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Selective looking at natural scenes: Hedonic content and gender☆

Margaret M. Bradley [a,*], Vincent D. Costa [b], Peter J. Lang [a]

[a] University of Florida, Gainesville, FL, United States
[b] National Institute of Mental Health, Bethesda, MD, United States

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ABSTRACT

Choice viewing behavior when looking at affective scenes was assessed to examine differences due to hedonic content and gender by monitoring eye movements in a selective looking paradigm. On each trial, participants viewed a pair of pictures that included a neutral picture together with an affective scene depicting either contamination, mutilation, threat, food, nude males, or nude females. The duration of time that gaze was directed to each picture in the pair was determined from eye fixations. Results indicated that viewing choices varied with both hedonic content and gender. Initially, gaze duration for both men and women was heightened when viewing all affective contents, but was subsequently followed by significant avoidance of scenes depicting contamination or nude males. Gender differences were most pronounced when viewing pictures of nude females, with men continuing to devote longer gaze time to pictures of nude females throughout viewing, whereas women avoided scenes of nude people, whether male or female, later in the viewing interval. For women, reported disgust of sexual activity was also inversely related to gaze duration for nude scenes. Taken together, selective looking as indexed by eye movements reveals differential perceptual intake as a function of specific content, gender, and individual differences.

1. Introduction

Affective cues in the visual field naturally draw and hold attention (e.g., Calvo and Lang, 2004; Rösler et al., 2005; LaBar et al., 2000; Nummenmaa et al., 2009) and we have interpreted this "natural selective attention" as reflecting activation of appetitive and defensive neural systems that have evolved to engage attention and arousal in the service of selecting an appropriate action (Bradley, 2009; Lang et al., 1997). Whereas initial attention capture is typically conceptualized as a relatively reflexive process, sustained processing of emotion-inducing cues, particularly in terms of continued perceptual intake, should reflect different functional responses that are optimal in specific affective contexts. In the current study, we monitored eye movements in a choice viewing paradigm which presented a pair of pictures (3 s) in which an affective "content" picture depicted either bodily mutilation, contamination, human threat, appetizing food, nude males, or nude females, together with a "control" picture that was always neutral in hedonic valence. The direction and duration of eye fixations on each picture in a pair were measured across the viewing interval as men and women looked at specific affective contents.

Scenes of both contamination (e.g., feces, vomit, etc.) and mutilation reliably elicit descriptions of disgust (Bradley et al., 2001b; Libkuman et al., 2007), which is classically conceptualized as a rejection response (evolutionarily associated with oral rejection of bad food; Rozin et al., 2000), which could prompt perceptual avoidance. On the other hand, some studies of attentional bias report greater exogenous attention capture for disgusting, compared to fear, stimuli. In these studies (see Carretié, 2014, for an overview; Carretié et al., 2011), emotional stimuli are presented as irrelevant distractors in the context of an ongoing primary task, and attention capture inferred by disruption of task performance (i.e., speed or accuracy). For example, Cisler et al. (2009) reported poorer accuracy on primary task performance 480 ms following the presentation of a disgust, compared to a fear, word, but not earlier or later. Using disgusting and fearful pictures (rather than words), van Hooff et al. (2013) reported reduced detection accuracy for probes presented in the context of disgusting, compared to fear, scenes, but only when presented 200 ms after picture onset, leading them to suggest that attention capture for disgust stimuli is a briefly-lived phenomenon. In the current study, we assessed gaze duration for scenes of contamination and mutilation as it varied across a 3 s interval, predicting relative rejection or avoidance following initial attention capture.

Attentional bias studies have also reported that, compared to other pleasant scenes, sexually-provocative distractors also reduce primary task performance (see Carretié, 2014). Moreover, erotic scenes prompt

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* Corresponding author.
E-mail address: bradley@ufl.edu (M.M. Bradley).

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enhanced sympathetic activity, measured by skin conductance or pupil diameter (e.g. Lang, Greenwald, Hamm & Bradley, 1993; Bradley et al., 2001a; Bradley et al., 2008) and a number of studies have outlined differences among men and women when viewing sexual stimuli (see Murnen and Stockton, 1997; Rupp and Wallen, 2008; Koukounas and McCabe, 1997; Steinman (1981)). In general, whereas biological measures of sexual arousal are often similar, men tend to report that scenes of opposite-, compared to same sex-nudes, are more arousing (Bradley et al., 2001b; Chivers et al., 2010; Jansson et al., 2003), whereas women do not always show a clear preference (Chivers et al., 2004; Costell et al., 1972). Experimental studies, however, have typically not given participants an explicit choice in terms of voluntarily sustaining or averting gaze by providing an alternative visual stimulus. In the current study, we assessed gender differences in choice viewing by presenting scenes depicting either opposite- or same-sex nudes paired with neutral control pictures to both men and women, and additionally measured both skin conductance and pupillary changes as indices of sympathetic nervous system activity.

