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Emotions in Context: Pictorial Influences on Affective Attributions

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The visual illusion *Terror Subterra*, by Roger Shepard (1990), depicts a seemingly large creature chasing another in a tunnel, yet both creatures are physically identical. In addition to this visual illusion, the two creatures also appear to exhibit different emotions, as the background creature (the pursuer) appears angry whereas the foreground creature (the pursued) appears fearful. We explored this context effect by first establishing the magnitude of the emotional bias effect. We then modified the original drawing in various ways, such as equating for perceived size, removing one creature from the scene, and removing the pictorial context altogether. Findings suggest that the emotional bias is due to the pictorial setting and to the perceived social–emotional relationship between the two creatures. These results highlight the importance of both perceptual and social–emotional influences in driving affective attributions.

Keywords: facial expression, emotion, context

In everyday situations, the way we interpret a social event often depends on contextual factors such as perceptual, conceptual, and emotional influences. Context can help to delineate and clarify ambiguities (Bar, 2004; Barrett, Lindquist, & Gendron, 2007; Carroll & Russell, 1996; Palmer, 1975). In the classic perceptual illusion *Terror Subterra* by Roger Shepard (1990), linear perspective gives the impression that the creature in the background is much larger than the one in the foreground, although the two are physically identical (see Figure 1a). Indeed, Shepard (1990) asked: "[D]o we also interpret their identical faces as expressing different emotions—such as rage on the part of the pursuer and fear on the part of the pursued?" (p. 47). The present study assessed this conjecture by testing whether *Terror Subterra* creates an emotional bias so that expressions are interpreted differently depending on their placement within the scene.

Facial expressions are particularly sensitive to their social context. Filmmakers are familiar with such effects as a result of early "experiments" by the Soviet film director, Lev Kuleshov. He took a shot of an actor, Ivan Mozhukhin, with a neutral facial expression and placed it after various pictorial scenes: "I alternated the same shot of Mozhukhin with various other shots (a plate of soup, a girl, a child's coffin), and these shots acquired a different meaning" (Levaco, 1974, p. 200). Psychological studies of the "Kuleshov effect" have confirmed this emotional context effect (Mobbs et al., 2006; Wallbott, 1988). For example, a neutral face presented after a positive picture (e.g., a photograph of babies) was rated positively, whereas the same face presented after a negative picture (e.g., a photograph of a growling dog) was rated negatively (Mobbs et al., 2006). Similar results were obtained when a neutral face was superimposed on to emotionally laden pictorial scenes (Righart & de Gelder, 2006, 2008).

Others, however, have observed a contrast or opposite bias effect. Tanaka-Matsumi, Attivissimo, Nelson, and D'Urso (1995) presented alternating pairs of faces in rapid succession, such as a neutral face alternating with a happy face. Ratings of the neutral face were biased in the opposite direction as the intervening face. That is, alternating a happy face with a neutral face caused the neutral face to appear less happy than if it alternated with an angry face (see also Webster, Kaping, Mizokami, & Duhamel, 2004). Russel and Fehr (1987) used simultaneous presentation of two emotional faces and found a contrast effect so that the emotional rating of a neutral face was biased in the opposite direction as the accompanying face.

These extant findings demonstrate reliable bias effects of facial expressions as a result of pictorial context, although both context-congruent and contrast effects have been observed. If *Terror Subterra* induces an emotional context effect, it offers an emotional bias effect different from previous ones as it is based on two identical faces interpreted differently as a result of the pictorial context. That is, the social–emotional context, which includes a foreboding tunnel, a creature in the background (the pursuer?), and one in the foreground (the pursued?), may influence the emotion displayed by the two creatures. To our knowledge, no study has explored such pictorial context biases on emotion. In the present study, we first used the original drawing to substantiate Shepard's (1990) conjecture and then altered the drawing to explore the nature of this emotional context effect.

