Modern Psychological Studies

Volume 14 | Number 1 Article 4

2008

Automatic vigilance: does emotional state affect search times for positively and negatively valenced targets?

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Automatic Vigilance: Does Emotional State Affect Search Times for Positively and Negatively Valenced Targets?

Recent research has suggested that specific emotions, such as fear, may impact visual acuity (Phelps, Ling, & Carrasco, 2006). To see if emotion can influence higher order perceptions, an affective priming visual search task (APVST) was used to examine the effect of either fear or joy on participants' ability to find an associated search stimulus. A face showing either fear or joy was presented to induce a mood state, and participants searched for either a spider or a flower in a wooded background. It was found that search times were faster for the spider, but mood induction seemed to have little effect. The robust phenomenon of automatic vigilance and its contributing factors are discussed, along with its relation to mood congruence. The findings suggest that no mood congruence occurs, but that search times are reduced when the target is threatening.

Much research has been focused on the robust phenomenon of automatic vigilance, where emotional cues in the environment are used to direct cognitive resources and affect subsequent processing of environmental stimuli (Larsen, 2004). A qualitative example of this phenomenon would be a person being bitten by a snake and later becoming apprehensive when seeing anything resembling a snake, such as a stick or hose. An empirical example of automatic vigilance can be found in affective priming (Klauer, 2003, p. 7). Participants are asked to judge whether a threatening or non-threatening stimulus is categorically "good" or "bad" following the presentation of either a negatively or positively charged word. Those primed with a negatively charged word are faster in categorizing threatening stimuli rather than non-threatening stimuli. This research raises the question of automatic vigilance being a result of either enhanced visual processing or learned attentional bias. Using a two-alternative forced-choice perceptual identification task Zeelenberg, Wagenmakers, and Rotteveel (2006) showed that attentional bias had no effect, whereas the visual processing of emotional stimuli was indeed enhanced.

While the physiological issues concerning automatic vigilance will not be discussed in detail, they do aid in the explanation of this phenomenon, and will no doubt prove useful in discerning the affect of emotion on cognition, and in turn visual processing. The most accepted explanation involves the amygdala, and its direct connection to the prefrontal and sensory cortices (LeDoux, 1996, p. 287). It is assumed that perceptual information is passed on to the amygdala before it is completely processed, and the perceptual coding of information

in is modified in turn (Zeelenberg et al., 2006). This physiological explanation may account for the recent research indicating that visual stimuli are affected by emotion, to which the amygdala is closely related.

Based on the assumption that the emotional salience of a stimulus determines the level of attention it receives, it can be posited that emotion effects basic perception. Using facial expressions to elicit emotional responses from participants, Phelps et al. (2006) showed that the threshold for contrast sensitivity was lowered in a visual search task after fearful faces were shown. This research indicates that basic visual acuity is enhanced when a fearful emotion is present, and meshes well with the phenomenon of automatic vigilance and the involvement of the amygdala.

The interplay between emotion, perception, and automatic vigilance may account for the phenomenon of mood congruence. Mood congruence can be described as the tendency to allocate attentional resources toward emotionally salient stimuli consistent with one's current mood (Eckhardt & Cohen, 1997). A robust finding is that individuals who are suffering from an emotional disorder have higher interference indices in a Stroop task when the stimuli are congruent with their emotional state (Gilboa-Schechtman, Revelle, & Gotlib, 2000). This interference of negative materials can be attributed to mood congruence, or, more specifically, Person and Miranda's (1992) mood-state hypothesis. This hypothesis states that activation of negative mood increases the likelihood of mood-relevant cognitive processes being activated and accessed. Whether these findings apply to positive moods as well as negative moods is debated. Baumeister, Bratslavsky, Finkenauer, & Vohs (2001) infer that stimuli of equal hedonic weight that are opposite in hedonic sign, will evoke unequal affective reactions. In other words, negative emotions are stronger than positive emotions, and so more attention is allocated to them. Others hold that mood affects attentional processing in both positive and negative affective states (Gilboa-Schechtman et al., 2000). For instance, Fox, Griggs, and Mouchlianitis (2007) explain the dichotomous nature of mood congruence by stating that the subjective emotional salience of a stimulus allocates more attention, rather than the emotion associated with that stimulus.

