SD = 9.59), (LSD < .001). For the

marginal-interest changes, there were significantly greater number of cycles until

detection in Block One (M = 120.80, SD = 24.00) and Block Three (M = 120.13, SD =

22.53) than in Block Two (M = 70.47, SD = 20.09). See Figure 1.

Figure 1
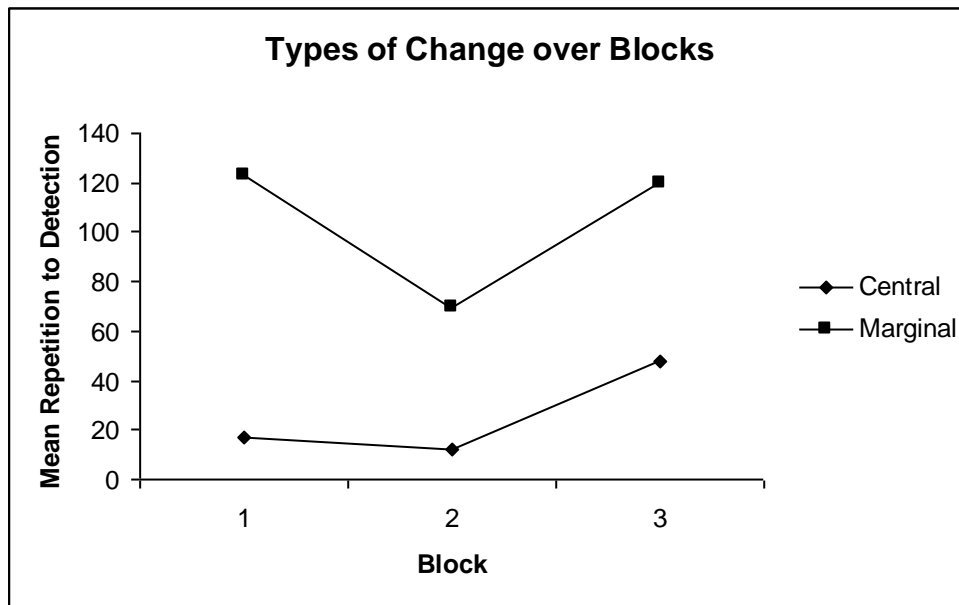
There was a significant main effect for Block, $F(2, 40) = 92.80$, $MSe = 21159.35$, $p < .001$, $\eta^2 = .82$. A follow-up paired samples t-test showed significantly more cycles to change detection for Block Three ($M = 86.78$, $SD = 16.89$) by contrast with Block One ($M = 51.38$, $SD = 9.34$); ($t(21) = -9.88$, $p < .001$). Similarly, there were more cycles before change detection for Block Three ($M = 86.78$, $SD = 16.89$) than for Block Two ($M = 48.28$, $SD = 16.97$); ($t(21) = -10.64$, $p < .001$). See Figure 2.

Additionally, there was a significant main effect for Location of Change, $F(1, 20) = 495.84$, $MSe = 200446.16$, $p < .001$, $\eta^2 = .96$. Marginal-interest changes required more cycles to change detection ($M = 100.42$, $SD = 84.53$) than did central-interest changes ($M = 25.41$, $SD = 43.578$). There was no main effect for Group or its interactions with other factors.

Figure 2
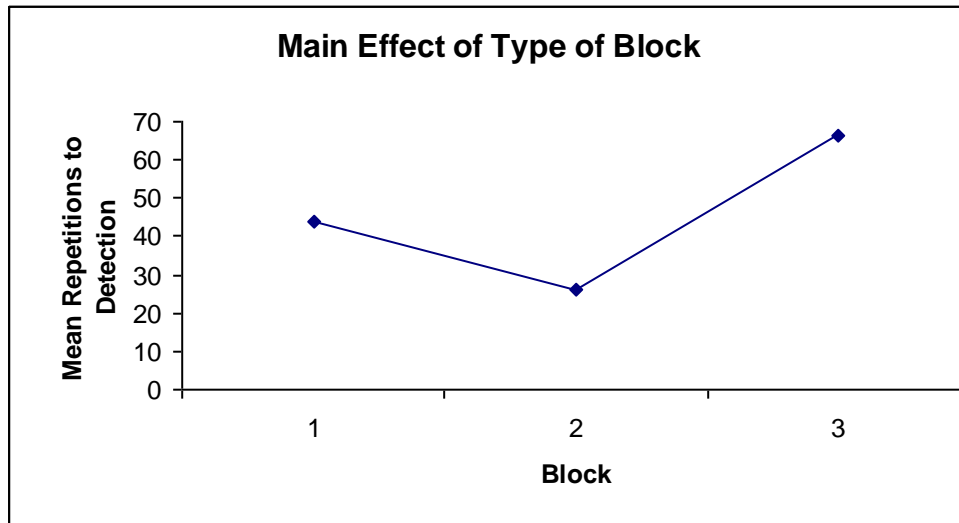
A continuing focus of attention to snake images might be expected to occur during scene presentations that closely follow presentations that include a snake. The interest here was in producing evidence of that continued focus. Therefore, comparisons were made that focused on the early scenes of the onset of Block Three. A repeated measures ANOVA was conducted to determine if there was a significant difference in repetitions before change detection between the last three image pairs of Block Two (that included a snake) and the first three image pairs of Block Three (that did not included a snake) across snake tolerant and snake phobic participants. There was not a significant difference between groups for these selected image-pairs (F (1, 20) = .90, MSe = 665.50, p = .354). This comparison was conducted in order to measure any discernable difference in performance between groups when the experimental task terminated the presentation of snake stimuli and returned to neutral stimuli.