Method

Participants and Design

We tested 168 participants in seven task conditions (24 participants per condition; 87 women, 81 men). Participants

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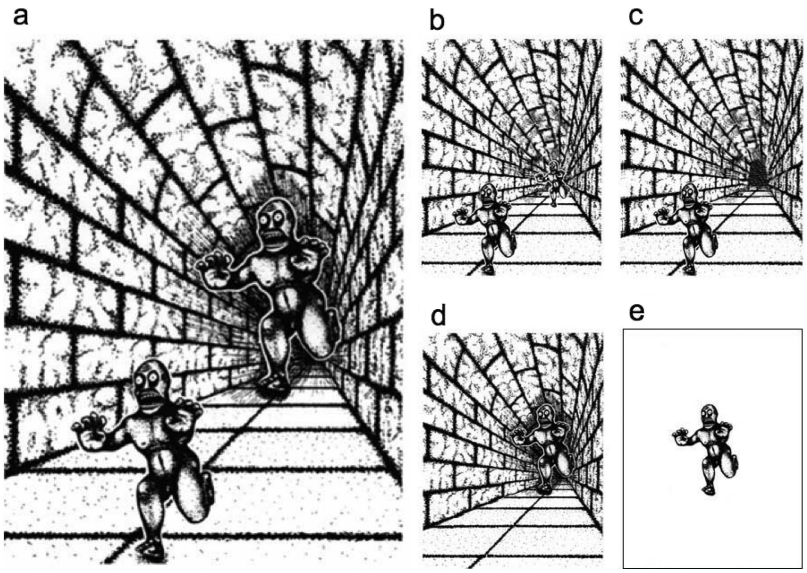

Figure 1. The stimulus displays used in the following tasks. (a) Task 1: the original version of *Terror Subterra* (Shepard, 1990); (b) Task 2: creatures equated for perceived size; (c) Task 3: single foreground creature in tunnel; (d) Task 3: single background creature in tunnel; and (e) Task 4: single creature in isolation. Reprinted with permission from Shepard, R. N. (1990), *Mind Sights,* New York: W. H. Freeman Co.

were undergraduates from the University of California, Berkeley, who received course credit as compensation for their participation. The drawing, *Terror Subterra* (Shepard, 1990) was presented in its original form or with various modifications manipulated with Adobe Photoshop software. We tested participants alone or in groups of 2–10 using an LCD projector that displayed a drawing for 3 s on a screen 6 ft. (1.83 m) wide placed approximately 8 ft. (2.44 m) from participants. Only one drawing was shown to each participant, and responses pertained to only one creature. Informed consent was obtained along with demographic information.

Measures

Participants were instructed to pay attention to the drawing, as they would be asked to answer questions about it. Immediately after presentation, a set of questions was displayed and read aloud by the experimenter. The critical question concerned the emotional disposition of a creature: "Which of the following words most accurately describes how the creature in the foreground [or in the background] was feeling? Angry, Disgusted, Fearful, Happy, Sad, Surprised, Neutral." Participants were also queried as to how they determined the creature's disposition, how they would describe what was happening in the scene, and how confident they were in their response. Participants were given as much time as needed to write their answers on response sheets.

Task 1: Original drawing. Using the original drawing (see Figure 1a), 24 participants rated the disposition of the foreground creature, and another 24 participants rated the disposition of the background creature. Responses to the critical question were categorized as angry, fearful, or other. The "other" category grouped the responses disgusted, happy, sad, surprised, and neutral, as none of these responses was frequent enough to warrant separate analysis. At the end of the session, participants were asked if they had ever seen the picture, or any version of it, before the experiment. To assure that responses were based only on viewing the drawing during the experimental session, we discarded data from anyone with previous exposure to *Terror Subterra*.

Task 2: Equating perceived size. We assessed the degree to which the emotion bias effect was due to the large, imposing creature in the background. We modified the original drawing by reducing the size of the background creature to match the perceived size of the foreground creature (see Figure 1b). Twenty-four participants rated the disposition of the foreground creature, and another 24 participants rated the disposition of the background creature. Responses and the exclusion criterion were the same as those used in Task 1.

Task 3: Single creature in tunnel. We modified the original drawing by removing either the background creature (see Figure 1c) or the foreground creature (see Figure 1d). Twenty-four participants rated the disposition of the foreground creature, and another 24 participants rated the disposition of the background creature. With only one creature in the scene, any difference in perceived emotion would be suggested by the position of the creature in the tunnel rather than the presence of another creature. Responses and exclusion criterion were the same as those used in Task 1.

Task 4: Single creature in isolation. This task assessed a baseline condition in which the emotion of a creature was judged in isolation. We removed the entire pictorial scene and displayed a single creature in the center of an otherwise empty rectangle (see Figure 1e). This condition offered a contextfree measure of the emotion of a

single creature. Responses and exclusion criterion were the same as those used in Task 1.