The purpose of the present study was two-fold. While there is evidence suggesting enhanced visual acuity occurs when a fearful mood is induced (Phelps et al., 2006), there is a need to determine if more complex processes can be enhanced by emotional stimuli. Also, the role of mood congruence in emotionally enhanced visual processing needs to be investigated. This was done by inducing an emotional state, and by using a visual search task. It was hypothesized that (a) that participants would locate targets faster when induced into a mood state; and (b) when induced into an emotional state the participants would be able to locate the fearful target more quickly.

Method

Participants

Thirty-five females and 29 males, ranging in age from 18-22 years, participated in this study. They were recruited from undergraduate psychology classes, and were given extra credit if offered by their professor.

Materials

Participants first completed a short survey consisting of a demographic questionnaire (age, sex, and ethnicity) and two consent forms. Controlling software was used to present both the mood-inducing faces and the visual search task, and was presented on a computer monitor. This task is referred to as an affective priming visual search task, or APVST.

Fearful, happy, and neutral faces from the Pictures of Facial Affect series (Ekman & Friesen, 1976) were presented in order to induce a particular mood state. To determine which faces evoke the most emotional response a short survey was given to students who did not participate in the experiment. This survey consisted of two sets of five faces, one set showing "happy" faces and one set showing "fearful" faces. Each face was rated on a 7-point Likert scale asking how happy or frightened the face appeared. It was assumed that the higher emotive rating a picture received the more it would induce an emotional state, so the highest scoring pictures for

the joyful and fearful categories were chosen to induce a mood state.

Every trial had a common "wooded-area" background and was presented in grayscale to reduce experimental confounds. The background was divided into 6 sections using a visible grid, and the sections were numbered from 1-6. A threatening stimulus (a spider) or a positive stimulus (a flower) was located in one of the six sections. These stimuli were taken from images online, and were also reduced to grayscale. The spider was a wolf spider, and the flower was a daisy.

Design and Procedure

The study used a 2 X 3 mixed design, crossing the variables of stimulus valance and mood state. The three levels of the mood induction stimuli were fearful, positive, or neutral faces. The participant first completed the demographic survey and signed the consent forms, keeping one for future reference. They were then explained their participant rights, the purpose of the study, the participant instructions, and were asked if they had any questions.

The APVST took place in a research cubicle, and took approximately 15 minutes to complete. A fixation cross first appeared on the monitor, and the participant was prompted to focus on the fixation cross and press the spacebar in order to proceed. The mood-inducing stimuli were then presented for 500 ms. The order of presentation for the mood-inducing stimuli was determined by a Latin square to control for sequential effects. An interstimulus interval (ISI) consisting of a blank screen was then presented for 2000 ms, which allowed time for the mood to be thoroughly induced (Gilboa-Schechtman et al., 2000). After the ISI, the visual search task began. The wooded background was presented, with the appropriate search stimulus being in one of the 6 grids. Two variations of the APVST were used, one with a threatening stimulus and one with positive stimulus, and each of the three types of mood induction stimuli (fearful, happy, or neutral faces) were presented 6 times. This produced 18 trials per experimental condition. The search stimuli were found equally in each section of the grid for each of the 18 trials, and were presented randomly to control for sequential effects. After the participant correctly reported the grid location of the search stimuli, the reaction time was recorded and the next trial began. A filler task consisting of questions about the computer program was completed between each mood-induction condition in order to remove the induced mood. Upon completion of the APVST the participant was then debriefed, and any questions they had were answered.

Results

Mean reaction times for each type of search target and levels of mood induction were calculated and are plotted in Figure 1. Inspection of the graph suggests that search times for the fearful target were faster than those of the joyful target, and that type of mood induced had no effect.

The search times were analyzed using a two-way ANOVA with repeated measures on the mood induction variable was used. While there was no significant main effect found for mood induction or an interaction between variables, the fearful target was found significantly faster than the joyful target, $f(1,62) = 9.29$, $p = .003$, $\text{eta}^2 = .13$.

Discussion

This study examined the relationship between the cognitive theories of automatic vigilance and mood congruence on perceptual abilities. Based on previous research (Phelps et al., 2006; Eckhardt & Cohen, 1997; Gilboa-Schechtman et al, 2000) it was hypothesized that participants would find fearful search targets more quickly than joyful or neutral search targets, and that mood induction would decrease search time. The impact of mood congruence, or the ability to find the search targets associated with the induced mood state faster, was also examined. The finding that the fearful targets were found faster can most easily be explained in evolutionary terms. It may be that the process of automatic vigilance evolved to aid earlier species in survival, making them more aware of cues and stimuli in their environment that were threatening. The amygdala's role is evidence of this, since it developed early in animals and its modification of incoming perceptual information may guide how much emotional salience is attached to specific

emotional cues (LeDoux, 1996, p. 287).

