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How children remember neutral and emotional pictures: Boundary extension in children's scene memories

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Boundary extension is the tendency to remember more of a scene than was actually shown. The dominant interpretation of this memory illusion is that it originates from schemata that people construct when viewing a scene. Evidence of boundary extension has been obtained primarily with adult participants who remember neutral pictures. The current study addressed the developmental stability of this phenomenon. Therefore, we investigated whether children aged 10–12 years display boundary extension for neutral pictures. Moreover, we examined emotional scene memory. Eighty-seven children drew pictures from memory after they had seen either neutral or emotional pictures. Both their neutral and emotional drawings revealed boundary extension. Apparently, the schema construction that underlies boundary extension is a robust and ubiquitous process.

When people try to remember neutral pictures, they recall more of the scene than was actually shown. This phenomenon is called boundary extension (Intraub & Richardson, 1989). Evidence of this memory illusion has been obtained in many studies using different memory tests. A good example is provided by a study by Intraub and Richardson (1989). These authors presented participants with pictures of common, neutral objects (e.g., flowers, car, telephone). When participants drew these pictures from memory, they reproduced the pictures with more expansive boundaries. Similar results were obtained using a recognition test known as the camera distance paradigm (Intraub & Richardson, 1989; Intraub & Bodamer, 1993; Intraub, Bender, & Mangels, 1992). In this paradigm, participants are confronted with test pictures after exposure to neutral pictures. They are then asked to judge whether the test pictures are the same, closer than, or farther away than the originals. In general, participants tend to accept wide-angled distractors as copies of the originals, indicating that they remember more of the scene than was actually shown.

Safer, Christianson, Autry, and Österlund (1998) speculated that in remembering of emotional pictures, boundary restriction rather than extension might occur. Boundary restriction, which is sometimes called

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tunnel memory, is the tendency to remember less of a scene than was actually shown. The authors argued that when one views an emotional scene, attention automatically narrows to the critical details that are the source of the emotional arousal. When a weapon is involved, the process of attentional narrowing is called the weapon focus phenomenon (Steblay, 1992). Tunnel memory would be the result of this attentional narrowing. However, evidence of the occurrence of boundary restriction or tunnel memory in remembering emotional pictures is mixed. Although Safer et al. (1998) found boundary restriction for one of two critical slides in their Experiment 1, the authors admit that the four-alternative, forced-choice recognition test (4AFC) used in that experiment may be a problem. In this test, the target at testing was one fourth of its original size. When using a recognition test in which the original and target slides were of the same size, Safer et al. (1998) obtained clear-cut boundary restriction in only one of their four studies (their Experiment 4), and boundary extension was found in one of their other studies (their Experiment 3). Recently, Candel, Merckelbach, and Zandbergen (2003) obtained clear evidence of boundary extension in remembering emotional pictures. In their Experiment 1, participants were asked to draw pictures from memory after they had seen either neutral or emotional pictures. Participants' reproduction of both neutral and emotional pictures revealed boundary extension. The degree of extension was highly comparable for the two classes of pictures. In Experiment 2 of the same study, participants watched either neutral or emotional pictures that formed a story line. Next, memory was tested with a camera distance recognition task (Intraub & Berkowits, 1996; Intraub & Bodamer, 1993). The majority of the participants demonstrated accurate camera distance judgments. However, participants who made an error more often displayed a boundary extension error than a boundary restriction error.

Intraub et al. (1992; Intraub, Gottesman, & Bills, 1998) argued that the boundary extension phenomenon originates from perceptual schemata that people construct when they view scenes. According to this view, picture perception activates a mental scene schema that provides observers with an immediate understanding of what is likely to exist just outside the boundaries of a picture. Next, the information contained in the schema is incorporated in the observer's mental representation of that picture. The empirical evidence for this perceptual schema account is fairly strong (see Intraub et al., 1998; Candel et al., 2003). Furthermore, the perceptual schema account precludes occurrence of a boundary restriction or tunnel memory effect. Nevertheless, many questions remain. For example, do children exhibit extended boundaries in their memories of scenes? With the exception of a study by Seamon, Schlegel, Hiester, Landau, and Blumenthal (2002), no study has addressed this issue. In the

