Attentional Bias to Brief Threat-Related Faces Revealed by Saccadic Eye Movements

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According to theories of emotion and attention, we are predisposed to orient rapidly toward threat. However, previous examination of attentional cueing by threat showed no enhanced capture at brief durations, a finding that may be related to the sensitivity of the manual response measure used. Here we investigated the time course of orienting attention toward fearful faces in the exogenous cueing task. Cue duration (20 ms or 100 ms) and response mode (saccadic or manual) were manipulated. In the saccade mode, both enhanced attentional capture and impaired disengagement from fearful faces were evident and limited to 20 ms, suggesting that saccadic cueing effects emerge rapidly and are short lived. In the manual mode, fearful faces impacted only upon the disengagement component of attention at 100 ms, suggesting that manual cueing effects emerge over longer periods of time. Importantly, saccades could reveal threat biases at brief cue durations consistent with current theories of emotion and attention.

Keywords: facial expressions, attention, saccades

Current evolutionary theories of emotion and attention state that we are predisposed to orient very rapidly toward threat (Mathews & Mackintosh, 1998; Öhman & Mineka, 2001). Rapid and accurate identification of threat-related information is critical for survival. Therefore, it has been proposed that threat-related stimuli have a special propensity to attract an observer’s attention. Currently, there is an ongoing debate about the specific constituents of attentional bias toward threat. Attending to a new stimulus consists of three components: (a) the initial orienting of attention toward the stimulus, (b) engaging attention with the stimulus, and (c) disengaging attention from the stimulus (Posner, 1980). The first two components are related to attentional capture by threat, and the third is related to increased difficulties in shifting attention away from threat. Enhanced attentional capture is thought to be an encapsulated process (Fox, Russo, Bowles, & Dutton, 2001), meaning that it is relatively impenetrable to cognitive control and unaffected by emotional meaning. This runs counter to theories (Mathews & Mackintosh, 1998; Öhman & Mineka, 2001) that propose a quick orienting of attention to threatening stimuli, resulting in improved awareness of threat in the environment. Impaired attentional disengagement may be related to difficulties in task performance in the presence of threat (Koster, Crombez, Verschueren, Van Damme, & Wiersma, 2006).

The ability of threat-related stimuli to influence the capture and disengagement components of attention can be measured by using the exogenous cueing paradigm. In its original form (Posner, 1980), a cue stimulus is presented in the left or right visual field and a target is presented in the same (valid) or opposite (invalid) spatial location where the cue had appeared. In comparison with neutral, no cue, trials, faster reaction times for the target in valid trials are thought to reflect attentional capture by the cue, whereas slower reaction times in invalid trials are thought to indicate difficulty in disengaging attention from the cue. In the emotional modification of the exogenous cueing task, the emotional meaning (e.g., threatening or neutral) of the cue is varied, enabling an investigation into attentional capture and disengagement as a function of cue valence. Several studies have investigated attentional cueing by threat with inconsistent findings. For example, difficulty in disengaging attention from threat has been demonstrated by slower responses on invalid trials containing threat-related cues than on invalid trials containing neutral cues (Fox et al., 2001; Fox, Russo, & Dutton, 2002; Yiend & Mathews, 2001). Alternatively, other studies have demonstrated attentional capture by threat, as is evidenced by faster responses on valid trials containing threat-related cues in comparison with valid trials containing neutral cues (Koster, Crombez, Van Damme, Verschueren, & De Houwer, 2004; Koster, Crombez, Verschueren, Vanvolsem, & De Houwer, 2007).