DISCUSSION

There has been much written about attention biases in those who experience anxiety, including phobias. With the advent of sound experimental tasks measuring visual attention, researchers of anxiety have benefited by making use of them. The principle aim of this experiment was to determine if snake-fearful persons are slow to disengage visual attention after having been exposed to snake-related stimuli in a flicker task. The hypothesis that snake fearful persons would demonstrate some form continued disengagement after being presented phobic-threatening stimuli was not supported.

McGlynn et al. (2008) hypothesized that snake-fearful persons in their experiments had difficulty disengaging visual search efforts away from snake-relevant information. The snake-fearful group, when compared to a snake-tolerant group, took more time to detect changes in neutral image-pairs, but there were no significant differences between the two groups with regard to snake-related image-pairs. The additional time required of the snake-fearful group was argued to be the result of a visual-attention bias. The snake-fearful group continued a search for snake-relevant changes during the presentation of neutral image-pairs, unlike the snake tolerant group. Hence, the snake-fearful persons were slower to detect neutral changes than snake-tolerant persons (McGlynn et al.).

The explanation of the McGlynn et al. (2008) experiments stemmed primarily from the work of Fox et al. (2001). Fox et al. made use of a dot-probe task with anxious and non-anxious persons who were instructed to depress a button that would indicate where a target circle appeared on a computer screen. The targets were preceded by visual

cues that were assigned an emotional valence of positive, neutral, or threatening. Cues, regardless of valence, were either valid or invalid. Compared to the non-anxious group, the anxious group was significantly slower at detecting targets preceded by invalid threatening cues, which has been described as a delayed disengagement away from a threat.

It was the intent for this experiment to produce a significant difference in performance between snake tolerant and snake phobic persons in a flicker task similar to McGlynn et al. (2008). The stimulus set for the current experiment was modified and arranged into three separate blocks based on the presence or absence of a snake image (neutral, snake, and neutral). The dividing of the stimulus set into three blocks was intended to reveal a snake fearful person's problematic disengagement of visual search efforts in Block Three. Block One presented only neutral image pairs. Block Two presented only snake-present image-pairs (with changes occurring to areas other than the snake). Block Three presented only neutral images and it was hypothesized to be a phase of the experiment where differences between the two groups' change detection would differ, which was not supported.

The flicker task used in McGlynn et al. (2008) presented snake and non-snake image-pairs in a random order. In each snake-related image-pair, the snake depicted was part of the signal change. For example, a change of color to a snake's scales may occur across snake-related image-pairs. However, the snake-related images for the current experiment were different compared to the McGlynn et al. experiments with regard to where the changes occurred in the snake-related image-pairs. For the current experiment,

the depicted snakes were not part of the signal change for any snake-related image-pair. Instead, areas away from the snakes depicted were used as the targets for change.

McGlynn et al. (2008) argued snake-fearful persons narrowed their visual search to identify snake-related information in neutral image-pairs, which were absent of any snake-related stimuli.

Rensink et al. (1997) contend that change detection requires explicit comparisons between stimuli. Change detection with a flicker paradigm, for example, requires that a person make explicit and purposeful comparisons between cycling image-pairs. A serial search is conducted while explicit comparisons of objects presented must occur in order to detect the change in the stimulus. As a person's visual attention is guided to the more salient features (central interests) of an image-pair, more numerous comparisons are made to these areas of an image-pair. One might have hypothesized that the snake-fearful group may have found the snakes to be more salient, which would have resulted in slower change detection for Block two. However, there were no differences in performance between the two groups in Block two.