Mood induction seemed to have little effect on search times. Two possible explanations exist for this finding: either mood congruence in a visual search task does not occur, or the method for mood induction was not effective. Perhaps the evolutionary process of automatic vigilance overrides mood congruence, since it has long been used to distinguish between threatening and non-threatening stimuli only. This notion would lend support to those who consider mood congruence to only occur with negative mood states (Baumeister et al., 2001). While this may be the case, the latter possibility must also be considered. The mood induction method was replicated from Phelps et al. (2006), which examined fear on basic visual perception. In examining the effect of different emotions on more complicated visual tasks, different methodology may be more effective. The faces used may be ineffective in this context, may need to be presented for longer periods of time, or may need to be presented only once versus every trial. The ISI may also be an issue. Presenting the ISI for 2000 ms, with the assumed result of a more complete induction, may have been too long and the emotion generated by the face may have dissipated.

Future research might examine the type of search target used to produce evidence supporting mood congruence in a visual search task. The targets in the study were found on the Internet, and consisted of a daisy and a spider. While the relative size of each target matched, the shape of the spider was more linear than that of the daisy. This may have aided the participants searching for the spider.

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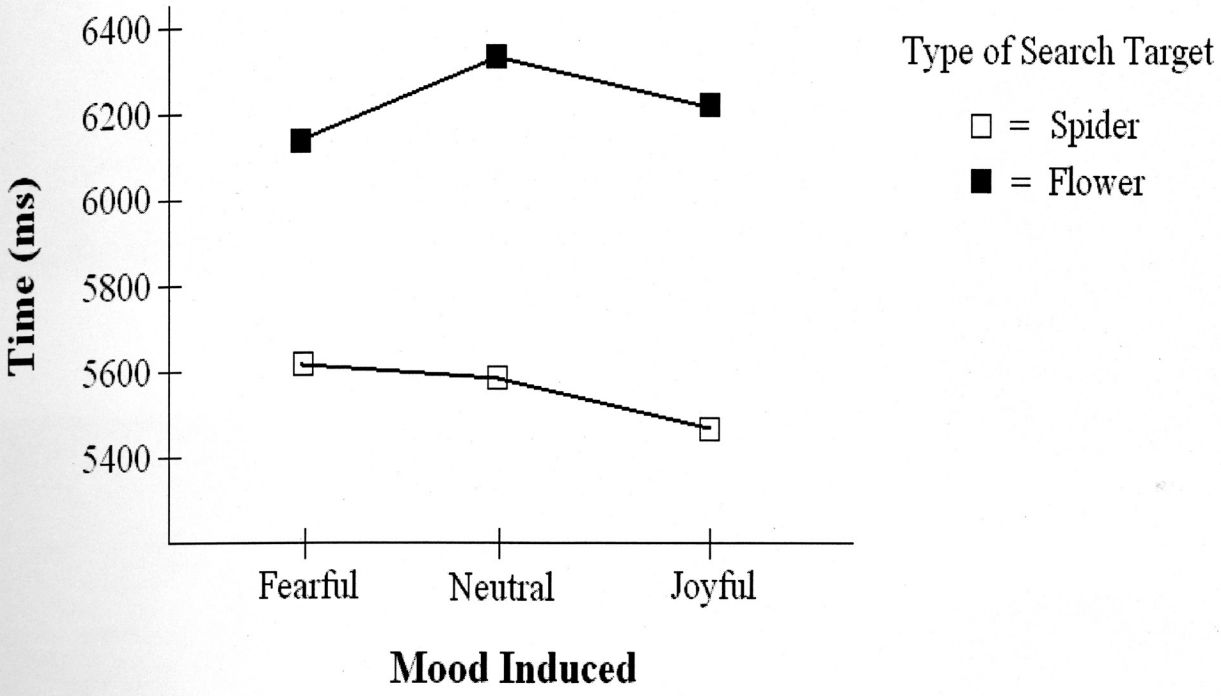
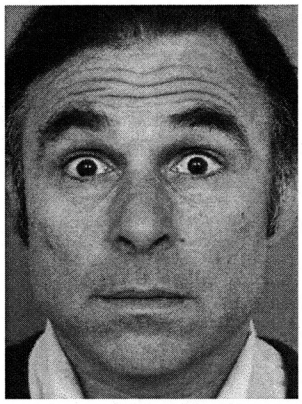
Figure 1

