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Is boundary extension emotionally selective?

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When they have to memorize a picture, people usually build a memory trace including more extensive boundaries than the original picture, a phenomenon known as boundary extension or BE. This article looks at whether the emotion category expressed (i.e., happiness, pleasure, irritation, or anger) by actors in short films could have an influence on the BE effect. The results showed that positively valenced emotions (happiness, pleasure) led to an extension effect, while the negatively valenced ones (anger, irritation) did not produce any significant memory distortion. The arousal dimension of emotions had no significant effect on BE. The current results were discussed in the light of previous studies on the links between BE and emotions.

Keywords: Visual perception; Boundary extension; Emotions.

When we observe a visual scene, the memory of it that we create often differs in various ways from the scene initially observed. While this frequently shows up as a loss of some information (e.g., Simons & Levin, 1997), sometimes the reverse is true: The information memorized is richer than that in the original scene. One of the manifestations of this potential enrichment of the memory trace with additional information that might have been just outside the scene's actual boundaries is a phenomenon known as boundary extension, or BE (Intraub & Richardson, 1989; e.g., Intraub, 2010, for a review). BE refers to a distortion of visual–spatial memory that occurs when observers trying to recall a picture tend to remember scene layout that was not in the original photograph but could be present just beyond the picture's actual boundaries (e.g., Gottesman & Intraub, 2002).

While there is a large body of research demonstrating that the BE phenomenon is robust (e.g., Dickinson & Intraub, 2008), there are a number of factors that seem likely to modulate this effect (e.g., Intraub, Hoffman, Wetherhold, & Stoehs, 2006), or even to make it disappear (e.g., Gottesman & Intraub, 2002). One such factor is the emotional nature of the stimulus (e.g., Candel, Merckelbach, Houben, & Vandyck, 2004; Candel, Merckelbach, & Zandbergen, 2003; Mathews & Mackintosh, 2004; Safer, Christianson, Autry, & Österlund, 1998), although few studies have dealt with the impact of emotions on BE, and those that have been conducted offer discrepant conclusions. Some have shown a BE effect following the presentation of stimuli with a negative valence (Candel et al., 2004; Candel et al., 2003, Experiment 1), whereas others have demonstrated the opposite effect: a shrinking of

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the remembered visual impression of the scene for negative-valence elements (Safer et al., 1998[1]). While these previous researches were limited to examining the effects of negatively valenced stimuli on BE, a study by Mathews and Mackintosh (2004) tested the effects of positively valenced stimuli, too. These authors also attempted to determine the impact of arousal on the phenomenon. Their results indicated a BE effect, regardless of the stimuli's valence. Moreover, the BE effect observed by these authors was weaker for negative and highly arousing stimuli.

Our study explores a different aspect of the impact of emotions on BE. In the current work, we tested participants on facial and body expressions of emotion acted out by another person and not, like on most studies, on effects of emotional induction. Static stimuli depicting expression of facial emotions present a limited ecological validity; we therefore used dynamic stimuli (short films) showing actors expressing emotions with different valences (positive, negative) and arousal levels (low, high): anger, happiness, irritation, and pleasure. All of the filmed sequences we used were taken from the GEMEP (Geneva Multimodal Emotion Portrayals) corpus (Bänziger, Mortillaro, & Scherer, 2012), which contains stimuli presenting both facial expressions and postural and gestural attitudes. These stimuli have been found to be powerful in terms of social communication (Bänziger et al., 2012; Vieillard & Guidetti, 2009). Their dynamic nature is another aspect that makes them different from the static stimuli (photographs) used in most BE studies (see, however, DeLucia & Maldia, 2006). Since BE is a process thought to be involved in the visual integration of scenes perceived in succession by the eye (e.g., Dickinson & Intraub, 2008), it seemed useful to test BE with such dynamic stimuli.

We used a standard BE task, called *camera distance paradigm* (e.g., Intraub, Daniels, Horowitz, & Wolfe, 2008), which we adapted to filmed stimuli. The participants underwent two experimental phases: a film-memorization phase, followed by a recognition test. In this second phase, they saw the *exact* same items as seen in the first phase, but they were told, incorrectly, that while some of the items would be exactly the same, others would be shown from farther away or from closer up. The participants used a 5-point scale to rate each film as to whether it was a more close-up view, a more wide-angle view, or the same view as that in the initial film. With this type of task, the BE effect will show up as a consistent tendency to judge the scenes as being filmed from closer up than they were in the first presentation.

