Measuring Visual Change Detection in Specific Phobia

by

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Abstract

The utility afforded from cognitive tasks in research concerning attentional bias and anxiety is well documented; however, whether it extends to research concerning specific phobia is uncertain. Often, the connection between attention and anxiety is eluded by the constraints of different tasks. It is represented ambiguously in latencies for detecting probes and naming colors, associated with cognitive interference, delayed disengagement, facilitated engagement, vigilance, and rumination. Ironically, results are often more indicative of the tasks themselves than of what the tasks proceed to measure.

According to the *Diagnostic and Statistical Manual of Mental Disorders-IV-TR* *(*American Psychiatric Association, 2000), specific phobia is a “marked and persistent fear that is excessive or unreasonable, cued by the presence or anticipation of a specific object or situation.” Due to the often concrete nature of the feared object, visual spatial tasks that employ objects, as stimuli, seem most appropriate for studying specific phobia. The flicker task is a visual spatial task that has demonstrated ecological validity (McGlynn, Wheeler, Wilamowska, & Katz, 2007). It involves detecting changes between pairs of scenes that simulate the environment in which feared objects appear. The scenes are interrupted by a short inter-scene interval, which blocks motion cues that would otherwise draw attention. This manipulation encourages participants to allocate attention intentionally to areas of the scene that interest them. The scenes cycle until participants detect change. McGlynn et al. found that snake fearful participants required more cycles than did snake tolerant participants to detect changes in neutral scenes.

The purpose of the current study was to test a hypothesis that the fearful participants in McGlynn, Wheeler, Wilamowska, and Katz's (2007) study demonstrated difficulties disengaging attention from snakes. The study mimicked that of McGlynn et al. with the exception of a 30-second inter-pair interval that was included in addition to the previously used 5-second inter-pair interval. The prediction was that snake fearful participants would take longer to detect change in neutral scenes than in scenes that included snakes, but only when the neutral scenes followed snake scenes juxtaposed by 5-second inter-pair intervals. The 30-second inter-pair intervals were suggested to be long enough to permit participants to disengage attention from snakes and thus detect change in neutral scenes that follow, as quickly as snake tolerant participants.

Results revealed a four-way interaction such that snake fearful participants detected marginal interest changes in neutral scenes that followed snake scenes juxtaposed by 5-second inter-pair intervals more quickly than they did marginal interest changes in neutral scenes that followed snake scenes juxtaposed by 30-second inter-pair intervals. By contrast, the participants detected central interest changes in neutral scenes that followed snake scenes juxtaposed by 30-second inter-pair intervals more quickly than they did central interest changes in neutral scenes that followed snake scenes juxtaposed by 5-second inter-pair intervals. These findings suggest that participants avoid snakes under conditions involving 5-second inter-pair intervals and demonstrate vigilance of them under conditions involving 30-second inter-pair intervals. A suggestion for future research that incorporates the strengths of multiple tasks is offered.

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1.Introduction

A child with a spider phobia may encounter a small, still spider in the trappings of its web, while walking along the side of the road. That same child may startle, rush towards the road and away from the spider, and enter the vicinity of actual danger. Fortunately, there was no traffic. In retrospect, this series of events seems irrational. How could an innocuous little spider selectively capture and hold the child's attention to the extent that the child is distracted from real danger? Indeed, theory suggests that humans, as well as other primates, are genetically prepared to fear certain creatures.

According to Ohman, Flykt, and Esteves (2001), natural selection endued us with two functionally different mechanisms of attention, one of which allows us to rapidly respond to threat-related stimuli. This mechanism operates on the basis of crude stimulus features, enabling us to automatically detect, appraise, and attend to those features that are compatible with stimuli that threatened our survival as a species. From a psychophysiological standpoint, LeDoux (1996) suggests that threat-related signals are sent from the thalamus directly to the amygdala via a sub-cortical pathway. A second pathway simultaneously sends signals to the cortical regions, which convey a more detailed depiction of the stimulus at a much slower rate. The sub-cortical pathway thus orients responding to the stimulus before conscious attention can be given.

The connection between anxiety and attention remains a topic of debate. Researchers have questioned the exact nature of attention, including how it is adaptive and whether it manifests differently in clinically anxious people as opposed to non-anxious people, people with trait anxiety as opposed to people without trait anxiety, people experiencing state anxiety as opposed to people not experiencing state anxiety. Any systematic difference would represent an attentional bias.

According to Bower (1981), people experiencing any transient emotion are likely to access mood congruent schemas, which influence what they attend to. Indeed, Rutherford, MacLeod, and Campbell (2004) found that all participants experiencing high state anxiety demonstrated emotion-related attentional biases. By contrast, trait anxious participants demonstrated more negative than positive emotion-related attentional biases, a finding which suggests that they were particularly concerned with processing threat (MacLeod & Campbell).

Previous research suggests that clinically anxious people demonstrate concern-related attentional biases (i.e., MacLeod, Mathews, & Tata, 1986; Mathews & MacLeod, 1985, 1986; Williams, Watts, MacLeod, & Mathews, 1997). For example, people with physical concerns demonstrate physical concern-related biases (Mathews & MacLeod, 1985). Similarly, people with spider concerns demonstrate spider concern-related biases (Watts, Trezise, & Sharrock, 1986). According to Mathews (1990) and Eysenck (1992), clinically anxious people are cognitively vigilant of the stimuli that represent their concerns. They visually scan their environments for these stimuli and become increasingly anxious and even more vigilant once they find them (Mathews). This cycle represents the core of their disorder.

Posner (1988) suggests that multiple processes characterize specific mechanisms of attention. As cited in King and Sloan's (2009) review, these processes include "interruption of ongoing activity, disengagement from the present stimulus, moving attention to the new location, and re-engaging attention to the new stimulus (p. 381)." Regarding the connection between anxiety and attention, various findings suggests that differences between anxious and non-anxious people are reflected within any one of these processes/mechanisms.

Cognitive tasks provide a vehicle from which to objectively measure attention. Because of their indirect nature, they are likely to reveal fairly accurate information about the mind. Researchers have used several of these tasks, including the emotional Stroop task (Gotlib & McCann, 1984), visual search task (Schneider & Shiffrin, 1977), and attention probe task (MacLeod, Matthews, & Tata, 1986) to explore attention among clinically anxious, state anxious, and trait anxious participants. Distinctions between participants are a matter of degree. Whereas trait anxious participants display enduring anxious tendencies, clinically anxious participants often meet DSM-IV criteria for a particular anxiety disorder. Any person can experience state anxiety.

Unfortunately, these tasks are somewhat unreliable, as researchers have often failed to obtain consistent findings across tasks and within versions of the same tasks. For example, the emotional Stroop task (Gotlib & McCann, 1984) offers evidence linking threat-related attentional bias with state anxiety (Mathews & MacLeod, 1985). It also offers evidence linking threat-related attentional bias with trait anxiety (Mathews, Mogg, May, & Eysenck, 1989). Subsequent versions offer evidence linking attentional bias with a combination of trait and state anxiety (Williams, Mathews, & MacLeod, 1996; Rutherford, MacLeod, & Campbell, 2004). According to Putman, Hermans, and Van Honk (2004), masked versions of the emotional Stroop task, in which participants are exposed to stimuli ephemerally, offer evidence linking threat-related attentional bias with facilitated engagement to perceived threat. Mixed versions of the emotional Stroop task in which participants are exposed to a counterbalanced arrangement of threat-related and neutral stimuli offer evidence linking attentional bias with difficulties disengaging attention from perceived threat (Fox, Russo, & Dutton, 2002).

Earliest versions of the Stroop task (1935) involve naming colors of printed words. The words are included as distracters. On some trials, words and colors are congruent, such that "blue" appears in blue ink. On other trials, words and colors are incongruent, such that "blue" appears in green ink. Furthermore, certain trials include meaningless symbols in the place of words. Generally, latencies for naming incongruent colors are longer than latencies for naming congruent colors or colors of meaningless symbols (Stroop, 1935; MacLeod, 1991). In addition, latencies are generally longer for naming commonly used words than for naming uncommonly used words (Klein, 1964; Scheibe, Shaver, & Carrier, 1967; Warren, 1972; 1974; Geller & Shaver, 1976). Latencies reflect the extent to which words interfere with color naming. When words and colors are congruent, interference is minimized. When words and colors are incongruent, interference is maximized (Stroop).