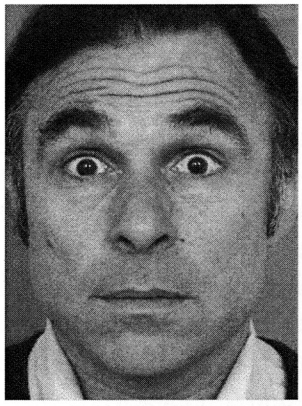

6400
6200
6000
5800
5600
5400
Time (ms)
Fearful
Neutral
Joyful
Mood Induced
Type of Search Target
□ = Spider
■ = Flower

Appendix 1

Please rate how **frightened** each face looks, with "1 being the **least** frightened, and "7 being the **most** frightened.



1 2 3 4 5 6 7



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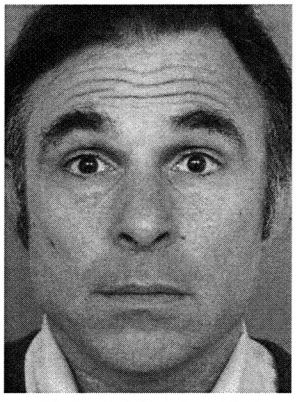
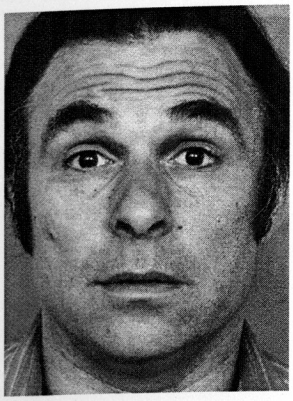
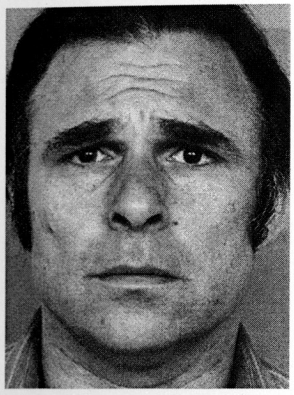


1 2 3 4 5 6 7

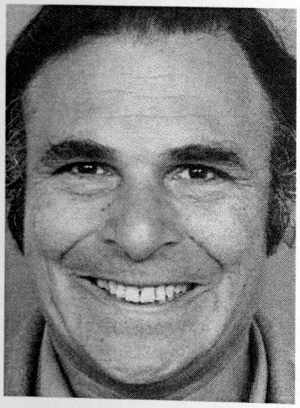


1 2 3 4 5 6 7

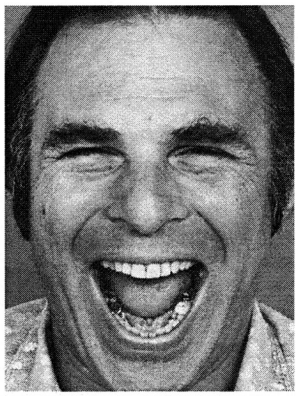


1 2 3 4 5 6 7

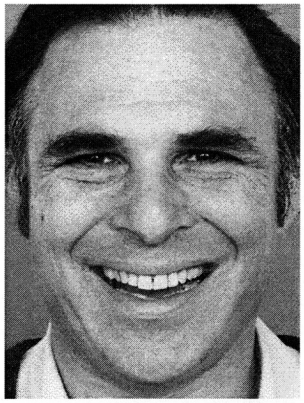
Please rate how **happy** each face looks, with "1 being the **least** happy, and "7 being the **most** happy.



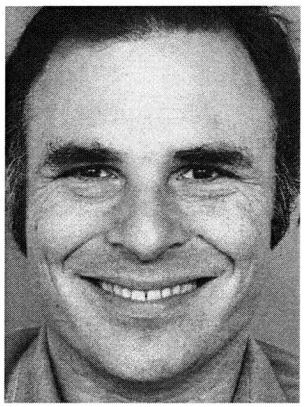
1 2 3 4 5 6 7



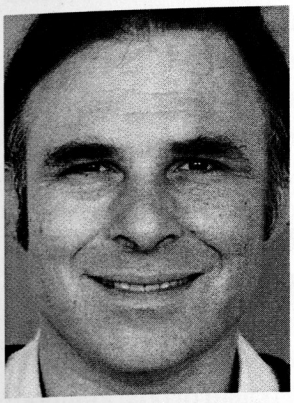
1 2 3 4 5 6 7



1 2 3 4 5 6 7



1 2 3 4 5 6 7



1 2 3 4 5 6 7