Results

Task 1 Results: Original Drawing

Fisher's exact tests were used to determine differences in response frequencies between conditions (see Table 1). There was a significant difference in the emotion attributed to the background and foreground creatures ($p < .001$). Participants tended to describe the creature in the background as angry (14 of 24 participants), whereas the creature in the foreground was described as fearful (22 of 24 participants). These findings confirm Shepard's (1990) conjecture that *Terror Subterra* offers a potent emotional bias effect based on the pictorial context of the two figures.

Task 2 Results: Equating Perceived Size

An emotional context effect was observed, even when the two creatures were perceived to be the same size ($p < .01$; see Table 1). The background creature was judged as angry by 9 of 24 participants and fearful by 13 of 24 participants. The foreground creature was judged as fearful by all but 1 participant. There appeared to be a slight influence of perceived size as the seemingly larger creature in Task 1 was judged as angry by more participants than the background creature in Task 2 (14 of 24 vs. 9 of 24; see Table 1), although this difference was not significant, $p > .10$. In any event, even when the perceived size of the two individuals was equated, a reliable emotional context effect was still observed.

Task 3 Results: Single Creature in Tunnel

The emotional disposition of a single creature was interpreted differently depending on its location within the tunnel (see Table 1), $p < .01$. Every participant who viewed the creature in the foreground described it as fearful. Thus, the pictorial setting itself (i.e., escaping from a foreboding tunnel) is sufficient to substantiate the foreground creature as fearful. Descriptions of the background creature were mixed. Fearful responses dominated (15 of 24 participants), although other responses were elicited (6 chose angry, and 3 chose a different emotion). Compared with the original drawing in which both creatures were present (Task 1), a marginally significant reduction in angry responses was evident when the background creature was alone (14 of 24 vs. 6 of 24 angry responses, $p < .06$). Thus, the presence of a foreground creature, perhaps as the one being pursued, biased the interpreted emotion of the background creature, the chaser, as expressing anger.

Table 1
Frequencies of Responses (Angry, Fearful, and Other) for Foreground and Background Creatures in Tasks 1, 2, and 3 (24 Participants per Task Condition)

	Foreground creature			Background creature		
Task	Angry	Fearful	Other	Angry	Fearful	Other
1	2	22	0	14	9	1
2	0	23	1	9	13	2
3	0	24	0	6	15	3

Note. For comparison purposes, Task 4 assessed a no-context condition in which a creature was displayed in the center of an otherwise empty rectangle. Of the 24 participants tested in this task, 4 responded "angry," 18 responded "fearful," and 2 responded "other."

Task 4 Results: Single Creature in Isolation

In this no-context condition, participants tended to judge the creature as fearful (18 of 24 participants), although not as frequently as the foreground creature in the context of the tunnel (Task 4 creature in isolation vs. Task 3 foreground creature, $p < .05$). Thus, the pictorial scene significantly biased the foreground creature's expression of fear. Only 4 of 24 participants judged the no-context creature as angry. This frequency is lower than any ratings of the background creature and was significantly different from the ratings of the background creature in the original drawing (Task 4 creature in isolation vs. Task 1 background creature, $p < .01$), although not reliably different from the ratings of the background creature in the other two tasks. These findings demonstrate that the pictorial context can significantly enhanced both the foreground creature as eliciting fear and the background creature as eliciting anger.

Confidence Ratings

Across tasks, statistical analyses of confidence ratings for anger and fear responses were nonsignificant, although in predictable directions. Participants elicited numerically lower confidence in their ratings of fear ($M = 3.3$) and anger ($M = 2.75$) in the no-context condition (Task 4), compared with ratings in context conditions. For example, mean confidence for fear ratings of the foreground creature was 3.69 in Task 1 (original drawing) and 4.41 in Task 2 (creatures equated for perceived size). Mean confidence for anger ratings of the background creature was 3.57 in Task 1 and 3.11 in Task 2. Thus, confidence for anger responses to the background creature was numerically higher when it was perceived as larger, although this effect was not significant, $t(21) = 1.4$, $p = .18$.

Discussion

Taken together, these findings explored a unique emotional context effect. Two identical and simultaneously presented individuals were judged as eliciting different feelings depending on their location in a pictorial scene. *Terror Subterra* offers an interesting emotional context effect as both the setting (dark tunnel) and presence of another individual influenced the bias effect. Specifically, the feeling of the creature was interpreted as fearful when positioned in the foreground of the tunnel. This bias was apparent even when the background creature was reduced in size (Task 2) or removed altogether (Task 3). A reasonable explanation for these findings is that the act of exiting or overcoming a harrowing event, such escaping from a dark tunnel, strongly elicits the interpretation of fear. Within the tunnel (or in isolation), the creature's emotion is more ambiguous and could be interpreted as anger or some other emotion (e.g., surprise).