Importantly, most of the above studies have used manual responses and cue durations ranging from 100 ms to 500 ms. Long cue durations (e.g., 500 ms) allow for more detailed processing and have been shown to be involved in sustaining attention (e.g., delayed disengagement) but not capture by threat (Yiend & Mathews, 2001). Conversely, shorter cue durations (e.g., 100–300 ms) produce mixed results, with some studies showing both capture and disengagement effects in anxious (Koster et al., 2006) and normal (Koster et al., 2004) individuals, while in others only disengagement effects have been found (Fox et al., 2001, 2002). Furthermore, in previous emotional exogenous cueing studies, there are differences in cue–target onset asynchrony (e.g., 150–960 ms), which can have an effect on reaction time owing to differences in the time course of attentional deployment.
However, emotion theories (Mathews & Mackintosh, 1998; Öhman & Mineka, 2001) posit that fast attentional orienting toward threat is most adaptive immediately after its presentation. Therefore, on the basis of theory, one would assume that at rapid cue durations the attentional capture component should be modulated by threat. Despite this, studies using rapid cue presentations (e.g., 28 ms) have failed to find either enhanced attentional capture or difficulty in disengaging attention from threat (Koster et al., 2007). The lack of facilitated capture at brief cue durations has been interpreted as a short cue presentation being insufficient to extract the threatening nature of the stimulus. However, this is discrepant to findings that have shown that the amygdala responds to masked threat-related faces presented briefly (Pessoa, McKenna, Gutierrez, & Ungerleider, 2002), and early electrophysiological markers react to threat-related expressions after short presentation (Fox, Derakshan, & Shoker, 2008). Most important, the encapsulation and associated absence of enhanced capture by threat at brief presentations does not fit with current theories (Mathews & Mackintosh, 1998; Öhman & Mineka, 2001) that propose a fast orientation of attention toward threat.

One possible explanation for the lack of facilitated capture at brief durations is the sensitivity of the manual response measure that is used. Recent studies have shown that there are differences in manual and saccadic responses for detection of briefly presented threat-related and neutral stimuli (Bannerman, Milders, de Gelder, & Sahraie, 2009; Bannerman, Milders, & Sahraie, 2009). Notably, saccadic biases toward threat (i.e., faster detection of fearful stimuli than of neutral stimuli) emerged at brief (20 ms) stimulus durations, whereas manual threat-related biases emerged only at longer (500 ms) stimulus durations, suggesting that saccades are sensitive to threat at shorter stimulus durations.

The relative speed of saccades means that they are initiated on the basis of less information than are manual hand movements, suggesting that they can reveal earlier stages of processing than can manual responses (Hunt, van Zoest, & Kingstone, 2010). In terms of assessing valence, a parsimonious model would imply that both saccadic and manual responses access a unified mechanism in a similar fashion. Alternatively, the response parameter of interest may change when different response modes and stimulus durations are used in an attentional manipulation task. Although several studies have examined saccades toward threat-related and neutral stimuli (Hermans, Vansteenkoven, & Eelen, 1999; Hunt, Cooper, Hurg, & Kingstone, 2007; Kissler & Keil, 2008; Nummenmaa, Hyöna, & Calvo, 2006), these studies did not directly compare saccadic and manual responses.

In the current study we investigated attentional cueing by peripherally presenting threat-related faces. We systematically varied the response mode (saccadic response vs. manual response) and duration (20 ms vs. 100 ms) of the cue to elucidate the time course of attentional cueing by threat-related information by different response systems.

**Method**

**Participants**

Twenty participants (10 women, 10 men; mean age = 20.3 years, range = 18–24) took part. All had normal or corrected-to-normal vision and normal state ($M = 33.7, SD = 6$) and trait ($M = 35.7, SD = 5$) anxiety levels as measured by the State–Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

**Materials**

The stimuli consisted of grayscale face pictures of 10 individuals (5 men and 5 women) taken from a standard set (Ekman & Friesen, 1976). Each individual portrayed two facial expressions, fearful and neutral. The face images subtended $7.5° \times 11.2°$, at a viewing distance of 37 cm, and were used as cues in the experiment. A $1.5° \times 1.5°$ fixation cross served as the target stimulus. Both cue and target stimuli were presented against a uniform white background and were positioned to the left or the right of a fixation cross, centered at $9.2°$ eccentricity. All stimuli were presented on a 21-inch CRT monitor with 100 Hz refresh rate using a SVGA graphics card (Cambridge Research Systems, U.K.) in a dimly lit room (10 lux).