Our objective was to find out whether the BE effect was likely to depend upon the valence and the arousal level of the emotions that the actors displayed in the films. On the basis of previous data, it seems difficult to predict the nature of the effects likely to be observed—that is, whether there will be boundary extension (Mathews & Mackintosh, 2004) or, conversely, boundary restriction (BR; Safer et al., 1998). However, research on memory for central and peripheral details reported that material depicting positive emotions enhances memory for both central and peripheral elements (i.e., memory broadening effect, e.g., Yegiyan & Yonelinas, 2011), whereas material depicting negative emotions promotes only central elements of an event (i.e., memory narrowing effect; e.g., Levine & Edelstein, 2009, for a review). On the basis of these observations, BE could be expected when the expressed emotions are positively valenced, and BR could be expected in the case of negatively valenced emotions. In this sense, BE could be seen as one example of these general memory mechanisms.[2] It is also likely that arousal modulates emotional valence effects on BE. Mathews and Mackintosh (2004) observed a significant interaction between these two variables, corresponding to a

[1] The conclusions drawn from this study, however, probably need to be taken with caution. Indeed, the principal objective of this research was not to study BE, and the method employed was unusual for BE studies (e.g., only two pictures tested).

[2] This idea was suggested by an anonymous reviewer in the first version of this article.

BE reduction for scenes that were at once very negative and highly arousing. Even if in our study the emotions were acted out by the actors and were not induced by an emotional induction paradigm, a similar interaction is expected, with more BR for anger movies than for irritation ones.

Method

Participants

The participants were 40 students from the University of Franche-Comté (32 women, 8 men), with a mean age of 21 years 2 months ($SD = 2$ years 11 months). All had normal or corrected-to-normal vision. None had knowledge of the experimental objectives.

Experimental device

The experiment was presented on a MacBook Pro portable computer with a 15″ screen and was run by Psyscope software. During the test session, the participants were seated at a distance of about 50 cm from the screen.

Stimuli

We used 16 short (1-second) silent film clips taken from the GEMEP corpus (Bänziger et al., 2012) featuring actors expressing emotions controlled on their valence and arousal (Vieillard & Guidetti, 2009). Four actors expressed each of the following emotions in turn: anger, happiness, irritation, and pleasure. Two of the emotions had a positive valence (happiness, pleasure), and two had a negative valence (anger, irritation). Likewise, two emotions involved a high degree of arousal (anger, happiness) and the other two, a low degree of arousal (irritation, pleasure).

As with the photographs typically used in BE tasks, the actors were located in the approximate centre of the screen, filmed against a plain background consisting of a blue curtain. The framing was done so that their bodies would be visible down to the mid-thigh or knee level, with the lower part of the body off screen (cf. Figure 1). During display, the films were framed with a white border and filled the entire screen. An additional film clip (neutral emotion) from the GEMEP corpus was presented to the participants in the familiarization phase.

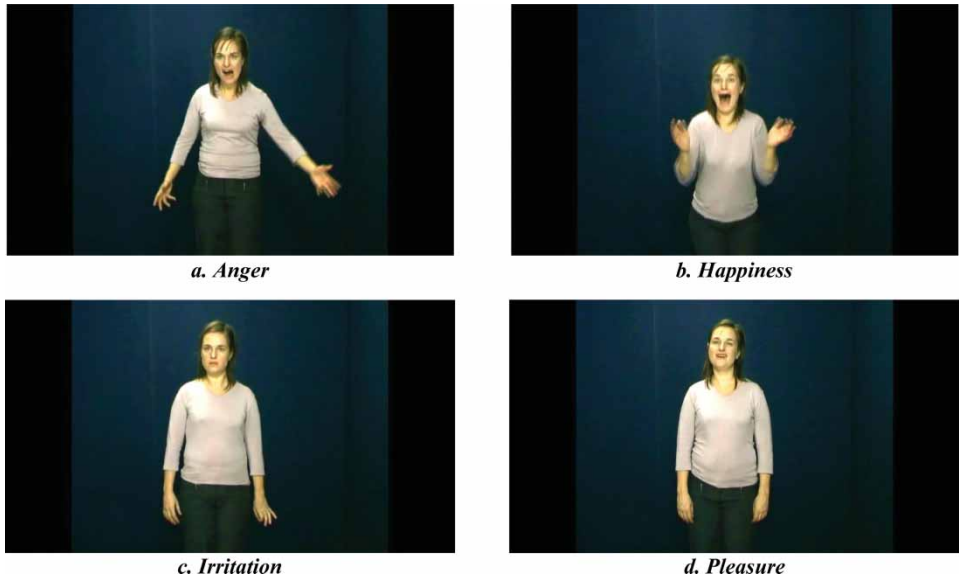

Figure 1. *Photographs a, b, c, and d show one of the actors expressing one of the four emotions used in the experiment. To view a colour version of this figure, please see the online issue of the Journal.*