The emotion displayed by the background creature appeared more malleable. Compared with the no-context creature (Task 4), the background creature in the original drawing elicited significantly more frequent anger responses. However, the attribution of the background creature as angry appeared to diminish somewhat when its size was reduced (Task 2, although a nonsignificant effect) and when it was presented alone within the scene (Task 3, a marginally significant effect, $p < .06$). Thus, various contextual factors, such as the impression of an imposing chaser or the inclusion of the person being pursued, appeared to influence the perception of the background creature—who is interpreted as being the aggressor—as angry.

Shepard (1990) presumed that the creatures' facial expression was the most salient feature driving the emotional context effect. In the present study, we did not instruct participants to base their judgments solely on facial expression, and it is possible that other factors, including body language and situational cues, led participants to attribute emotional states to the creatures. After participants made their responses, they were asked to describe the reasons for their decision. Two raters who were unaware of task conditions coded these descriptions with respect to five features: facial expression, facial feature (e.g., bulging eyes, open mouth, furrowed brow), body language (e.g., outstretched arms, running posture), situation (e.g., in a dark tunnel, being chased), and relative size. The raters were in agreement 92.9% of the time. When they were not in agreement, a third rater resolved their decision. Across all tasks, 84.5% of participants cited facial expression or facial feature as the reason for their response (separating the two factors, 64.3% mentioned facial expression and 32.7% mentioned facial feature). Body language was reported as a factor by 52.4% of participants, and situation was reported by 39.3% of participants. Thus, on the basis of these self-reports, participants assigned affect to the creatures primarily by interpreting facial expressions or features, although body posture and situational cues did play a role.

These findings add to a growing number of emotional bias effects involving facial expressions. In previous studies, the prior presentation of an emotionally laden scene (i.e., the Kuleshov effect; Mobbs et al., 2006; Wallbott, 1988) or the simultaneous presentation of an emotionally laden scene with a face (Righart & de Gelder, 2006, 2008) can bias facial expressions. In these cases, judgments of facial expressions are congruent with the emotion generated by the pictorial scene. In other studies, facial expressions are biased in the opposite direction from previously viewed facial expressions. For example, after viewing a happy face for 3 min, participants rated neutral faces (i.e., morphed blends of 50% happy and 50% angry faces) as angry (Webster et al., 2004). Similar contrast effects were obtained when participants viewed a video clip of a happy face changing into a neutral expression or an angry face changing into a neutral expression (Marian & Shimamura, 2011). In these cases, the neutral face at the end of the clip appeared angrier when it began as a happy face and happier when it began as an angry face. Contrast biases appear to be specific to conditions when other faces act as the contextual agent, whether presented in succession (Marian & Shimamura, 2011; Tanaka-Matsumi et al., 1995; Webster et al., 2004) or simultaneously (Russel & Fehr, 1987). When pictorial scenes act as the contextual agent, facial expressions are interpreted as congruent with the emotion generated by the scene.

Neurocognitive analyses of context effects suggest that such influences can occur at rather early stages of information processing. Righart and de Gelder (2006) assessed the N170 event-related potential (ERP) response to fearful faces superimposed on to neutral or fearful scenes. The N170 is a face-selective, negative varying ERP that peaks around 170 ms after presentation and is centered in the occipital–temporal cortex (Bentin, Allison, Puce, Perez, & McCarthy, 1996). N170 ERPs to fearful faces were enhanced when superimposed on to fearful scenes, compared with the same faces superimposed on to neutral scenes (see also Righart & de Gelder, 2008). As the gist of a pictorial scene can be gleaned in a single fixation (see Bar, 2004), its influence on face processing may be achieved rather quickly. It is likely, however, that rather large-scale neural networks are involved in processing context, which would include top-down or metacognitive control processes (see Miller & Cohen, 2001; Shimamura, 2008).

In summary, a potent emotional context effect was obtained by a pictorial scene in which two identical individuals appeared to express different emotional expressions. Unlike previous context effects in which the emotional context is presented sequentially or spatially separate from the objects of interest, the pictorial scene used here created a social–emotional context in which the objects of interest were embedded within the scene. Many interpreted the scene as an imposing creature pursuing a helpless victim and thus judged the former creature as angry and the latter creature as fearful. These biases were enhanced by the pictorial context, compared with judgments of emotion in the absence of any context, and suggest important ways in which the attribution of affect can be influenced by the situational context.

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