The emotional Stroop task (Gotlib & McCann, 1984) involves naming colors of emotionally relevant words. Often included are words that are emotionally neutral. Generally, color naming latencies are longer for emotionally relevant words than for emotionally neutral words (Mathews & MacLeod, 1985). Of interest is that latencies for naming colors of threat-related words are particularly long. This result is often demonstrated by participants who are clinically anxious (Mathews & MacLeod, 1985; Golombok, Stravrou, Mogg, Critchlow, & Rust, 1991; Mathews, Mogg, Kentish, & Eysenck, 1995; Martin, Horder, & Jones, 1992; Watts, Trezise, & Sharrock, 1986), and participants scoring high on measures of state and/or trait anxiety (Richards & Millwood, 1989, Riemann & McNally, 1995).

As mentioned previously, the emotional Stroop task (Gotlib & McCann, 1984) is intended for measuring interference from words. Longer latencies imply greater interference. Whether this interference is associated with participants' selective engagement to threat-related words, delayed disengagement from them, or some other variable is unclear. Because words and colors are not spatially separate, sufficient evidence cannot be obtained to suggest that attention is being shifted.

Despite the above methodological issues, certain versions of the Stroop task have yielded results consistent with a delayed disengagement theory. This theory is in opposition to previously held beliefs that anxious participants demonstrate biases of facilitated engagement. Indeed, according to Eriksen and Eriksen (1974) and Treisman (1969), visual stimuli located within one degree of foveal vision cannot be ignored. Thus, participants should not demonstrate differences of an engagement component of attention. White (1996) and Fox (1994) offer confirming evidence, as they did not observe differences between fearful and non-fearful participants who were asked to name colors spatially separate from either a threat-related or neutral word. Indeed, difficulties disengaging attention from threat-related words were demonstrated when threat-related and neutral words were arranged in a counterbalanced order such that threat-related words preceded neutral words (Holle, Neely, & Heimberg, 2004).

Cognitive tasks that employ words have certain limitations. Indeed, researchers generally agree that images represent stimuli better than words do. Notably, on tasks that involve threat-related images, both moderately and highly anxious participants demonstrate threat-related attentional biases (Bradley, Mogg, & Millar, 2000); however, on tasks that involve threat-related words, only highly anxious participants demonstrate them (Broadbent & Broadbent, 1988; Bradley, Mogg, Millar, & White, 1995; MacLeod & Mathews, 1988; MacLeod & Mathews, 1986; Mogg et al., 1994). Questions remain as to whether attentional bias is the product of frequency-related or valance-related effects. In the sense that familiarity with words and accessibility to them influences color naming latencies, anxious participants, who are more familiar with threat-related words than are non-anxious participants, should be more likely to demonstrate frequency-related effects, respectively (Bradley et al.).

The visual search task (Schneider & Shiffrin, 1977) generally involves detecting a single target stimulus from within a matrix of uniform distracter stimuli. Stimulus arrays are typically two-by-three or three-by-two in size. In earliest versions, short latencies for detecting threat-related targets were linked with evidence of threat-related facilitated engagement (Ohman, Flykt, & Esteves, 2001; Ohman, Lundqvist, & Esteves, 2001; Blanchette, 2006; Brosch & Sharma, 2005). Later versions offer different evidence. In Hansen and Hansen's (1994) face-in-the-crowd version, which involved judging whether matrixes did or did not include a discrepant face, participants took longer to judge that a friendly face was absent than they did to judge that an angry face was absent (Hampton, Purcell, Bersine, Hansen, & Hansen, 1988). If detection had involved threat-related facilitated engagement, latencies for judging that a friendly face was absent would have been relatively short in the sense that participants would have automatically engaged the locations of the angry distracter faces to infer absence of a friendly target face (Hampton et al.).

Versions of the visual search task, which involve detecting single target faces at different distances from an initial fixation point offer similar confirmation. Moreover, participants actively searched the arrays of stimuli for an angry target face, which was consistent with evidence that they took longer to detect more distant angry faces than less distant angry faces (Hampton, Purcell, Bersine, Hansen, & Hansen, 1988). Participants would have detected either face with equal efficiency, regardless of distance, had they demonstrated threat-related facilitated engagement (Hampton et al.).

Researchers distinguish between two search patterns, one that is serial and the other that is parallel (Treisman & Gelade, 1980). Serial search is deliberate, as it is mediated by conscious attention. By contrast, parallel search is automatic, as it is mediated by pre-attentive processes (Treisman & Gelade). Evidence of facilitated engagement is consistent with the assumption that visual search is parallel (Ohman, Flykt, & Esteves, 2001; & Ohman, Lundqvist, & Esteves, 2001). Parallel search involves simultaneous engagement to all aspects of a visual field. Because latencies for detecting threat-related targets steadily increased as a function of matrix size participants were suggested to have demonstrated conscious attention indicative of serial search (Eastwood, Smilek, & Merikle).

Debate remains as to whether pre-attentive processes influence the connection between anxiety and attention. According to Treisman and Gelade (1980), feature integration is a perceptually based process in which distinct features gain preferential attention and indistinct features do not. Evidence that participants take longer to detect friendly target faces than similarly featured angry target faces, when either face is paired with neutral distracter faces, has encouraged researchers to explore other processes that may be involved (Ohman, Lundqvist, & Esteves, 2001).

According to Ohman et al., threat-related stimuli activate an encapsulated fear mechanism that functions independently of conscious attention and operates on the basis of crude stimulus features to facilitate rapid responding. Hampton, Purcell, Bersine, Hansen, and Hansen (1988) suggest, however, that early detection must involve conscious attention. Their findings revealed differences between latencies that were demonstrated to detect threat-related stimuli that resembled specific concerns and threat-related stimuli that did not. If an encapsulated fear mechanism was involved, latencies would not have been different, as participants would not have discerned between concern-related and unrelated threat-related stimuli. Similarly, if an encapsulated fear mechanism was involved, snake experts would not have demonstrated shorter latencies to detect poisonous snakes that they feared than to detect non-poisonous snakes that they did not fear, as they would not have discerned between snakes (Purkis, & Lipp, 2007).

Overall, the visual search task has contributed moderately to our understanding of attention with respect to anxiety. As in the emotional Stroop task (Gotlib & McCann, 1984), participants select relevant from irrelevant stimuli, both of which are generally visible, and may equally account for variance between groups. Whether differences reflect difficulties disengaging attention from distracter stimuli, facilitated engagement to target stimuli, or a combination of both is equivocal.

The attention probe task (MacLeod, Mathews, & Tata, 1986) involves detecting single probes cued by one of two cues. The cues are located five cm units apart and equally distant from an initial fixation point. Generally, the cue that the probe replaces is referred to as the valid cue, whereas the cue that the probe does not replace is referred to as the invalid cue. According to Eysenck (1992), vigilance is the state in which people become “oversensitive in detecting threat.” Borrowing from this theory, researchers suggest that vigilance underlies rapid detection of probes that follow threat-related cues (MacLeod, Mathews, & Tata, 1986; Wilson & MacLeod, 2003; Bradley, Mogg, & Miller, 2000; Broadbent & Broadbent, 1988; Bradley, Mogg, Miller, & White, 1995; MacLeod & Mathews, 1988; Mogg et al., 1994).

A vigilance/avoidance theory was tested under conditions involving different levels of threat. According to Wilson and MacLeod (2003), all participants demonstrated short latencies indicative of vigilance to detect probes that followed highly valenced threat-related cues. Similarly, all participants demonstrated long latencies indicative of avoidance to detect probes that followed mildly valenced threat-related cues. Differences were reflected in latencies to detect probes that followed moderately valenced threat-related cues, with anxious participants, as opposed to non-anxious participants, demonstrating short latencies indicative of vigilance (Wilson & MacLeod).

Wilson and MacLeod's (2003) findings suggest that disproportionate levels of threat may account for inconsistencies within the literature. Indeed, using schematic faces, Bradley, Mogg, and Miller (2000) found that moderately to highly anxious participants demonstrated latencies that were shorter to detect probes that followed valid threat-related cues than probes that followed valid neutral cues. In a task involving words, however, Broadbent and Broadbent (1988) found that only highly anxious participants demonstrated latencies that were shorter to detect probes that followed valid threat-related cues than probes that followed valid neutral cues, with moderately to low anxious participants demonstrating relatively long latencies.