Seamon et al. study, participants of different age categories (i.e., 6–7 years, 10–12 years, 18–21 years, and 58–84 years) drew pictures from memory after they had been briefly exposed to the originals. All age groups produced pictures with extended boundaries. However, children and older adults appeared to be more susceptible to the boundary extension illusion than college students. This is an interesting finding because it suggests that the perceptual schemata underlying extension phenomena can already be found in young children. Although the Seamon et al. data demonstrate that boundary extension for neutral pictures is a developmental stable phenomenon, their study did not address what happens when children remember emotional pictures. Interestingly, many studies from the domain of childhood fears indicate that, in general, a substantial population of 10- to 12-year-olds experience specific fears, notably fears of bodily injury and physical danger (Muris & Merckelbach, 2001). With this in mind and in line with Safer et al. (1998), one could speculate that children in this age group react with boundary restriction to aversive pictures. On the other hand, the perceptual schema hypothesis predicts that people tend to display boundary extension in remembering pictures, irrespective of their valence. Because Seamon et al. (2002) did not include emotional pictures, the aim of the current study was to explore how children remember neutral and emotional pictures. To evaluate their boundary distortion tendencies, we asked children to draw pictures from memory after they had seen either neutral or emotional pictures.

EXPERIMENT

METHOD

Participants

The study involved 87 primary school children (58 girls and 29 boys). Their mean age was 10.71 years ($SD = 0.59$; range, 10–12 years). Children were tested individually and participated in the experiment after parents and teachers had given informed consent.

Materials

We used two types of stimuli, namely neutral and emotional pictures (Figure 1). Neutral pictures (i.e., a tire, bananas, a bucket, and a stuffed bear) were used in previous studies by Intraub and her colleagues (Intraub & Berkowits, 1996; Intraub, Gottesman, Willey, & Zuk, 1996) and were downloaded from the Web (http://faculty-staff.ou.edu/G/Carmela.Gottesman-1/). Emotional pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1995). Like the neutral pictures, emotional pictures depicted single objects (i.e., a shark, a snake, a gun, and a knife) against a simple back-

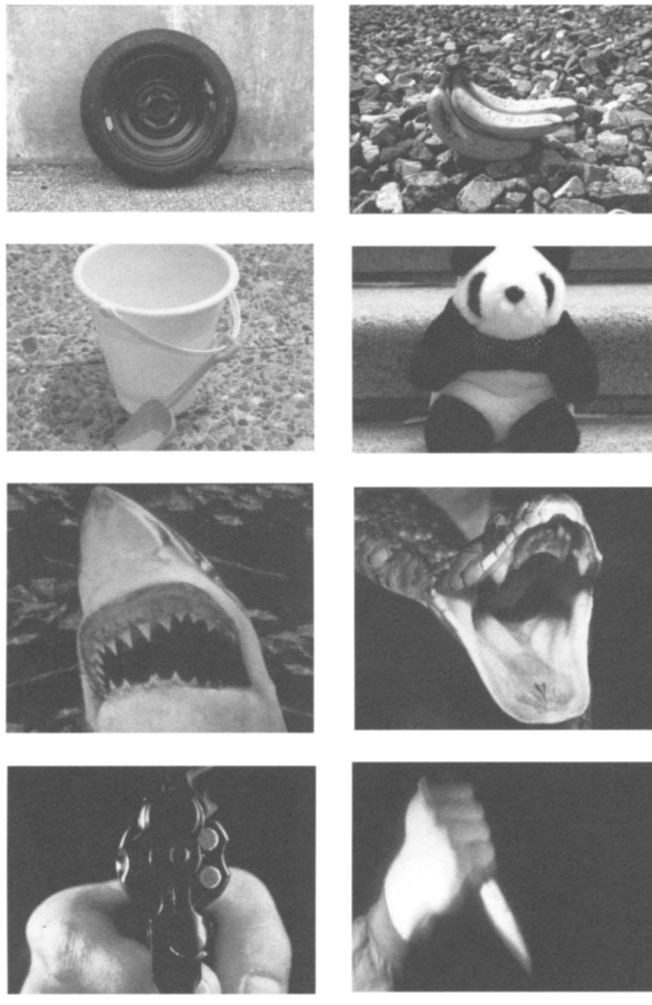

Figure 1. Neutral and emotional stimuli

ground. In Lang et al.'s study, children rated the aversive targets used in the current experiment as highly unpleasant and highly arousing. The amount of space occupied by the objects was exactly the same for the two classes of pictures, $t(6) = -.25$, $p = .81$. Therefore, the potential for extension or restriction was similar for neutral and emotional pictures. Pictures were 100 × 150 mm (approximately 4 × 6 inches) and were presented on a computer screen with a gray background.