Procedure

The participants were tested individually. Prior to the experiment, they were asked to fill out the STAI-Y (State–Trait Anxiety Inventory, Form Y; Spielberger, 1983/1993). This was aimed at eliminating from the sample those participants who exhibited anxiety levels (state or trait) that were too high at the time of the experiment. The BE task proposed was an adaptation of the camera distance paradigm to film sequences. It was preceded by a familiarization phase, during which the experimenter used a sample film that was emotionally neutral in order to explain the general principle of the study. Then the experiment proper began, in two successive phases: a memorization phase, followed immediately by a recognition test.

Memorization phase. The participants were asked to memorize each of the 16 filmed sequences to the best of their ability, while paying attention both to the actor and to the manner in which he/she was framed. Each stimulus was preceded by a mid-screen fixation point lasting 600 ms that warned the observer of the imminent arrival of the film clip to memorize. The stimuli were displayed in random order, lasted one second each, and were followed by a blank screen.

Recognition phase. The participants were told that each of the films previously memorized was going to reappear on the screen in random order, but that some of them had been modified with regard to the camera perspective from which it had been filmed. The participants' task was to use a 5-point scale (ranging from –2 to 2) to rate each film presented as to whether it seemed identical to the original (a value of 0 on the scale), just a little closer (–1), much closer (–2), a little farther away (1), or much farther away (2). Contrary to the experimenter's statement, the film clips shown the second time were all exactly the same as those presented in the first phase of the experiment.[3] No time limit was set for responding.

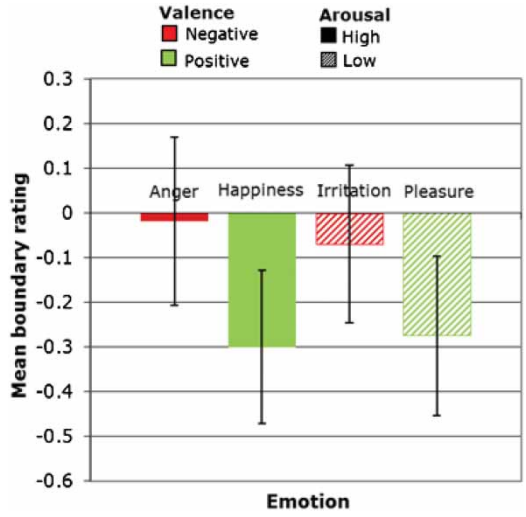

Figure 2. *Mean boundary ratings for each emotion. Error bars indicate the .95 confidence interval around the means. To view a colour version of this figure, please see the online issue of the Journal.*

Results

The mean score distributions on the state–trait anxiety measure (Spielberger, 1983/1993) did not contain any extreme values (± 3 standard deviations), so none of the participants were excluded from the analysis.

The mean boundary ratings for each expression category are shown in Figure 2. To determine whether each mean rating differed significantly from zero, .95 confidence intervals were computed for each one (presented with error bars in Figure 2). If a rating did not differ significantly from zero ("same"), neither BE nor BR occurred. By contrast, a significant deviation from zero indicated a distortion of the remembered size of the film. A negative rating indicated that the viewer remembered the film as having more background than it actually had (a BE effect); a positive rating

[3] The use of a preexisting corpus of experimentally validated films (Vieillard & Guidetti, 2009) did not allow us to include distractor films shot from closer up or farther away, as is generally done in studies based on this paradigm (e.g., Intraub et al., 2008). However, the studies that, like ours, did not employ distractors did not fail to observe a BE effect (e.g., Munger, Owens, & Conway, 2005).

indicated that the viewer remembered the film as having less background. For all emotions taken together, the confidence intervals revealed an overall BE effect (mean = –0.17, $SD = 0.47$). However, as the error bars in Figure 2 show, there was a significant BE effect for only two of the emotions tested: happiness and pleasure. Anger and irritation, by contrast, did not produce a significant memory distortion.

We conducted an analysis of variance (ANOVA) on the boundary ratings for each participant, with valence (positive, negative) and arousal (high, low) as within-subject factors. The results indicated a main effect of valence, $F(1, 39) = 14.91$, $p < .001$, $\eta_p^2 = .277$, suggesting that participants extrapolated the spatial structure more from stimuli depicting positively valenced emotions than from those showing negatively valenced emotions (mean positive valence = 0.29, $SD = 0.56$; mean negative valence = 0.04, $SD = 0.58$). There was no effect of arousal, $F(1, 39) < 1$, nor a significant interaction between valence and arousal, $F(1, 39) < 1$.