Because both valid and invalid cues are task relevant and displayed simultaneously, their effects cannot be analyzed as separate. Moreover, shorter latencies demonstrated to detect probes that follow valid threat-related cues, when paired with invalid neutral cues, and compared with valid neutral cues, when paired with invalid threat-related cues, may indicate attention is being facilitated to the location of a valid threat-related cue. It may also indicate that participants are unable to disengage their attention from the location of an invalid threat-related cue. To conclude that participants demonstrate facilitated engagement to threat-related cues would be premature, as these cues influence both components of attention.

With a manipulation that offered comparison between detection latencies involving two neutral cues and a neutral and threat-related valid/invalid cue combination, Derryberry and Reed (2002) found that latencies demonstrated to detect probes that followed valid threat-related cues were not significantly different from latencies demonstrated to detect probes that followed two neutral cues. Differences were, instead, reflected in latencies demonstrated to detect probes that followed invalid threat-related cues, which were significantly longer than latencies demonstrated to detect probes that followed two neutral cues (Derryberry & Reed). Evidence of this effect suggests that difficulties disengaging attention from an invalid threat-related cue are expressed in demonstrations of shorter latencies to detect probes that follow valid threat-related cues than probes that follow valid neutral cues.

Versions involving single cue conditions offer evidence consistent with a delayed disengagement theory (Yeind, & Mathews, 2001; Fox, Russo, Bowles, & Dutton, 2001). Using a modified version of Posner's cued attention task (1980), which involves detecting targets that follow valid cues two thirds of the time, invalid cues one third of the time, and no cue one third of the time, Yeind and Mathews found that shy participants demonstrated latencies that were longer to detect targets that followed threat-related invalid word cues than targets that followed neutral invalid word cues. Fox et al. similarly found that highly anxious participants demonstrated longer latencies to detect probes that followed an invalid angry face cue than probes that followed an invalid happy or neutral face cue. Non-anxious participants did not demonstrate these same differences. Interestingly, Fox et al. found that highly anxious participants demonstrated latencies that were longer to detect probes that followed a valid angry face cue than probes that followed a valid happy face cue. These findings are opposite of what would be expected if anxious participants had demonstrated threat-related facilitated engagement (Fox et al.).

According to Fox, Russo, and Dutton (2002), participants may adopt a response heuristic in which they determine whether a probe is or is not located at a specific location, and respond accordingly. This strategy would enable them to focus their attention at only one location while ignoring the other location. To encourage participants to shift their attention between locations, Fox et al. included square and circle probes that needed to be discerned. This manipulation did not produce noticeable differences relative to the previous task. Results confirmed that an attentional mechanism, rather than a response heuristic, accounted for much of the variance. Specifically, anxious participants took longer to detect probes that followed invalid angry face cues than probes that followed invalid neutral face cues, when compared with non-anxious participants (Fox et al.).

Manipulations to the cue-probe onset asynchrony or duration between termination of cues and presentations of probes are suggested to capture the effects of different components of attention (Mogg, Bradely, De Bono, & Painter, 1997). Researchers propose that 100 ms and 1500 ms durations reflect differences of an engagement and disengagement component, respectively (Mogg et al.). Unfortunately, Mogg et al. did not yield significant differences between conditions involving cue-probe onset asynchronies of 100, 500, or 1500 ms. Ultimately, the attention probe task (MacLeod, Mathews, & Tata, 1986) does not indicate whether latencies to detect probes reveal information concerning delayed disengagement or facilitated engagement.

Although the above tasks are often used to study attentional bias among anxious individuals, they may not instantiate biases of interest for people with specific phobias. Moreover, the visual search task (Schneider & Shiffrin, 1977) presumably measures attentional shifts, but fails to distinguish between mechanisms of attention, whereas the attention probe task (MacLeod, Mathews, & Tata, 1986) offers mild utility distinguishing between mechanisms of attention, but is too contrived to yield findings that are ecologically valid. Visual stimuli are better represented within a context, or at least a matrix, when used to study specific phobia. A visual spatial field that approximates the environment in which feared objects appear would enable researchers to study initial shifts of attention as well as shifts of attention that occur within the context of the feared object.

Tasks that involve detecting change in scenes are grounded in the assumption that focused attention can only be given to a limited portion of visual space at one time (Rensink, Regan, & Clark, 1997). Because change detection demands focused attention, researchers are able to study the manner in which people attend to images by how easily they detect change (Rensink et al.). Images in which participants do not allocate focused attention are stored for only a brief moment in sensory memory before they are no longer available for making comparisons between old and new visual information (Rensink et al.). This phenomenon, referred to as visual change blindness, can occur naturally, during a saccade, when motion signals that accompany a changing image are blocked from vision and cause a person not to notice a difference (Rensink et al.). Certain experimental preparations have also been used to induce change blindness, thus, enabling researchers to examine attentional phenomena associated with various personality traits and psychopathological conditions (McGlynn, Wheeler, Wilamowska, & Katz, 2007).

A person will readily attend to stimuli with certain properties (Rensink, Regan, & Clark, 1997). According to Rensink, visual attention is often pulled toward transient motion cues that accompany visual change, or it is drawn to areas of central interest. To understand the relationship between transient motion cues and attention, imagine viewing stationary images from a flipbook appear to move as the pages are flipped. If you have ever witnessed this “phi” phenomenon (Wertheimer, 1912) you may now understand how your perceiving motion was the result of your attending to motion signals that accompanied rapidly changing images. This same concept has been applied in research involving visual change detection; however, cognitive preparations were used to swamp or reduce the saliency of motion signals, thus enabling detection, indicative of focused attention, to be influenced by areas of interest alone (Rensink et al.).

In distinguishing central from marginal interest areas, Rensink, Regan, and Clark (1997) asked participants to briefly describe a scene that was presented to them. Descriptions given by three of the five participants were defined as central interest areas, or areas that readily engaged attention. Areas that were not described were defined as marginal interest areas, or areas that did not readily engage attention. When participants were asked to detect change in scenes that included both marginal and central interest areas, the participants detected change in the central interest areas more quickly than they detected change in the marginal interest areas (Rensink et al.); thus, a task of visual change detection revealed indices of attention, mediated by areas of interest.

Two distinct preparations have been used to study the role of attention in mediating visual change perception (Rensink, Regan, & Clark, 1997). The first involves detecting change in pairs of simple figure and letter sequences. The sequences are separated by a brief inter-stimulus interval. Half of the pairs of sequences are identical. The others contain one change within the second sequence. Change detection was found to be poorest for juxtaposed sequences separated by durations of 60 to 70 ms, whereas change detection was most accurate for juxtaposed sequences separated by shorter durations (Rensink et al.). This finding is consistent with evidence that unattended images remain accessible through sensory memory for brief time durations. After these durations end, the images are no longer available for detecting change (Rensink et al).

Saccade-contingent change blindness is a type of visual change blindness that results when visual change occurs during a saccade and is therefore not noticed (Rensink, Regan, & Clark, 1997). Findings suggest that this type of change blindness is caused by a swamping of motion signals that accompany an eye blink (Rensink et al.). In the absence of such signals, attention must “voluntarily” be given to the relevant stimulus change (Rensink et al.). Thus, characteristics of visual memory and the accessibility of motion signals both influence a common underlying mechanism of attention that mediates the detection of visual change (Rensink et al.).

The flicker task (Rensink, Regan, & Clark, 1997) is a visual spatial task originally used to study saccade-contingent change blindness. It involves quickly detecting change in pairs of almost identical scenes that are different from other pairs of scenes. Scenes are presented sequentially starting with the first of a pair of scenes, followed by a blank screen, and then a second scene. Both scenes are presented repeatedly until participants detect a difference. The inclusion of an interval between the first and second scenes in a pair creates a flicker that causes a swamping of motion cues, which would otherwise automatically draw attention. Without these cues detection becomes relatively difficult and depends mostly on higher-level cognitive processes and preferences. According to Rensink et al., when a pair of scenes is presented without an intervening interval, participants readily detect change; thus, slow responding cannot be attributed to inconspicuous changes in scenes. Rather, participants experience change blindness to relatively large changes in locations that do not engage their attention (Rensink et al.).