Design and procedure

Children were assigned to either the neutral ($n = 43$) or the emotional ($n = 44$) condition. The groups were matched on age and sex. Instructions were de-

rived from Gottesman and Intraub (1999) and were as follows: "You will be presented with some pictures. Please, pay close attention to each picture and try to remember the main object and the background in as much detail as possible. Try also to remember the size and the localization of all objects. In other words, try to retain an exact copy of each picture in your memory."

Children then viewed the pictures. Picture sequence was counterbalanced, and their presentation was followed by a drawing test. Instruction for this task were taken from Gottesman and Intraub (1999, p. 90) and were as follows: "In each rectangle, draw the picture named above in as much detail as possible. Don't worry if you are not a great artist; just do your best to represent everything you saw in the picture. Consider the edges of the rectangle to be the edges of the picture you saw. Try to capture the layout of the picture. That is, try to draw everything in the same relative size and position as in the picture. After you draw each picture, make all the changes you think are necessary, and if you want to clarify any part of your drawing please feel free to use words as labels." Response sheets were handed out in the same order as pictures had been presented. A one-word title on the top of the sheet indicated the picture to be drawn. Each sheet contained a rectangle that measured 100 × 150 mm (approximately 4 × 6 inches). Thus, rectangles had the same size as original stimuli. After the drawing test, participants were asked to rate pictures on 5-point scales in terms of experienced pleasure, comfort, and threat, from 1 (*not at all*) to 5 (*very much*). Either a smiling or a frowning face accompanied the anchors to clarify their meaning.

Area measurement

To measure the area of the main object, we used the paper-and-pencil method described by Gottesman and Intraub (1999). Thus, all drawings were covered with a transparent graph paper (5 squares/mm). Next, the number of grid squares that each object covered was counted and divided by the number of grid squares that the original stimulus covered. A proportion of 1, then, indicates that the object's size is accurately captured in the drawing. A proportion smaller than 1 indicates boundary extension (i.e., the object covers a smaller area in the drawing than in the original). A proportion exceeding 1 indicates boundary restriction (i.e., the object covers a larger area in the picture space).

RESULTS

Manipulation check

Emotional pictures were rated as less pleasant than neutral pictures, $t(85) = -9.44$, $p < .001$, with means of 2.56 ($SD = 0.87$) and 4.08 ($SD = 0.56$), respectively. Moreover, emotional pictures were rated as more uncomfortable than neutral pictures, $t(85) = -6.10$, $p < .001$, with means of 4.06 ($SD = 0.63$) and 3.00 ($SD = 0.95$), respectively. Similarly, emotional pictures were evaluated as more threatening than neutral pictures, $t(85) = -7.89$, $p < .001$, with means of 4.38 ($SD = 0.75$) and 2.73 ($SD = 1.16$), respectively.

Drawings

We obtained a total of 348 drawings (172 neutral and 176 emotional drawings). An independent judge measured the area each object covered. The obtained proportions ("proportions drawn"; Intraub & Bodamer, 1993) were averaged across drawings of both categories (Table 1). The mean proportion drawn was significantly smaller than 1.00 for both neutral pictures, $t(42) = -11.41$, $p < .001$, and emotional pictures, $t(43) = -19.94$, $p < .001$, indicating that children displayed boundary extension for both neutral and emotional pictures. The amount of extension did not differ between the two classes of pictures, $t(85) = -0.38$, $p = .71$. Figure 2 shows a typical example of a drawing displaying boundary extension. The tendency to extend boundaries was not typical only for proportions averaged over pictures. The proportion drawn was less than 1.00 for all individual drawings of both categories, except for 14 neutral drawings (4 × tire, 7 × bananas, 2 × bucket, 1 × stuffed bear) and 9 emotional drawings (4 × snake, 5 × knife).