**Procedure**

For the saccade mode each trial commenced with a fixation point appearing in the center of the screen for 1000 ms, followed by a 200-ms gap period (blank screen), thought to speed up saccade initiation (Fischer & Weber, 1993). The cue stimulus (fearful or neutral face) was then presented on the left or right side of the screen for either 20 ms or 100 ms. The target (a plus sign) was presented immediately after on the left or right side of the screen for 1000 ms. We chose 100 ms as our longer cue duration because previous studies using this duration have found evidence for both enhanced attentional capture and delayed disengagement from threat in the normal population (Koster et al., 2007). The participants’ task was to saccade, as quickly as possible, toward the target. Each participant performed 320 trials, divided into eight blocks of 40 trials each (four blocks at 20-ms cue duration; four blocks at 100 ms cue duration). Cue duration order was counterbalanced between participants. Fifty percent (160) of the experimental trials were valid (i.e., the cue and target appeared in the same spatial location), and 50% were invalid (i.e., the cue and target appeared in opposite spatial locations). Participants were informed that the cue would predict the location of the target on some, but not all, of the trials. The experimental protocol for the manual mode was exactly the same as those for the saccade mode except that participants had to indicate the location of the target by pressing one of two buttons on a response box as quickly and as accurately as possible. The ordering of the response mode was counterbalanced.

**Response Recording**

Eye movements were monitored and recorded using electrooculography (EOG). EOG relies upon the steady (approximately 0.4–1.0 mV) difference in potential that exists between the cornea and retina, resulting in an electrical field near the eye. This field is linearly related to eye position up to 30° from fixation (Andreatsi, 1995). Horizontal eye movements were recorded using 4-mm electrodes applied to the participants’ left and right canthi and ear (ground), using the DC method and a sampling rate of 1000 Hz (ACKNOWLEDGE v. 3.59; Biopac Systems, Goleta, CA).
As EOG was continuously recorded, raw EOG files from each participant were processed using EOG decoder software, which flags the most salient data (e.g., when cue and targets were present on screen) and separates the data into the different conditions (e.g., fear valid, fear invalid, neutral valid, and neutral invalid) for further analysis. EOG signals for these different conditions were then normalized before saccadic reaction times (SRTs) were computed. As a first criterion, only saccades on correct trials that exceeded an amplitude threshold of 30 mV were analyzed. SRTs were determined as the time difference between the onset of target (Time 0) and the start of the saccade toward the target. Saccade latencies exceeded more than 3 SD above the mean were discarded. In the saccade mode, anticipatory saccades (<80 ms) were also discarded.

**Results**

Mean reaction times (RTs) are displayed in Figures 1A (saccade mode) and 1B (manual mode). Mean correct RTs were analyzed by a 2 (mode: saccadic vs. manual response) × 2 (cue duration: 20 ms, vs. 100 ms) × 2 (cue valence: fearful vs. neutral) × 2 (cue validity: valid vs. invalid) analysis of variance (ANOVA). There were main effects for mode, $F(1, 19) = 289.26, MSE = 2423994, p < .001, \eta_p^2 = .94$, for cue duration, $F(1, 19) = 65.09, MSE = 241615, p < .001, \eta_p^2 = .77$, and for cue validity, $F(1, 19) = 47.49, MSE = 58726, p < .001, \eta_p^2 = .71$, showing that participants were faster overall in the saccade mode ($M = 243$ ms, $SD = 33$) than in the manual mode ($M = 417$ ms, $SD = 42$); faster at 20 ms ($M = 303$ ms, $SD = 30$) than at 100 ms ($M = 358$ ms, $SD = 36$) cue duration; and when the face cue was valid ($M = 317$ ms, $SD = 36$) than when it was invalid ($M = 344$ ms, $SD = 25$), respectively. There was a significant four-way interaction of Mode × Cue Duration × Cue Valence × Cue Validity, $F(1, 19) = 24.13, MSE = 2514, p < .001, \eta_p^2 = .56$. To interpret the four-way interaction, we conducted separate ANOVAs for each response mode.

**Saccade Mode**

In the saccade mode a 2 (cue duration: 20 ms, vs. 100 ms) × 2 (cue valence: fearful vs. neutral) × 2 (cue validity: valid vs. invalid) ANOVA showed significant main effects of cue duration, $F(1, 19) = 34.43, MSE = 128312, p < .001, \eta_p^2 = .64$, with faster SRTs at 20 ms ($M = 215$ ms, $SD = 26$) than at 100 ms ($M = 271$ ms, $SD = 49$), and significant main effects of cue validity, $F(1, 19) = 26.52, MSE = 61976, p < .001, \eta_p^2 = .58$, with faster SRTs on valid trials ($M = 223$ ms, $SD = 47$) than on invalid trials ($M = 263$ ms, $SD = 23$). The interaction between cue duration × cue valence × cue validity was also significant, $F(1, 19) = 11.75, MSE = 1776, p < .01, \eta_p^2 = .38$. To interpret the three-way interaction, separate 2 (cue valence) × 2 (cue validity) ANOVAs were performed at each cue duration.