The flicker task was modified to measure attentional bias in people who are snake-fearful (McGlynn, Wheeler, Wilamowska, & Katz, 2007). The scenes used were similar to the scenes used by Rensink, Regan, and Clark, (1997), and included commonplace rooms, hallways, and out-door vistas. Half of the scenes included snakes; half did not. All scenes were administered in pairs sequentially, cycling between intervals of 80 ms until participants detected change and emitted a response. The inter-pair intervals were 5-seconds. Each pair was administered to a group of six participants designated snake fearful and a group of six participants designated non-fearful. This design was used in two experiments. Of interest was the time or number of scene pair repetitions before participants detect change (McGlynn et al.).

The two experiments produced significant main effects (McGlynn, Wheeler, Wilamowska, & Katz, 2007). First, snake-fearful participants required more scene-pair repetitions to detect changes in scenes than snake-tolerant participants. Secondly, participants detected changes made to central interest areas of scenes more quickly than changes made to marginal interest areas of scenes. Furthermore, participants detected changes made to neutral scenes more quickly than changes made to snake present scenes (McGlynn et al.).

The first and second experiments revealed two-way and three-way interactions, respectively (McGlynn, Wheeler, Wilamowska, & Katz, 2007). In the first experiment, snake fearful participants detected change in neutral scenes slowly. In the second experiment, snake fearful participants detected change in marginal interest areas of neutral scenes slowly. One interpretation of the Group x Scene interaction is that snake fearful participants, after viewing an image of a snake, were unable to disengage their attention from the snake and were less able to quickly detect change in a subsequent pair of neutral scenes (McGlynn et al.). In the previous experiments, a brief 5-second interval between change detection and the presentation of a new scene was used.

The present experiment was designed to test a hypothesis that delayed disengagement from snakes had caused the fearful participants in McGlynn, Wheeler, Wilamowska, and Katz's (2007) study to detect change in neutral scenes more slowly than change in snake-related scenes. It incorporated the basic experimental design used by McGlynn et al., but included a 30-second inter-pair interval in addition to the previously used 5-second inter-pair interval. An equal number of sequences were included in which snake absent pairs followed snake present pairs, snake present pairs followed snake absent pairs, snake absent pairs followed snake absent pairs, and snake present pairs followed snake present pairs. Each sequence was associated with an equal number of marginal versus central interest changes, which was associated with an equal number of 30-second versus 5-second inter-pair intervals. Central interest locations of snake scenes always included a snake, as pilot participants described snakes in all of these scenes.

If results support our hypothesis, fearful participants, when detecting changes in neutral scenes that follow snake scenes after 30-second inter-pair intervals, should demonstrate latencies similar to that of snake-tolerant participants. Differences should be reflected within latencies for detecting changes in neutral scenes that follow snake scenes after 5-second inter-pair intervals, such that snake-fearful participants demonstrate relatively long latencies to detect change.

II. Method

Participants

One-hundred-fifty-seven Auburn University undergraduate students currently enrolled in psychology courses were recruited to take part in an initial screening session, which involved responding to two questionnaires. Of the 157 students, 20 were selected to participate in the study. Ten were assigned to a snake fearful group; ten were assigned to a non-fearful group. The fearful group included two female and eight male participants. The non-fearful group included three male and seven female participants.

Measures

The fear survey schedule-II (Wolpe & Lang, 1964) is a self-report survey commonly used in research on fear. It contains 51 word items that represent commonly feared objects and situations. Participants rate their fears on a likert type scale of zero (no fear) to six (terror). Geer (1967) reported total mean scores of 100.16 (SD= 36.11) for a sample of 109 females and mean scores of 75.78 (SD= 33.84) for a sample of 161 males. Bernstein and Allen (1969) reported a total mean score of 98.64 (SD = 38.47) from a mixed sample of 1,814 female and male undergraduates. Item means revealed four different factors; one of which was “Live Organisms” (Bernstein & Allen). The “snake” item produced means scores of 3.07 (Bernstein & Allen) for males and 4.02 for females (Geer). The item of concern for the present study is “snake.”

The Snake Questionnaire (Klorman, Weerts, Hastings, Melamed, & Lang, 1974) is a self-report measure including 30 true-false items that concern fears of snakes. It demonstrates good test-retest reliability and internal consistency (Klorman, et al). It also demonstrates good predictive and convergent validity with respect to a measure of aversion to snake images (An tony, & Barlow, 2002). Klorman et al. reported total mean scores of 7.79 (SD = 6.05) for 851 females and 4.92 (SD = 3.77) for 456 males.

Apparatus

A custom computer program written in E-prime on a Pentium four computer was used to administer the flicker task. The task along with an initial set of verbatim instructions and a single practice trial was displayed on the monitor. The stimuli were presented in serial fashion, cycling until a spacebar was pressed. Response latencies were stored within the program.

Stimuli

The stimuli were pairs of 33 digital scenes discovered using a Google search engine. The duplicate scenes were modified via Photoshop software to include one additional component or to have one component removed. Modifications were selected to be obvious enough so that, in the event that the original and modified scenes were to be displayed in succession without an intervening interval, participants would detect changes rapidly. Half of the pairs of scenes included snakes; half did not. Their themes were chosen to be similar, and included either humans interacting with snakes or humans interacting without snakes. Scenes were arranged in a counterbalanced fashion such that the number of snake present scenes preceding snake absent scenes was equal to the number of snake absent scenes preceding snake present scenes, snake absent scenes preceding snake absent scenes, and snake present scenes preceding snake present scenes. Each of these sequences was linked with an equal number of marginal versus central interest changes that were linked with an equal number of 30-second versus 5-second inter-pair intervals.

Procedure

Pilot Analysis

Following Rensink, Regan, and Clark's (1997) lead, preliminary data was taken concerning areas of central and marginal interest from five pilot participants. The participants were asked to describe 33 scenes that were presented to them sequentially on a computer screen. Areas that three of the five pilot participants described were defined as central interest areas. Areas that none of the five pilot participants described were defined as marginal interest areas. When present, images of snakes were always described; thus, all snake-related scenes included snakes in central interest areas. After the scenes were created, a different group of four pilot participants were administered the flicker task without intervening inter-scene intervals. This step was essential for determining whether changes would be obvious without the inter-scene interval and for establishing whether variance would reflect processes associated with change blindness. All of the pilot participants detected change automatically, suggesting that the changes were obvious.

Participant selection

Potential participants were recruited via Sona Systems (http://auburn.sona-systems.com). They were administered the FSS-II and SNAQ, which were used to select participants and assign them to groups. Participants who rated the "snake" item on the FSS-II as a five or six, and yielded a score of 19 or higher on the SNAQ were assigned to a snake fearful group. Participants who rated the "snake" item on the FSS-II as a zero or one, and yielded a score of four or lower on the SNAQ were assigned to a snake tolerant group.

Flicker Task

Participants were seated in front of a computer monitor, where instructions were conveyed verbatim and the flicker task was administered (see Appendix A.). Participants received one practice trial, which was used to confirm whether they understood the task. Participants were able to ask questions at this time. The task involved rapidly detecting change in pairs of cycling scenes. Participants pressed a spacebar to confirm that they had detected a change. The cycling ended when the space bar was pressed. Participants then verbalized the change that they noticed. A new scene was presented after either a 5-second or 30-second interval following detection. Scenes appeared for 240 ms durations.

III. Results

Four pilot participants detected change in scenes without intervening intervals. Their latencies for detecting change were significantly shorter than those of participants who detected change in scenes with intervening intervals.

Each participant produced scores on the FSS-II and the SNAQ, which were averaged with respect to their participant group. Mean FSS-II and SNAQ scores are represented in Table 1.

Table 1. Mean Scores and Ranges for the FSS-II and SNAQ

Measure						
	Snake Fearful			Snake Tolerant		
	M	Min	Max	*M*	Min	Max
FSS Scores on Snake Question	5.7	5	6	.8	0	1
FSS Overall Scores	132.3	95	172	85.7	39	126
SNAQ Scores	22.1	19	27	3.3	1	5

On the flicker task, each participant produced two numbers (mean response times) for each of the 16 experimental conditions. These numbers were averaged and reduced to 16 numbers. A total of 320 numbers (16 numbers for 20 participants) comprised the variance that was characterized via a 4 (pair sequence) X 2 (change location) X 2 (inter-pair interval) X 2 (participant group) ANOVA. The within and between subjects ANOVA of variance is presented in Table 2. Mean response latencies in seconds for detecting change are presented in Table 3.