DISCUSSION

The results of the current study can be summarized as follows. In a free recall drawing task, children tend to extend boundaries of both neutral and emotional pictures. Moreover, the degree of extension is highly similar for neutral and emotional pictures. These results provide a straightforward replication of our previous study (Candel et al., 2003) with adult

Table 1. Mean proportion drawn for each photograph and averaged for neutral and emotional stimuli

Picture name	Mean proportion drawn
Neutral	
Tire	.57 (.50)
Bananas	.57 (.50)
Bucket	.39 (.30)
Stuffed bear	.39 (.28)
Mean	.48 (.30)
Emotional	
Shark	.48 (.21)
Snake	.52 (.34)
Gun	.26 (.17)
Knife	.58 (.38)
Mean	.46 (.18)

Note. Standard deviations are in parentheses.

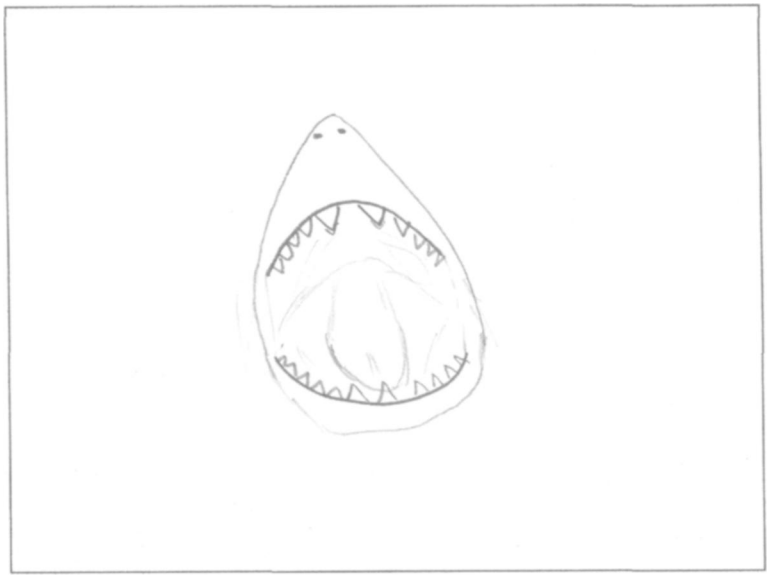

Figure 2. Example of a drawing showing boundary extension

participants. In that study, we obtained mean proportions drawn of .46 for neutral and .42 for emotional stimuli. The mean proportions drawn in the present study were .48 and .46 for neutral and emotional stimuli, respectively. Thus, both adults and children remember wide-angled versions of neutral and emotional scenes. Our finding that children remember neutral pictures with extended boundaries replicates the results of Seamon et al. (2002). Our study extends previous work in this domain by showing that children's susceptibility to boundary extension also occurs with emotional material. Apparently, boundary extension is a robust and ubiquitous phenomenon that crosses developmental borders and stimuli classes. As to the underlying mechanism, the most parsimonious explanation for boundary extension is Intraub's perceptual schema hypothesis (Intraub et al., 1992, 1998), according to which schema activation during perception determines subsequent memory for scenes. The current results suggest that such processes occur early during developmental maturation, without the extensive cognitive experience of adults. In Seamon et al.'s (2002, p. 163) words, "Even 6-year-old children have sufficient experience with perceiving framed scenes to understand implicitly that objects and backgrounds can extend beyond the boundaries of a picture." One could counter that boundary extension has nothing to do with schemata or memory. Perhaps people just use less space when they draw previously viewed pictures. Gottesman and Intraub (2002) address this issue at length in a study in which they used pictures depict-

ing a truncated view of a continuous world and pictures that did not. The results indicate that boundary extension occurs only when the background depicts parts of a continuous surface or when it can be construed as such. Boundary extension is eliminated when backgrounds do not represent truncated views (e.g., cut-out objects on blank rectangles).

Although the backgrounds of the stimuli used in our study depict parts of a continuous surface, one might wonder whether children drew more background. More specifically, boundary extension was demonstrated by objects being drawn smaller, and as a consequence backgrounds became larger. In general, these backgrounds were empty. According to Seamon et al. (2002), drawing more background features might depend on the amount of quantifiable features in the background. In the current study, only one emotional picture (i.e., the shark) had some quantifiable features in the background (i.e., waves). This might be why in the shark drawings the fewest empty backgrounds were found (35 as compared with 43 in the snake drawings and 44 in the gun and knife drawings). The absence of quantifiable features in the background of the other emotional stimuli might be responsible for (almost) all empty backgrounds in their drawings. However, the relationship between background characteristics and boundary extension warrants further study.

Notes

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