At 20 ms cue duration, there was a significant main effect of cue validity, $F(1, 19) = 22.82, MSE = 13520, p < .001, \eta_p^2 = .55$. SRTs were significantly faster on valid trials ($M = 202$ ms, $SD = 33$) than on invalid trials ($M = 228$ ms, $SD = 23$). More important,
a significant interaction of Cue Valence × Cue Validity, $F(1, 19) = 34.49$, $MSE = 2420$, $p < .001$, $\eta^2_p = .65$, was observed. To examine this interaction further, we conducted paired samples $t$ tests to assess attentional capture and disengagement effects. Emotional effect on attentional capture was investigated by comparing the mean SRT for fearful and neutral face cues on valid cue trials. At 20 ms cue duration, SRTs following valid fearful face cues ($M = 195$ ms, $SD = 35$) were faster than were SRTs following valid neutral face cues ($M = 208$ ms, $SD = 32$), $t(19) = 3.90$, $p < .01$, $d = .87$, indicating enhanced attentional capture by fearful faces. Emotional effect on attentional disengagement was assessed by comparing the mean SRT for fearful and neutral face cues on invalid cue trials. At 20 ms cue duration, SRTs following invalid fearful face cues ($M = 232$ ms, $SD = 24$) were slower than were SRTs following invalid neutral face cues ($M = 223$ ms, $SD = 24$), $t(19) = 3.91$, $p < .01$, $d = .87$, indicative of difficulty in disengaging attention from fearful faces. Formal statistical analysis of accuracy levels (percentage of correct eye movements toward the target) was consistent with this view in that accuracy levels were significantly lower on invalid trials when the face cue was fearful ($M = 86.2\%$, $SD = 10$) than when it was neutral ($M = 92.3\%$, $SD = 8$), $t(19) = 3.51$, $p < .01$, $d = .78$.

At 100 ms cue duration, the 2 (cue valence) × 2 (cue validity) ANOVA revealed a main significant effect of cue validity, $F(1, 19) = 16.37$, $MSE = 55599$, $p < .001$, $\eta^2_p = .46$, with significantly faster SRTs on valid trials ($M = 245$ ms, $SD = 74$) than on invalid trials ($M = 298$ ms, $SD = 33$) trials. However, the interaction of Cue Valence × Cue Validity was nonsignificant, $F(1, 19) = .64$, $MSE = 108$, $p > .4$, $\eta^2_p = .03$. Notably, at 100 ms cue duration there were no significant differences in SRT between fearful and neutral faces on valid, $t(19) = .12$, $p = .907$, $d = .03$, power = .05, or invalid, $t(19) = 1.12$, $p = .275$, $d = .25$, power = .19, cue trials and no significant differences in the accuracy of responses, $t(19) = 1.60$, $p = .127$, $d = .36$, power = .46, between fear and neutral faces on invalid trials. No enhanced attentional capture by, or delayed disengagement from, fearful faces was observed at 100 ms cue duration in the saccade mode.

**Manual Mode**

In the manual mode a 2 (cue duration: 20 ms vs. 100 ms) × 2 (cue valence: fearful vs. neutral) × 2 (cue validity: valid vs. invalid) ANOVA showed significant main effects of cue duration, $F(1, 19) = 60.66$, $MSE = 113529$, $p < .001$, $\eta^2_p = .76$, and cue validity, $F(1, 19) = 28.59$, $MSE = 8791$, $p < .001$, $\eta^2_p = .60$. Manual reaction times (MRTs) were significantly faster at 20 ms ($M = 391$ ms, $SD = 47$) than at 100 ms ($M = 444$ ms, $SD = 41$) cue duration and on valid trials ($M = 410$ ms, $SD = 41$) than on invalid trials ($M = 425$ ms, $SD = 43$), respectively. There was also a significant three-way interaction of Cue Duration × Cue Valence × Cue Validity, $F(1, 19) = 6.93$, $MSE = 828$, $p < .05$, $\eta^2_p = .27$.

