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17 Carrying Over Effect on Face Recognition

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It was reported that the performance of the face recognition task after reading large letters in Navon figures (a large letter composed of smaller letters) was better than its performance after reading small letters. The aim of this study was to examine whether the carrying over effect occurred in a composite face recognition task. The accuracy of 'old' face recognition after reading large letters was higher than that after reading small letters. As regards the accuracy of 'composite' face recognition, no difference was found. This suggests that enhancing the accuracy of the composite face recognition is difficult.

I. Introduction

Verbal overshadowing effect refers to the description of a target face from memory before a recognition test impairs subsequent recognition performance. This verbal overshadowing effect is an important phenomenon not only in psychology but also in the field of law.

One of the explanations of the verbal overshadowing effect is transfer-inappropriate processing shifts (Schooler, 2002). The transfer-inappropriate processing shift explanation was supported by studies that used letter-reading tasks. In the letter-reading tasks, the Navon figures (Navon, 1977) were presented. The Navon figure is a large letter made up of small letters. Reading a large letter requires global processing. Reading a small letter requires local processing. Lewis, Mills, Hills, and Weston (2009) reported that the performance of face recognition task after reading large letters in Navon figures was higher than the performance after reading small letters. It was suggested that the processing shift caused by a large letter reading task was carried over in a face recognition task; this shift influenced the performance of the face recognition task because global processing was at work during face recognition. The results supported the transfer-inappropriate processing shift explanation.

In the person identification procedure, which is used in actual criminal investigations, composite faces are sometimes presented. The aim of this study was to investigate whether processing shift was carried over in a 'composite' face recognition task.

II. Experiment

1. Method

1. 1. Participants

Twenty-one undergraduate students (15 women and 6 men) participated in the experiment. Each was randomly assigned to a global group (8 women and 3 men) or a local group (7 women and 3 men).

1. 2 Materials

Monochromatic facial photos were prepared, which were the same as those used by Hine, Nouchi, and Itoh (2011). Seventy-two photos of old faces were prepared for this study; half the photos were of men and half were of women. The old faces were prepared using Photoshop 5.0 (Adobe). The old faces consisted of four parts from four different monochromatic facial photos of full faces with neutral facial expressions, with each individual wearing a white robe. All individuals were photographed using the same background and lighting. The size of each old face was 128 × 128 pixels. Each old face included the hair outline, eyes and eyebrows, nose, and mouth from four different faces of the same sex. Since it was important that the quality of the faces presented during the learning phase and the test phase were not greatly different, the faces presented during the learning phase were old faces and not real faces.

Next, the old faces were separated into three sets of 24 composite faces each (12 female, 12 male). These faces were divided into four parts, and 72 composite faces were produced using the facial parts of these old faces. Each composite face consisted of the hair outline, eyes and eyebrows, nose, and mouth from four different old faces of the same sex in the same group. No composite face shared parts of the same old face. In addition, six composite female faces were prepared to avoid primacy and recency effects.

One hundred Navon figures were created for the Navon task. The Navon figures were large capital letters that consisted of small capital letters. The large capital letters used 36-point Arial font. These Navon figures were adjusted within the range of 340 dots in length and 230 dots in width. The small capital letters were “A,” “C,” “E,” “F,” “I,” “K,” “L,” “N,” “P,” or “V.” The Navon figures were “C,” “D,” “F,” “H,” “K,” “L,” “P,” “S,” or “V.” These large Navon figures were presented as 400 × 480 pixel (12.9˚ × 16.8˚) images on a gray background.

Two hundred test figures were also created for the Navon task. The test figures contained three capital letters. One of the letters was the same letter as the large capital letter in the corresponding Navon figure. The other one was the same as the small capital letter in the corresponding Navon figure. The third capital letter was different from the large and small capital letters in the corresponding Navon figure. The position of the capital letters in the test figure was adjusted to create even spacing. Two types of test figures were prepared: one in which the size of the letter was 36 points (small test figure) and the other in which the size of the letter was 300 points (large test figure). The test figures were presented as 640 × 480 pixel (22.3˚ × 16.8˚) images on a gray background.

1. 3 Procedure

This experiment was performed in one group. The participant was seated in front of a personal computer. The distance between the display and the participant was approximately 45 cm. In the encoding phase, the participants viewed a set of 48 photos (24 men, 24 women) of old faces for a fixed period of 3 s each and were instructed to try to memorize them for a subsequent recognition test. Moreover, the six composite faces of women were placed in the first three and last three positions to avoid primacy and recency effects. The interstimulus interval (ISI) was 1.5 s.