Table 2. Within and Between Subjects Anova of Variance.

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Subjects					
Group	739000000	1	739000000	3.959	>.062
Error(Group)	3.360	18	186700000		
Within Subjects					
Sequence	1936000000	3	645400000	10.452	>.000
Sequence * Group	772000000	3	257300000	4.167	>.010
Error(Sequence)	3335000000	54	61751009.859		
Location	25055810.332	1	25055810.332	.450	>.511
Location * Group	20626074.395	1	20626074.395	.370	>.550
Error(Location)	1003000000	18	55706836.789		
Interval	6160361.251	1	6160361.251	.112	>.742
Interval * Group	42443503.820	1	42443503.820	.769	>.392
Error(Interval)	993500000	18	55196301.044		
Sequence * Location	277200000	3	92391192.888	1.384	>.258
Sequence * Location * Group	150300000	3	50084510.438	.750	>.527
Error(Sequence*Location)	3605000000	54	66762864.214		
Sequence * Interval	734100000	3	244700000	5.340	>.003
Sequence * Interval * Group	116700000	3	38913278.147	.849	>.473
Error(Sequence*Interval)	2474000000	54	45811613.536		
Location * Interval	1925000000	1	1925000000	19.953	>.000
Location * Interval * Group	292600000	1	292600000	3.032	>.099
Error(Location*Interval)	1737000000	18	96488952.122		
Sequence * Location * Interval	6199000000	3	2066000000	28.766	>.000
Sequence * Location * Interval * Group	6.95600000	3	231900000	3.227	>.029
Error(Sequence*Location*Interval)	3879000000	54	71837978	.210	

Table 3. Mean Response Latencies for Different Combinations of Stimulus Sequence, Location, and Interval.

	Neutral-Snake Sequence				Neutral-Neutral Sequence				Snake-Neutral Sequence				Snake-Snake Sequence			
Change	Central		Marginal		Central		Marginal		Central		Marginal		Central		Marginal	
Inter-pair Interval	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30
Fearful	7	7	7	11	15	7	8	12	38	5	7	24	5	13	12	10
Non-fearful	7	8	6	7	11	6	6	13	17	4	5	14	4	12	11	8

Results revealed a significant four-way interaction between stimulus sequence, inter-pair interval, change location, and participant group such that snake fearful participants took longer to detect marginal interest changes in neutral scenes that followed snake scenes after 30-second inter-pair intervals (*M* = 24.48) than they did to detect marginal interest changes in neutral scenes that followed snake scenes after 5 second inter-pair intervals (*M*= 6.52). They took longer to detect central interest changes in neutral scenes that followed snake scenes after 5-second inter-pair intervals (*M*= 38.19) than they did to detect central interest changes in neutral scenes that followed snake scenes after 30-second inter-pair intervals (*M*= 5.14), *F* (3,18) = 3.227, *p* = .029 (See figure 3). After correcting for a violation of sphericity, the four-way interaction was no longer significant, *p* = .059. Thus, it should be interpreted with caution, but not without acknowledgement of its potential significance in literature concerning attentional bias.

One of the four main effects was significant. Specifically, participants (*M* = 14.38) took longer to detect change in neutral scenes that followed snake scenes than they did to detect change in snake scenes that followed neutral scenes (*M* = 7.73), neutral scenes that followed neutral scenes (*M* = 9.88), and snake scenes that followed snake scenes (*M* = 9.39), *F* (3, 18) = 10.45, *p* = .00 (See figure 1).

Three of the four main effects were not significant. Moreover, latencies for detecting marginal interest changes were not significantly different from latencies for detecting central interest changes *F* (1, 18) = .450, *p* = .511. Similarly, latencies for detecting change in scenes that followed 5-second inter-pair intervals were not significantly different from latencies for detecting change in scenes that followed 30-second inter-pair intervals *F* (1, 18) = .112, *p* = .742.

Furthermore, snake fearful participants did not demonstrate detection latencies that were significantly different from that of snake tolerant participants *F* (1, 18) = 3.959, *p* = .062.

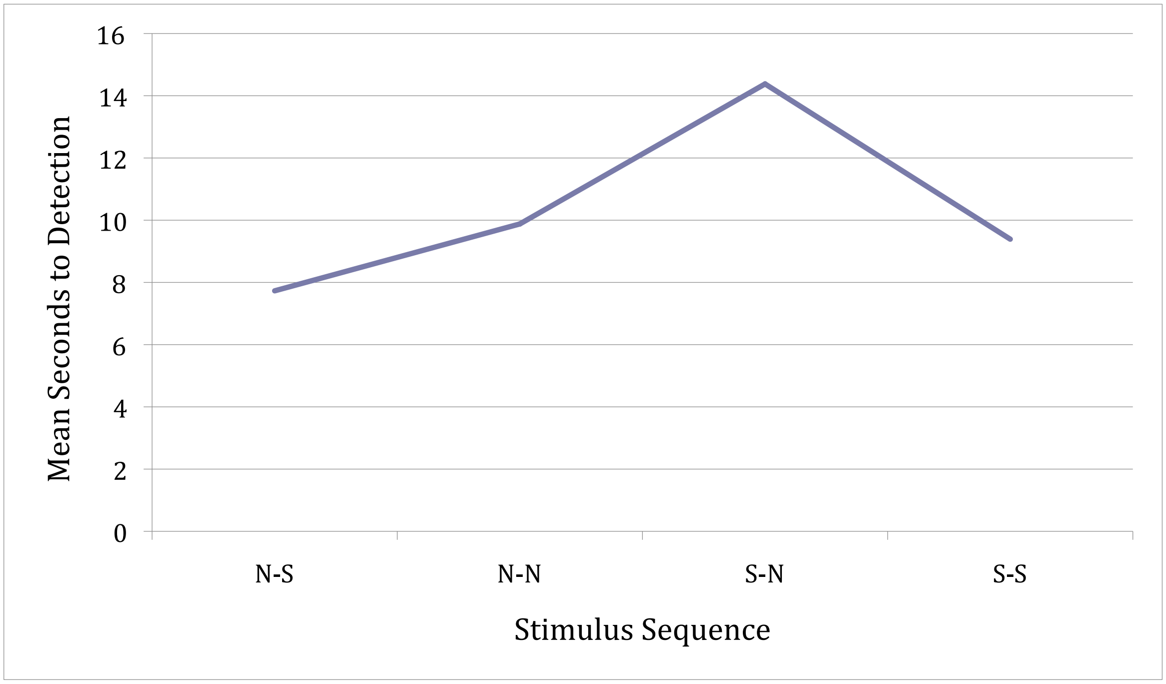
In addition to the significant four-way interaction, four other interactions were significant. The first was a two-way interaction between participant group and stimulus sequence such that snake fearful participants took particularly long to detect change in neutral scenes that followed snake scenes (*M* = 18.59); snake tolerant participants took relatively less time (*M* = 10.17), *F* (3, 18) = 4.167, *p* = .01 (See figure 2).

The second significant interaction was a two-way interaction between change location and inter-pair interval such that latencies for detecting change in central interest locations of scenes that followed 5-second inter-pair intervals (*M*= 13.22) were significantly longer than latencies for detecting change in central interest locations of scenes that followed 30-second inter-pair intervals (*M*= 8.03). Latencies for detecting change in marginal interest locations of scenes that followed 5-second inter-pair intervals (*M*= 7.75) were significantly shorter than latencies for detecting change in marginal interest locations of scenes that followed 30-second inter-pair intervals (*M*= 12.38), *F* (1, 18) = 19.953, *p* = .00.

The third significant interaction was a two-way interaction between stimulus sequence and inter-pair interval such that participants demonstrated longer latencies to detect change in neutral scenes that followed snake scenes after 5-second inter-pair intervals (*M* = 16.92) than they did to detect change in neutral scenes that followed snake scenes after 30-second inter-pair intervals (*M* = 11.82), *F* (3, 18) = 5.341, *p* = .003.