A 2 (cue valence) × 2 (cue validity) ANOVA performed at 20 ms cue duration showed a main effect of cue validity, $F(1, 19) = 14.49$, $MSE = 2856$, $p < .01$, $\eta^2_p = .43$, with faster MRTs on valid trials ($M = 385$ ms, $SD = 47$) than on invalid trials ($M = 397$ ms, $SD = 49$), but no significant interaction of Cue Valence × Cue Validity, $F(1, 19) = .33$, $MSE = 36$, $p > .5$, $\eta^2_p = .02$. Paired-samples $t$ tests showed no significant differences in MRT between fearful and neutral face cues on valid trials, $t(19) = 1.45$, $p = .164$, $d = .32$, power = .28, or invalid trials, $t(19) = .22$, $p = .827$, $d = .05$, power = .06, revealing that no enhanced attentional capture by, or delayed disengagement from, fearful faces was observed at 20 ms cue duration in the manual mode.

At 100 ms cue duration, the 2 (cue valence) × 2 (cue validity) ANOVA revealed a main effect of cue validity, $F(1, 19) = 28.87$, $MSE = 6267$, $p < .001$, $\eta^2_p = .60$, with faster MRTs on valid trials ($M = 435$ ms, $SD = 41$) than on invalid trials ($M = 453$ ms, $SD = 42$), and a significant interaction of Cue Valence × Cue Validity, $F(1, 19) = 9.89$, $MSE = 1201$, $p < .01$, $\eta^2_p = .34$. Paired-samples $t$ tests showed that at 100 ms cue duration, there were no significant differences in MRT between fearful and neutral faces on valid cue trials, $t(19) = 1.59$, $p = .129$, $d = .36$, power = .33. However, MRTs following invalid fearful faces were slower ($M = 458$ ms, $SD = 43$) than were MRTs following invalid neutral faces ($M = 447$ ms, $SD = 42$), $t(19) = 4.16$, $p < .01$, $d = .93$, suggesting that difficulty in disengaging attention from fearful faces was evident at 100 ms cue duration.

In summary, the data reported showed divergence of the time course for saccadic and manual cueing responses. In the saccade mode, both enhanced capture and slower disengagement of attention from fearful faces was observed only at 20 ms cue duration. Conversely, in the manual mode, the valence of the face cue did affect reaction time, but this effect was evident only in the disengagement component of attention at 100 ms cue duration. To rule out any low-level image differences that may have accounted for the cueing effects, we examined responses toward upright and inverted fearful face cues in a control experiment ($n = 20$; 13 women and 7 men; mean age = 24.1 years, range = 19–28). Inversion interferes with the holistic processing of faces (Tanaka & Farah, 1993) and the recognition of facial emotion (Searcy & Bartlett, 1996) while maintaining feature differences. If the cueing effects observed with fearful faces are due to low-level features, then responses toward upright and inverted fearful face cues should be similar because all of the same features are present in both images. Data are plotted in Figures 1C (saccade mode) and 1D (manual mode), and analysis shows that upright and inverted face cue responses show divergence. Notably, upright faces were associated both with enhanced attentional capture (valid cue trial: upright face $M = 208$ ms, $SD = 36$; inverted face $M = 228$ ms, $SD = 25$), $t(19) = 4.07$, $p < .01$, $d = .91$, and with delayed disengagement (invalid cue trial: upright face $M = 248$ ms, $SD = 30$; inverted face $M = 233$ ms, $SD = 31$), $t(19) = 5.51$, $p < .001$, $d = 1.14$, in comparison with inverted faces at 20 ms in the saccade mode. Upright faces were also associated with delayed disengagement (invalid cue trial: upright face $M = 380$ ms, $SD = 34$; inverted face $M = 366$ ms, $SD = 40$), $t(19) = 3.15$, $p < .01$, $d = .70$, at 100 ms in the manual mode. Thus, the valence of a face cue can influence attentional effects in an exogenous cueing task, while not being attributable to low-level features.

**General Discussion**

The present study examined the time course of emotional attentional cueing using saccadic and manual responses. The data demonstrate enhanced attentional capture by, and difficulty disengaging attention from, threat-related cues under specific conditions. Notably, in the saccade mode, both the capture and disen-
gagement components of attention were modulated by fearful facial expressions. This modulation was limited to very rapid (20 ms) cue durations, because no saccadic emotional modulation (capture or disengagement) was observed at 100 ms cue duration. Conversely, in the manual mode, no emotional modulation (capture or disengagement) was observed at 20 ms cue duration. However, at the longer cue duration (100 ms), the valence of the face cue did modulate attention, but this effect was evident only for the disengagement component. Overall, the results suggest that fearful faces have the power both to capture and to subsequently hold attention.