After the encoding phase, the participants were given a Navon task. One trial began with a 1-second presentation of a fixation cross in the center of the screen, followed by a Navon figure for 250 ms. Then, one of the test figures was presented. Participants in the global Navon task group were required to answer in which position the large letter appeared in the Navon figure. Participants in the local Navon task group were required to answer in which position the small capital letter appeared in the Navon figure. Participants responded with 1, 2, 3 on the ten-key number pad (left, center, and right, respectively). The test figure for the global Navon task group was large. The test figure for the local Navon task group was small. Participants were also required to respond as quickly and correctly as possible. The test figure disappeared when the participants gave a response. Inter stimulus interval (ISI) was 1 s. When a participant gave the wrong answer or the reaction latency was over 600 ms, the following feedback was presented for 500 ms: "×" or "Speed UP," respectively. The Navon task was performed for 10 min.

After the Navon task, a self-paced old-new recognition test was administered to the participants. In the old-new recognition test, 72 individual faces were presented in succession. Twenty-four of these faces were old faces that had been presented during the learning phase, 24 were composite faces that consisted of parts from four different faces seen during the learning phase, and 24 were new faces. The assignment of faces that was presented to each group (as old, composite, and new) was counterbalanced across participants. The photos were presented in a random order, although photos of the same type were not presented successively more than four times. The participants were given the following instructions: Please select "Old" when the photograph presented is that of a face seen in the learning phase. Please select "New" when the photograph presented is one not seen in the learning phase.

After completing the experiments, the participants were thanked and debriefed. The experiment lasted for approximately 30 min.

2. Result

The rate of changes in the 'old' response for old and composite faces were calculated for each participant. There were individual differences in the rates of 'old' responses to new faces, which were considered the baseline rates. Therefore, the rate of 'old' response for new faces was subtracted from the rate for old and composite faces respectively, and the calculated value was divided by the rate of 'old' response for new faces. This value was called the rate of changes in this study. One participant in the global condition and two participants in the local condition did not make any 'old' responses for new faces. The data of these three participants were excluded from the study.

In the global condition, the average of the rate of changes in old response for old faces was 6.83 (SD=4.88). The average of the rate of changes for composite faces was 2.37 (SD=1.61). In the local condition, the average of the rate of changes for the 'old' response for old faces was 2.07 (SD=1.29). The average of the rate of changes for composite faces was 0.75 (SD=0.62). Figure 1 shows the average of the rate of changes in the 'old' response for old and composite faces.

To compare the performance of the face recognition task, a 2 × 2 ANOVA was conducted on the average of the rate of changes in the 'old' response for old and composite faces using a Navon task (global, local) and face type (old, composite) as factors. The main effect of the Navon task was significant, $F(1,16) = 6.83$, $MSE = 90.39$, $p < .05$. The main effect of the face type was also significant, $F(1,16) = 17.32$, $MSE = 74.31$, $p < .001$. There was a significant interaction between the Navon task and the face type, $F(1,16) = 5.10$, $MSE = 21.87$, $p < .05$.

The average of the rate of changes in the 'old' response for old faces was larger in the global group than in the local group, $F(1, 32) = 11.47$, $MSE = 100.60$, $p < .005$. There was no significant difference between the global and local groups with regard to composite faces, $F(1, 32) = 1.33$, $MSE = 11.67$, *ns*. Furthermore, in the global group, there was a significant main effect of face type, $F(1,16) = 20.61$, $MSE = 88.41$, $p < .001$. This was not the case in the local group, $F(1,16) = 1.81$, $MSE = 7.77$, *ns*.

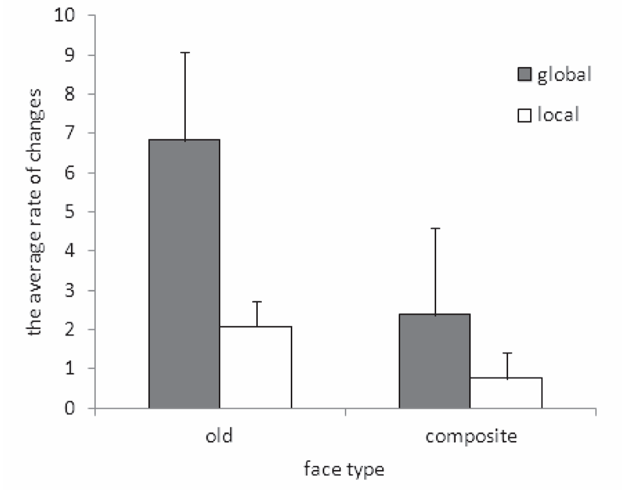

Figure 1. The average rate of changes in "old" response for old and composite faces in the global and local condition. Error bars represent standard errors.

III. Discussion

The aim of this study was to examine whether the carrying over effect occurred in a face recognition task, which included the old, new, and composite faces. The accuracy of old face recognition after reading large letters was higher than the accuracy after reading small letters. For the accuracy of composite face recognition, no difference was observed. This meant that global processing before an old face recognition task is effective in enhancing face recognition. However, global processing before a composite face recognition task was not effective in enhancing face recognition. This suggests that the accuracy of face recognition needs global processing and global information on the face.

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