Finally, the fourth significant interaction was a three-way interaction between stimulus sequence, inter-pair interval, and change location such that participants took longer to detect marginal interest changes in neutral scenes that followed snake scenes after 30-second inter-pair intervals (*M* = 19.27) than they did to detect marginal interest changes in neutral scenes that followed snake scenes after 5-second inter-pair intervals (*M* =4.61). They took less time to detect central interest changes in neutral scenes that followed snake scenes after 30-second inter-pair intervals (*M* = 4.39) than they did to detect central interest changes in neutral scenes that followed snake scenes after 5-second inter-pair intervals (*M* = 27.99), *F* (3,18) = 28.766 *p* = .000.

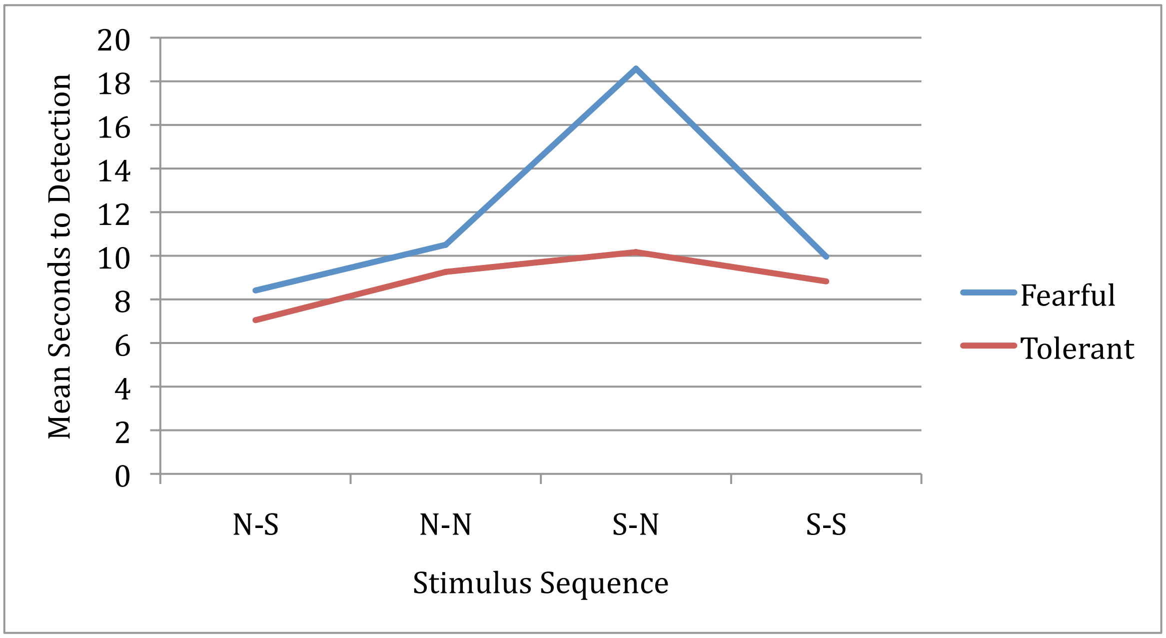
Figure 1. Graph of Main Effect for Stimulus Sequence



Note. N-S = Neutral stimulus followed by Snake stimulus; N-N = Neutral stimulus followed by Neutral stimulus; Snake stimulus followed by Neutral stimulus; Snake stimulus followed by Snake stimulus.

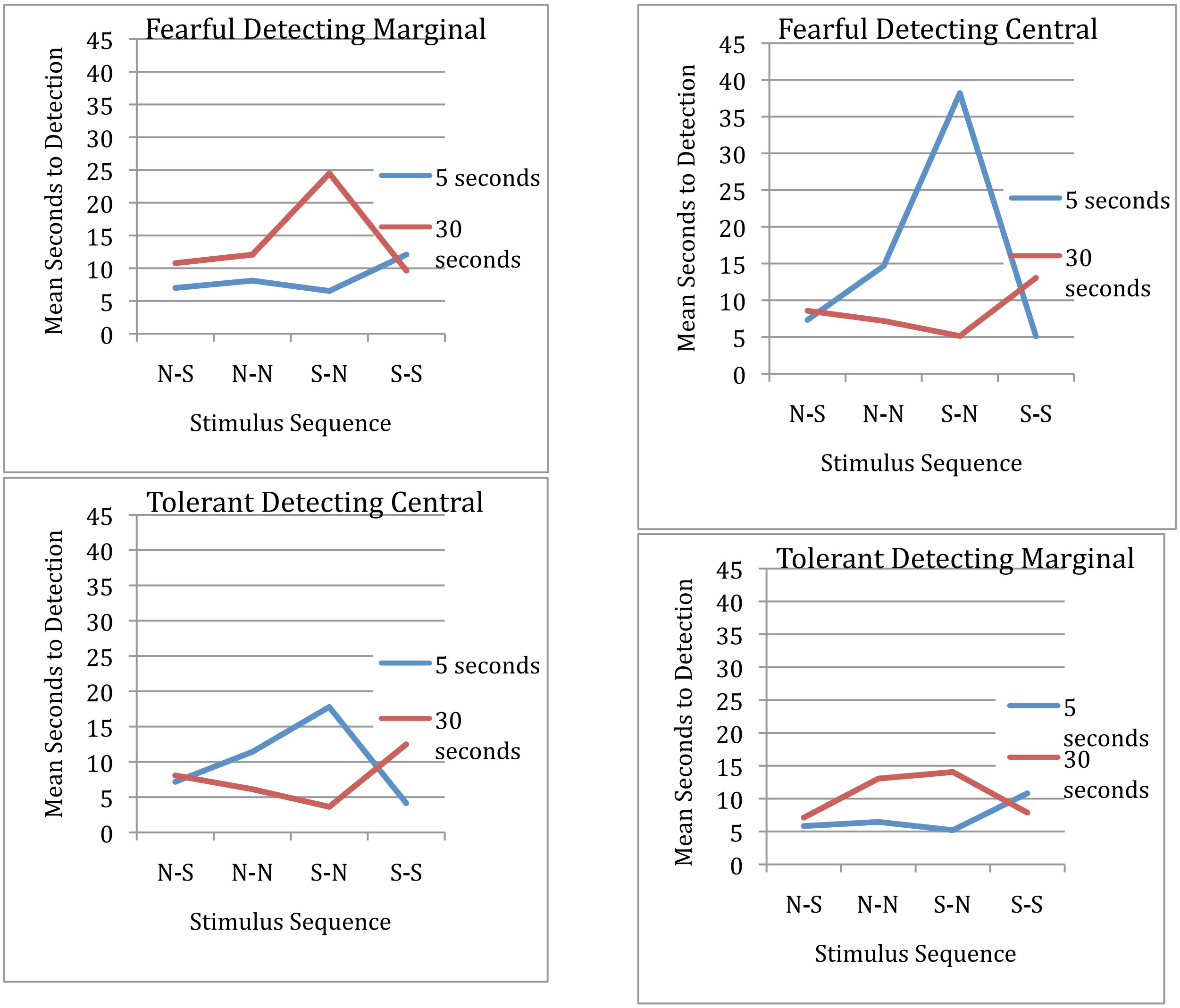
Six of the 11 interactions were not significant. Moreover, neither of the latencies for detecting changes in central interest locations and marginal interest locations differed as a function of participant group, *F* (1, 18) = .370, *p* = .550. Similarly, neither of the latencies for detecting changes in scenes that followed 5-second inter-pair intervals and scenes that followed 30-second inter-pair intervals differed as a function of participant group, *F* (1, 18) = .769, *p* = .392. Furthermore, latencies for detecting change in either combination of change location and inter-pair interval were not significantly different between groups, *F* (1, 18) = 3.032, *p* = .099. When latencies were compared across sequences, the groups did not demonstrate differences between variables of change location, *F* (3, 18) = .750, *p* = .527, or inter-pair interval, *F* (3, 18) = .849, *p* = .473. Similarly, latencies for detecting change in different stimulus sequences did not vary as a function of change location, *F* (3, 18) = 1.384, *p* = .258.