In order to control that the effect we observed was due to the emotional valence and not to the spatial expanse of the gestures,[4] we compared (a) the average distances in pixels between the actor's arms and the boundaries (horizontal, vertical), and (b) the minimal distances in pixels between the actor's arms and the boundaries (horizontal, vertical) for negative- and positive-valence stimuli. In all the cases, no significant difference was observed, with (a) $t(14) = 1.049$ and $t(14) = 0.505$, for horizontal and vertical average distances, respectively, and (b) with $t(14) = 0.21$, and $t(14) = 0.397$, for horizontal and vertical minimal distances, respectively.

Discussion

The present study was aimed at determining whether emotions such as happiness, pleasure, irritation, and anger expressed by actors in short films were likely to affect the boundary extension phenomenon. The results indicated a BE effect only for positively valenced stimuli (i.e., happiness, pleasure), while negatively valenced ones (i.e., anger, irritation) did not lead to memory distortion. Moreover, there was no observed effect of arousal, nor an interaction between valence and arousal.

First, these results show that the BE effect, which to date has been observed almost exclusively with photographs, can also be obtained when films are presented (DeLucia & Maldia, 2006). This finding is important in the sense that BE, so far mainly studied by having participants memorize still photographs, seems to be involved in the visual integration of scenes perceived in succession by the eye (e.g., Dickinson & Intraub, 2008).

Concerning the influence of the emotions expressed by the actors, our results support only partially previous observations on the links between BE and emotions. Like Mathews and Mackintosh (2004), we found a BE effect for positive-valence stimuli, but contrary to these authors (but see Safer et al., 1998), we did not observe a BE effect with negative-valence films. Although the previous researches showed discrepant findings on the effects of emotional stimuli on BE, our results support the observations made by researches on the effects of emotion on memory (e.g., Levine & Edelstein, 2009). Indeed, it was shown that emotional valence involves a different treatment as stimuli represent a positive or a negative valence. As positive stimuli broaden attentional focus and facilitate the memory broadening phenomenon (e.g., Fenske & Eastwood, 2003; Yegiyan & Yonelinas, 2011), it is likely that these mechanisms could be the cause of the BE phenomenon observed for happiness and pleasure. On the other hand, negative stimuli classically involve narrowing of attentional focus and memory (e.g., Fenske & Eastwood, 2003; Levine & Edelstein, 2009), which could be the cause of the absence of significant memory distortion that we observed for anger and irritation. One hypothesis, which would need to be tested in the future, is that the results could be due to a differing attention

[4] The more an object fills a stimulus, the greater BE we will observe (e.g., Gottesman & Intraub, 2002).

level or amount of attention directed to a photograph, depending on the valence of the emotions expressed in the films.

Whereas arousal is traditionally described as a fundamental component of emotional stimuli (e.g., Levine & Edelstein, 2009), we observed no significant effect of this variable on BE. If these results seem surprising, in particular as Mathews and Mackintosh (2004) observed an effect of arousal on BE, it is possible that the nature of the presented stimuli had an incidence on our observations. Contrary to previous studies, arousal was not being designed to induce, but to *convey* emotions through the portrayal of the actors. On this matter, it has been shown that emotion recognition (i.e., perception) and experience (i.e., induction) refer to independent processes (Ille et al., 2011). Moreover, the sequences presented during our study are characterized by their dynamic aspect and have the particularity to simulate social interactions. Indeed, emotional expressions transmit sociocommunicative signals relative to the internal state of an individual, from which the observer will infer behavioural intentions (Scherer & Bänziger, 2010).

In summary, our results showed that positively valenced emotions led to an extension effect while the negatively valenced ones did not produce BE. If different hypotheses can account for the discrepant findings observed in the literature on BE and emotions, one must notice that these studies have an high heterogeneity in the methodology used across studies: drawing tasks (e.g., Candel et al., 2004; Candel et al., 2003), camera distance paradigm (e.g., Candel et al., 2003; Safer et al., 1998; our study), and forced-recognition choice test (e.g., Mathews & Mackintosh, 2004; Safer et al., 1998). For a better understanding of the influence of emotion on the BE effect, further researches would have to examine whether the observed differences are mainly linked to the different methodologies used, and, if so, why.

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