Eye movement behavior, including scanning and gaze duration, is less reflexive than sympathetically-mediated autonomic responses and is clearly amenable to voluntary control. For example, Nummenmaa et al. (2006) reported that specific instructions to look at a neutral picture in a pair decreased the number and duration of fixations on the accompanying affective scene. Rinck and Becker (2006) found that spider phobics show reliably shorter sustained gaze duration on fear-related pictures, compared to non-fearful participants, and In-Albon et al. (2010) reported that children with separation anxiety were more likely to fixate scenes of separation, rather than reunion, compared to healthy children. More relevant to the current study are data indicating elevated initial fixations on scenes of contamination by participants reporting high fear of contamination (Armstrong et al., 2012). Thus, in the current study, individual differences in reported disgust of contamination, mutilation and sexual activity were measured using the Disgust Scale (Haidt et al., 2002) to assess effects on selective looking.

Several previous studies that used a selective looking paradigm specifically instructed participants to direct attention to each member of the pair (e.g., same/different valence decision; Calvo and Lang, 2004; Nummenmaa et al., 2006). In the current study, we used a free viewing (no-task) context to avoid biasing the direction and duration of eye movements. On each 3 s trial, a neutral control picture was presented with a scene that depicted contamination, mutilation, threat, appetizing food, nude males, nude females or another neutral content picture. Gaze duration for affective content pairs was compared both to eye movement behavior for pairs that contained a neutral content picture, as well as directly to the neutral control picture in each pair. To avoid effects due to the presence of a person in one member of the pair, both pictures in a pair either portrayed people or did not. To rule out differences due to color, all pictures were presented in grayscale, and mean brightness was matched for exemplars in each content category and for each pair. The dependent measure was gaze duration, defined as the sum of the fixation durations on the content picture in each pair expressed as a proportion of the total duration of eye fixations (to the content or neutral control picture in each pair) for each half-second interval across the 3 s viewing period.

2. Method

2.1. Participants

Forty-two students from a University of Florida General Psychology course participated for course credit. The study was approved by the University of Florida Institutional Review Board and written informed consent obtained. Due to data loss or quality, the final N in analyses for gaze duration and pupil diameter was 39 (22 females), and for skin conductance, 40 (22 females).

2.2. Materials and design

Stimuli were pictures selected from the International Affective Picture System[1] (IAPS: Lang et al., 2005) and the internet. The content pictures in each pair were a scene depicting one of 7 contents that included 8 pictures in each of 6 different affective categories: 1) contamination, 2) mutilation, 3) threat, 4) food, 5) nude males, 6) nude females, as well as 7) a set of neutral content pictures (16 pictures). These 64 pictures were paired with 64 control pictures that were always neutral in hedonic valence. Pictures were presented in pairs on each trial, with one content picture and one control picture in each pair. All pictures were presented in grayscale, with brightness adjusted in Photoshop such that mean brightness was matched for exemplars in each content group and the mean brightness did not vary as a function of scene content or pair type. Pairs were arranged such that if the content picture on a trial portrayed people, the neutral control picture also portrayed people; conversely, if the content picture did not include people, the neutral control picture did not include people. Across participants, each neutral control picture was presented in a pair that included each of the affective and neutral content pictures.

Picture presentation was controlled by an IBM-compatible computer running Presentation software (Neurobehavioral Systems, San Francisco, CA). Pictures were displayed on a 19″ in monitor (screen size: 38 cm × 30 cm) located in the experimental room, at a distance of 89 cm from the participant. Two seconds before the presentation of each pair, a fixation cross appeared in the center of the screen and flashed 750 ms prior to picture onset to draw attention to the central fixation point prior to pair presentation. Each picture in a pair was displayed in 8-bit grayscale and subtended a visual angle of 10° (width) by 7.5° (height). The center of each picture was located at 7° of visual angle to the left or right of the central fixation cross, with 14° of visual angle from center-to-center of each pair. Each pair was displayed for 3 s and followed by a blank 3 s intertrial interval. The intertrial interval display consisted of a uniform grayscale background set to the midpoint of an 8-bit grayscale range.

Pictures were arranged in sub-blocks such that one exemplar from each of the content categories occurred twice in each sub-block, once on the left and once on the right side of the fixation point. Content pictures within each category were presented equally often on the left and right side of the fixation cross for each participant. Across participants, each neutral control picture was presented with an exemplar from each of the 7 content categories, with the restriction that pictures involving people were only paired with content pictures portraying people.

2.3. Physiological recordings

Eye movements and pupil diameter were monitored and recorded using an ASL model 504 eye-tracker system (Applied Science Laboratories, Bedford, MA) which allows free movement of the head, and consists of a video camera and an infrared light source pointed at the participant's right eye. A magnetic sensor, attached to a headband tracks and adjusts for head movement. The recording video camera was located in a box in front of the subject covered by a red translucent screen that obscured it from view. Eye position and pupil diameter were sampled at 60 Hz for 2 s prior to picture onset and for 3 s during picture onset.

Skin conductance was measured using VPM software (Cook, 1997) running on an IBM-compatible computer. Skin conductance was recorded using two large sensors placed adjacently on the hypothenar eminence of the left palmar surface after being filled with 0.05-m

[1] The list of the subset of pictures used in this study from the IAPS (Lang et al., 2008) is available from the authors.