Figure 2. Graph of Interaction Between Stimulus Sequence and Group



Note. N-S = Neutral stimulus followed by Snake stimulus; N-N = Neutral stimulus followed by Neutral stimulus; Snake stimulus followed by Neutral stimulus; Snake stimulus followed by Snake stimulus.

Figure 3. Graph of Interaction between Stimulus Sequence, Change Location, Inter-pair Interval, and Group



Note. N-S = Neutral stimulus followed by Snake stimulus; N-N = Neutral stimulus followed by Neutral stimulus; Snake stimulus followed by Neutral stimulus; Snake stimulus followed by Snake stimulus.

Post hoc comparisons revealed 7 significant effects. As predicted, the neutral scene following snake scene pair produced significant effects. Moreover, latencies to detect central interest change in neutral scenes that followed snake scenes after a 5 second inter-pair interval were relatively long; latencies to detect marginal interest change in neutral scenes that followed snake scenes after a 30 second inter-pair interval were relatively short. These effects were significant for both the fearful *t* (9)= 3.505, *p* = .007, *t* (9)= -7.114, *p* = .000, and non-fearful groups *t* (9)= 2.421, *p* = .039, *t* (9)= -3.013, *p* = .015, respectively.

The snake scene following snake scene pair also produced significant effects. Moreover, latencies to detect central interest change in snake scenes that followed snake scenes after a 30 second inter-pair interval were relatively long. This effect was significant for both the fearful *t* (9)= -3.731, *p* = .005, and non-fearful groups *t* (9)= -4.915, *p* = .001.

Furthermore, the neutral scene following neutral scene pair produced a significant effect. Moreover, latencies to detect marginal interest change in neutral scenes that followed neutral scenes after a 30 second inter-pair interval were relatively long. This effect was only significant for the non-fearful group *t* (9)= -4.251, *p* = .002.

IV Discussion

As predicted, snake fearful participants took longer to detect change in neutral scenes that followed snake scenes than they did to detect change in any other sequence. Thus, our results support a hypothesis that fearful participants demonstrate difficulties disengaging their attention from threat-related stimuli. Interestingly, latencies for detecting change in neutral scenes that followed snake scenes varied as a combined function of change location and inter-pair duration. Moreover, snake fearful participants took longer to detect central interest changes in neutral scenes that followed snake scenes after 5-second inter-pair durations than they did to detect central interest changes in neutral scenes that followed snake scenes after 30-second inter-pair durations. They also took longer to detect marginal interest changes in neutral scenes that followed snake scenes after 30-second inter-pair durations than they did to detect marginal interest changes in neutral scenes that followed snake scenes after 5-second inter-pair durations.

One possible explanation for the Sequence x Change Location x Inter-pair Interval x Group interaction is that snake fearful participants initially avoided snakes. Their avoidance was evidenced in relatively long latencies that were demonstrated to detect central interest changes in neutral scenes that followed snake scenes after 5-second inter-pair durations, and in relatively short latencies that were demonstrated to detect marginal interest changes in neutral scenes that followed snake scenes after 5-second inter-pair durations. These results suggest that participants continued to allocate attention to the marginal interest locations of the computer screen after they had detected a snake and as the first of a pair of subsequent neutral scenes was presented.

After briefly avoiding the snake, participants shifted their attention to the central interest location of the screen. The 30-second inter-pair duration was long enough to enable fearful participants to begin to anticipate a snake appearing in a subsequent scene and to become vigilant. They attended to the center of the screen, prepared to detect change as quickly as possible so as to "escape" the snake as soon as possible. Their vigilance was reflected in relatively short latencies that were demonstrated to detect central interest changes in neutral scenes that followed snake scenes after 30-second durations, and in relatively long latencies that were demonstrated to detect marginal interest changes in neutral scenes that followed snake scenes after 30-second durations.

In short, avoidance likely characterized the participants' initial response to the image of the snake; however, vigilance characterized their subsequent responses. Participants demonstrated avoidance of snakes for up to 5-second durations, which was synonymous with the avoidance previously demonstrated after 500 ms durations between cues and probes (Mogg & Bradley, 2006). Whether participants in the present study demonstrated vigilance up to 500 ms durations following exposure to snakes, or avoidance shortly after 500 ms durations following exposure to snakes is equivocal, as attention at these durations was not measured. Indeed, the present design captured components of attention demonstrated relatively long after exposure to snakes.

Post hoc comparisons suggest, however, that fearful participants demonstrate avoidance at an even earlier span following detection of change in a snake scene and the presentation of a subsequent snake pair. The 30-second inter-pair interval between detection of change in a snake scene and the presentation of a new scene should have contributed to the fearful participants becoming vigilant of a potential snake; however, when the new scene included a snake, fearful participants immediately shifted attention away from the snake, which is consistent with the fact that they took longer to detect central interest change in snake scenes that followed snake scenes after a 30-second inter-pair interval than they did to detect central interest change in neutral scenes that followed snake scenes after a 30 second inter-pair interval. The non-fearful participants also took relatively long to detect central interest change in snake scenes that followed snake scenes after a 30-second inter-pair interval. The fact that they also took relatively long to detect marginal interest change in neutral scenes that followed neutral scenes after a 30-second inter-pair interval suggests that a process other than avoidance is involved. Perhaps, the non-fearful participants simply lost interest after 30 seconds.

Previous studies have not adequately addressed the distinction between engagement and disengagement. Fearful participants were suggested to have demonstrated facilitated engagement to threat-related cues (Mogg, Bradley, & Painter, 1997), but they were also suggested to have demonstrated delayed disengagement from them (Fox, Russo, & Dutton, 2002). Fearful participants in the present study did not demonstrate facilitated engagement. Moreover, latencies for detecting changes in central interest locations that included snakes were not significantly different between groups. Indeed, fearful participants detected central interest changes in subsequent neutral scenes relatively slowly, which suggests that they continued to avoid the location of the snake.

Several recent studies involving the attention probe task (MacLeod, Mathews, & Tata, 1986) suggest that anxious people demonstrate biases within a disengagement component (Fox, Russo, & Dutton, 2002; Derryberry & Reed, 2002). The present study offers confirming evidence. It also offers evidence to suggest that different mechanisms operate at different durations following exposure to perceived threat. Five and 30-second inter-pair durations revealed multiple indices of attention, namely those associated with avoidance and vigilance. Future research should address the connection between avoidance and vigilance. Perhaps, avoidance motivated participants to respond vigilantly to central interest locations of neutral scenes that followed snake scenes after 30-second inter-pair durations so as to abruptly terminate the presentation of a potential snake.

Consistent with an evolutionary perspective, participants could have demonstrated pre-attentive vigilance. According to Mogg, Bradley, and Painter (1997), this process would have occurred within the 100-1500 ms span that, unfortunately, our task did not measure. In the present study, vigilance was demonstrated after 30-second durations and likely involved conscious attention. Whether conscious attention is required is debatable. Evidence that participants detect threat-related masked stimuli more quickly than benign masked stimuli suggests that conscious attention is not required (Dimberg & Ohman, 1996; & Ohman & Manica, 2001); however, researchers question the extent to which images are in fact "masked."

Evidence from the current study suggests that fearful participants may demonstrate avoidance at the earliest stages of conscious attention and vigilance at later stages. Indeed, Posner (1980) suggests that several different processes interact at different durations to direct attention within visual spatial fields. These processes may jointly underlie attentional differences between anxious and non-anxious people.

In future research, flicker task (Rensink, Regan, & Clark, 1997) scenes need to be analyzed with respect to how easily participants detect changes in them, and modified until all changes are equally discriminate. Although preliminary data was obtained to confirm whether changes were equally discriminate, the scenes that were modified were only modified once. In order to determine whether scenes were adjusted adequately researchers need to continue collecting data until all scenes are equally discriminate. Any differences between groups that follow from this initial procedure should be less likely to violate statistical assumptions, as multicollinearity should be reduced.

Researchers should continue to explore strengths associated with different cognitive tasks. Perhaps, the abovementioned tasks could be combined in the development of a novel approach to measuring attention. Indeed, the attention probe task (Mogg, Bradley, & Painter, 1997), and flicker task (Rensink, Regan, & Clark, 1997) share similar features. They both prime attention to locations on a screen revealing information about the nature of attention under different conditions. Inter-stimulus intervals are similarly manipulated for exploring different components of attention. Perhaps, these tasks can be combined to incorporate the strengths of each task and to minimize their weaknesses as single tasks.