Of particular interest was the divergent time course of saccadic and manual cueing effects. At 20 ms, the saccadic RT data showed enhanced attentional capture and impaired disengagement from fearful faces. By contrast, the manual RT data at 20 ms revealed no cueing modulation. This is consistent with previous studies that have used short (e.g., 28 ms) cue durations and have failed to find any effects of attentional modulation by emotion using manual responses (Koster et al., 2007). Such findings were initially interpreted as the duration being too short an interval to allow sufficient time for extracting the threatening value of a stimulus. However, our saccade data show that brief cue durations are sufficient to extract threat-related information and that this threat information can subsequently modulate cueing effects. Fast attentional orienting to briefly presented threat is of high relevance for safety and is in line with ERP studies that have shown that early electrophysiological markers react to threat-related information after very short presentation times (Fox et al., 2008). Interestingly, it has been argued that the exogenous cueing task is especially sensitive to attentional disengagement effects instead of to attentional capture (Fox et al., 2001, 2002). It has been suggested that the attentional capture component is an encapsulated process that is not modulated by the emotional meaning of the cue (Fox et al., 2001). However, our saccade data show that it is not an encapsulated process, in that facilitated attentional capture with threat-related information can be observed in the emotional exogenous cueing paradigm. This finding fits well with current theories (Mathews & Mackintosh, 1998; Öhman & Mineka, 2001) that state that we are predisposed to orient toward threat, even when it is presented briefly. Such effects are not surprising when one considers that the very nature of saccades (e.g., rapid and naturalistic) make them ideal for examining capture by different stimuli. Nevertheless, the fact that no emotional modulation was observed at 100 ms cue duration in the saccade mode may suggest that enhanced attentional orienting to and increased attentional dwell time on threat-related information, at least when measured with saccades, is a short-lived phenomenon. It appears that at 100 ms cue duration in the saccade mode we can successfully inhibit threat-related information. This may be due to eye movements, which begin sampling at a time point earlier in the target localization process than do manual responses and may begin to function at ceiling, thus revealing no modulation by threat.

In contrast, the manual data at 100 ms cue duration did reveal cueing effects, with fearful faces leading to delayed disengagement in comparison with neutral faces. This is consistent with previous studies using longer cue durations (e.g., 100 ms, 250 ms, and 500 ms), which have found that threat-related stimuli are especially effective in holding visual attention (Fox et al., 2001, 2002; Yiend & Mathews, 2001). Such findings were initially reported only in highly anxious individuals (but see Koster et al., 2004, 2007). However, our data show that threat-related information influences the capture and disengagement components of attention with saccades and the disengagement component of attention with manual responses in normal, healthy individuals. These findings are consistent with attentional models of threat that posit that threat-related information is prioritized for processing in all individuals (Mathews & Mackintosh, 1998).

The different time course of saccadic and manual cueing effects is not consistent with a parsimonious model that a single, central process affects all reaction time measures in a similar fashion. A recent report (Bompaas & Sumner, 2008) documenting reaction time differences between luminance and short-wavelength-specific stimuli, with RTs being twice as long for manual responses than for saccades, also provides evidence against the parsimonious view. Importantly, this report may point toward saccades being driven more by fast signals than are manual responses. Fast signals are also associated with subcortical processing via the superior colliculus (SC). Notably, the retinotectal pathway, which projects directly from the retina to the SC, plays a major role in saccade generation (Bompaas & Sumner, 2008). Moreover, there is evidence of a subcortical route to the amygdala involved in rapid, survival-enhancing responses toward threat (Le Doux, 1996). Of importance here are the SC and the pulvinar, whose nuclei are activated by viewing fearful faces (Morris, de Gelder, Weiskrantz, & Dolan, 2001). Interestingly, the subcortical route functions optimally when stimuli are briefly flashed and capture attention (Le Doux, 1996), consistent with the larger saccadic cueing effects observed at brief (20 ms), as opposed to longer (100 ms), cue durations observed in the current study.

In summary, the current study shows that the quick capturing of attention by threat signals is dependent upon response mode. Saccades influence both the capture and disengagement components of attention, but only at very rapid (20 ms) cue durations. Manual responses, conversely, do not show cueing effects at rapid cue durations; they instead influence the disengagement component of attention over more extended periods of time.

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