Making use of complex arrays of matrices, Ohman et al. (2001) concluded that phobics gave the threats top priority in comparison with non-phobics when detecting phobic threats among other affectively neutral images. The flicker task used in the current experiment did not seem to demonstrate that the phobics gave the threatening stimuli top priority. If such prioritization occurred, it did not result in any group differences.

<u>Limitations</u>

The McGlynn et al (2008) experiments indicate the flicker task may be of use to better understand visual attention biases. As there are no other published experiments using the flicker task with phobics, the current experiment attempted to provide further evidence of slowed disengagement away from threats. It would seem as if group differences may have been washed out by the robust effect size of the Location of change variable. Detection of marginal interest changes, secondary to a serial search, vary widely but certainly require significantly more time for detection, compared to central interest changes.

<u>Future Directions</u>

Change detection paradigms can present numerous different phobic threats making use of colorful and vivid images. Despite the lack of group differences in the current experiment, change detection paradigms may still be able to provide useful information regarding visual attention biases among phobic persons. It is recommended that experimentation continue with the flicker task, for example, without the central versus marginal comparisons. Robust data are available, see above, pertaining to change blindness. However, McGlynn et al. (2008) argue that phobics may not effectively disengage attention away from the search for phobic threats. The comparison of central versus marginal, at this point, seems to provide little information regarding a phobic person's visual attention biases. Additionally, the robust data yielded when comparing central versus marginal change detection may wash out any group (snake tolerant versus snake fearful) differences. A flicker task comparing such groups making use of only

central interest changes may provide more useful data regarding disengagement or dwell time.

The response latency of phobic persons has been compared to that of non-phobics, and the literature often has concluded that phobic persons are faster to detect threats than controls (e.g. Öhman, 2001; & Mineka & Öhman, 2002). This experiment does not allow for such measurement of response latency of phobic threats, but an eye-tracking protocol would allow for inferential comparisons of the rate at which snake tolerant group versus snake fearful locate threats. Additionally, it would allow for measurement of how much time phobics compared to a control group spends "dwelling" on a threat.

Mogg, Garner, and Bradley (2007) made use of an eye-tracking methodology that would appear suitable for incorporation into a flicker task. Mogg et al. indicated that eye-tracking research has been limited to response latency and little is published on the investigation of visual biases. Eye-tracking, in conjunction with a similar flicker task, would allow for direct measurement of the amount of time snake-fearful persons spent gazing at the phobic-threats presented in Block Two. Fewer inferences would be required pertaining to the group differences of visual attention. According to Mitroff, Simons, & Franconeri (2002), more explicit comparisons are made between the cycling image-pairs to the salient features compared to less salient features of a flicker task. A snake-fearful group may make more explicit comparisons to the snake-related stimuli presented in a flicker task, and eye-tracking would make clear indications of such comparisons.

In the current experiment, vivid and colorful snake images of a variety of snake species were depicted. Discerning what features of phobic threats have gained stimulus control over visual attention has future research implications and perhaps treatment considerations as well. Future experimenters will be able to further study what features, species, or activities of snakes initiate the onset of a visual attention bias. Perhaps there are some threat signals of venomous snakes, for example, that result in greater or lesser visual attention bias. According to Mitroff, Simons, & Franconeri (2002), change detection requires explicit comparisons between the changing stimuli of change detection tasks. Specific features of a phobic threat may be more or less likely to disrupt the serial search and thereby alter the explicit comparisons of phobic persons.

Change detection methods, such as the flicker task, should be considered for quantifying how "much" of a threat signal is needed to elicit a visual attention bias. The misinterpretation of stimuli by phobic persons (Misperception of Stimuli discussed above) suggests that some features of phobic threats may be more or less salient to phobic persons compared to non-phobic persons. Öhman's (1994) masking procedure, for example, may be incorporated into a flicker task to determine what specific features of phobic-threats elicit a visual attention bias.

The flicker task has offered important data for the understanding of strategic visual attention biases of phobic persons. The initial McGlynn et al. (2008) publication indicated that phobic persons showed ineffective change detection to neutral scenes of a flicker task. Snake-fearful persons can experience both an increased dwell time for the phobic threats and inefficient disengagement. These two attentional biases can co-occur, according to Cisler et al. (2007), and the flicker task can be configured to allow for

further experimentation with such biases. The flicker task, and perhaps other change

detection procedures, should receive further consideration for the experimental study of

visual strategic attentional biases of anxious persons.

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