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Appendix A

Fear Survey Schedule II (FSS-II)

Instructions: Below are 51 different stimuli that can cause fear in people. Please rate how much fear you feel using the following rating scale and record your answer in the space provided.

0 = None 1 = Very little fear 2 = A little fear 3 = Some fear

4 = Much fear 5 = Very much fear 6 = Terror

_______1. Sharp objects
_______2. Being a passenger in a car
_______3. Dead bodies
_______4. Suffocating
_______5. Failing a test
_______6. Looking foolish
_______7. Being a passenger in an airplane
_______8. Worms
_______9. Arguing with parents
_______10. Rats and mice
_______11. Life after death
_______12. Hypodermic needles
_______13. Being criticized
_______14. Meeting someone for the first time
_______15. Roller coasters
_______16. Being alone
_______17. Making mistakes
_______18. Being misunderstood
_______19. Death
_______20. Being in a fight
_______21. Crowded places
_______22. Blood
_______23. Heights
_______27. Being with drunks
_______28. Illness or injury to loved ones
_______29. Being self-conscious
_______30. Driving a car
_______31. Meeting authority
_______32. Mental illness
_______33. Closed places
_______34. Boating
_______35. Spiders
_______36. Thunderstorms
_______37. Not being a success
_______38. God
_______39. Snakes
_______40. Being with a member of the opposite sex
_______41. Cemeteries
_______42. Speaking before a group
_______43. Seeing a fight
_______44. Death of a loved one
_______45. Dark places
_______46. Strange dogs
_______47. Deep water
_______48. Stinging insects
_______49. Untimely or early death

______24. Being a leader

______25. Swimming alone

______26. Illness

______50. Losing a job

______51. Automobile accident

Appendix B

Snake Questionnaire (SNAQ)

Instructions: Answer each of the following statements either True or False as you feel they generally apply to you. If the statement is true most of the time or mostly true for you, you would answer **true**. If it is mostly false or false most of the time, mark it **false**. Indicate your answer by placing a mark (**X**) in the appropriate column.

TRUE	FALSE		
______	______	1.	I avoid going to parks or on camping trips because there may be snakes about.
______	______	2.	I would feel some anxiety holding a toy snake in my hand.
______	______	3.	If a picture of a snake appears on the screen during a motion picture, I turn me head away.
______	______	4.	I dislike looking at pictures of snakes in a magazine.
______	______	5.	Although it may not be so, I think of snakes as slimy.
______	______	6.	I enjoy watching snakes at the zoo.
______	______	7.	I am terrified by the thought of touching a harmless snake.
______	______	8.	If someone says that there are snakes anywhere about, I become alert and on edge.
______	______	9.	I would not go swimming at the beach if snakes had ever been reported in the area.
______	______	10.	I would feel uncomfortable wearing a snakeskin belt.
______	______	11.	When I see a snake, I feel tense and restless.
______	______	12.	I enjoy reading articles about snakes and other reptiles.
______	______	13.	I feel sick when I see a snake.
______	______	14.	Snakes are sometimes useful.
______	______	15.	I shudder when I think of snakes.
______	______	16.	I don’t mind being near a non-poisonous snake is there is someone there in whom I have confidence.
______	______	17.	Some snakes are very attractive to look at.
______	______	18.	I don’t believe anyone could hold a snake without some fear.
______	______	19.	The way snakes move is repulsive.
______	______	20.	It wouldn’t bother me to touch a dead snake with a long stick.
______	______	21.	If I came upon a snake in the woods I would probably run.
______	______	22.	I’m more afraid of snakes than any other animal.
______	______	23.	I would not want to travel “down south’ or in tropical countries because of

			the greater prevalence of snakes.
______	______	24.	I wouldn’t take a course in biology if I thought I might have to dissect a snake.
______	______	25.	I have no fear of non-poisonous snakes.
______	______	26.	Not only am I afraid of snakes, but worms and most reptiles make me feel anxious.
______	______	27.	Snakes are very graceful animals.
______	______	28.	I think that I’m no more afraid of snakes that the average person.
______	______	29.	I would prefer not to finish a story if something about snakes was introduced into the plot.
______	______	30.	Even if I was late for a very important appointment, the thought of snakes would stop me from taking a shortcut through an open field.

Appendix C

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INFORMED CONSENT
For a Research Study Entitled
Measuring Visual Change Detection in Specific Phobia

You are invited to participate in a research study of visual change detection. This study is being conducted by Kelly McEnerney, under the supervision of F. Dudley McGlynn, Ph.D. I am exploring how people attend to certain stimuli. ***If you are less than 19 years old you will be required to provide a parental consent form before participating in the study.***

If you decide to participate in this research study, you will be invited to take part in the first portion of the study. During this portion, you will be asked to complete two questionnaires. The questionnaires should take approximately 10 minutes to complete. You will receive 1/2 hour credit for participating in the first portion of the study. You may be contacted at a later time to take part in the second portion of the study. During this portion, you will be asked to view several scenes on a computer screen. The scenes will contain images that may be frightening for some participants. This portion of the study should take approximately 25 minutes. You will receive 1/2 hour of credit for participating in this portion of the study and an additional 1/2 hour of bonus credit. In short, you may take part in the first portion of the study. If you are contacted for the second portion of the study, you may also take part in it.

Some participants may fear certain images (containing pictures of things that people are commonly afraid of) that will be displayed on the computer screen. You may choose to discontinue the experiment at any time for any reason without a penalty. You will receive full credit for the portion of the study you participate in regardless of whether you complete it. Choosing to withdraw from the study will not affect your standing with Auburn University in any way. You may also choose to have any information that pertains to you, such as identification and questionnaire data, removed from the data file at any time. It will be shredded and will not be used in the study.

Your participation in this study may help contribute to an area in psychology that is currently being explored in relatively new ways. You can also learn about our research. You may contact us with any questions you have regarding the study. We will be able to give you an overview of the study after all of the data has been collected and interpreted.

Participant initials ____________

Any information obtained in connection with this study will remain confidential. Information obtained from your completion of the questionnaire and experimental portion will be linked to you by a code number. Your name will only appear on the contact form so that we can contact you if needed. Only Kelly McEnerney, the principal investigator, and Dr. McGlynn will have direct access to identity. The questionnaires and data from the experimental portion of the study will be kept secure at all times. All confidential information will be destroyed after the data have been collected and analyzed. Information collected through your participation may appear in a published article or may be presented at a professional meeting. All participant information will be anonymous in either circumstance.

If you have any questions about this study, you are welcome to ask questions at anytime. You can contact Kelly McEnerney at (klm0006@auburn.edu, 407-617-5229) or Dr. McGlynn, Ph.D. (mcglyfd@auburn.edu, 334-844-6472) if needed. You will receive a copy of this document to keep.

If you have any questions concerning your rights as a research participant you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

Participant's signature	Date	Investigator's signature	Date
Print Name	Date	Print Name	Date

Appendix D

Flicker Task Instructions

At this computer you are going to be shown several pairs of pictures. Each pair of pictures is going to be identical with the exception of one small detail. We want you to find what is different between each pair of pictures as quickly as you can. Once you have found the difference, press the space bar. Then, verbally indicate the change that you noticed.

Good Job! Now you are ready to begin the task. The program will stop automatically when you have finished all of the picture pairs. This part of the experiment will take approximately 25 minutes. Remember your informed consent that you signed, which states that you are free to leave at any time, as you are a volunteering participant of this study.

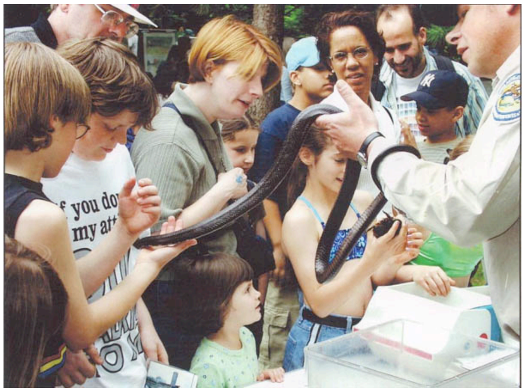
Appendix E

Flicker Task Stimuli

Snake Stimuli








Neutral Stimuli


GILWELL