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The accuracy of memory for faces of personally known individuals

Serge Brédart, Christel Devue
Department of Cognitive Science (B-32), University of Liège, B 4000 Liège, Belgium;
e-mail: serge.bredart@ulg.ac.be
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Abstract. The present study was aimed at evaluating whether the very high accuracy of memory for familiar faces, demonstrated by Ge et al (2003, *Perception* **32** 601 – 614) with a very familiar famous person, generalises to faces of personally known individuals. The accuracy of participants' perceptual memory for a close colleague's face and for their own face was evaluated by presenting original and manipulated pictures of these two targets. The manipulation consisted of increasing or decreasing the interocular distance. As in Ge et al's study, results indicated that proportions of correct recognition of the original faces, and just noticeable differences for the detection of alterations in the recognition task, were not significantly different from the corresponding measures in a perceptual discrimination task performed by a sample of participants who did not know the target persons at all. High accuracy of memory generalises to faces of personally known individuals.

1 Introduction

Recently, Ge et al (2003) have proposed an interesting experimental procedure to examine the accuracy of our memory for highly familiar faces. Instead of presenting faces of different individuals, they presented the original and manipulated pictures of one target face: Mao Tse Tung's face that was particularly familiar to their Chinese participants. The original face was slightly altered on only a single dimension: the interocular distance was either increased or decreased. The participants' task was to judge whether each seen face was that of Mao or an altered version of Mao's face. By presenting one face stimulus at a time to the participants and asking them to judge whether the seen face is the same as, or different from, the image of Mao that they have in memory, the minimal change needed for a face stimulus to be judged as an altered picture of Mao was determined. This just noticeable difference (JND) provided a threshold-level estimation of the accuracy of participants' memory for Mao's face. Ge et al showed that this memory threshold approximated the perceptual discrimination threshold of participants who were not familiar with Mao's face. Using the procedure proposed by Ge et al it was possible to study the recognition of familiar faces in a more precise fashion. In addition to the ability to identify an individual among others, this procedure enables the investigation of the ability to detect changes in a familiar face from memory.

Ge et al demonstrated a remarkably accurate recognition of the face of a famous individual who was mainly known from his standard portrait. The important question whether such accuracy applies to very familiar faces in general or only to those famous people who are mainly known from a particular iconic portrait (eg Mao, Che Guevara, etc) cannot be answered from the study of Ge et al. From their study, it is unclear whether people have an excellent memory for Mao's face, or an excellent memory for the particularly famous portrait that was used as the stimulus. To address this point, we examined the accuracy of memory for highly familiar faces of personally known individuals such as that of a close colleague and one's own face. We do not know personally familiar people from a particular standard portrait. Instead, we have experienced a variety of exemplars both of our own face and those of close colleagues. We have seen each of these faces in different views, showing different facial expressions, and possibly with different hairstyles, makeups, and so on. However, several authors have stressed that the distribution of views of one's own face is more restricted than the distribution of views of other familiar faces (Laeng and Rouw 2001; Troje and Kersten 1999). Because this difference could be relevant to the formation of robust representations for faces (Tong and Nakayama 1999), in the present study the recognition of one's own face was systematically compared with the recognition of a close colleague's face. JNDs in the self-recognition task were compared with JNDs in the recognition task of a colleague's face (within-subjects comparison). As in the study of Ge et al, these JNDs were, respectively, compared with JNDs from another group of participants involved in a perceptual discrimination task (between-subjects comparison). However, the ease of detection of alterations is not the only aspect of accuracy. The ability to recognise the original, unaltered, version of the target face also seems important. Therefore the proportion of correct responses to the original version of the target face was also used as a dependent measure.

2 Methods

2.1 *Participants*

Twenty-four volunteers (twelve women) aged between 17 and 29 years participated. Twelve of them (six women) participated in a recognition task. They had known their same-gender colleague for between 2 and 5 years (mean 3.7 years). The other twelve participants were recruited as controls and took part in a perceptual discrimination task. Participants in the recognition task were totally unfamiliar to participants in the discrimination task. All participants had normal or corrected-to-normal vision.

2.2 *Materials*

The twelve participants in the recognition task were photographed in front of the same beige wall and were depicted with a neutral facial expression. A full face, frontal-view colour photograph of each of these participants was taken at a distance of 150 cm with a digital camera (Nikon Coolpix 2500). None of these participants had facial hair or wore glasses. Each image has a width of 16 cm and height of 21 cm (450 by 587 pixels), with a resolution of 0.035 cm per pixel or 2.41 min of arc per pixel. The image manipulation software GIMP was used to increase or decrease the distance between the eyes in each target face, 2 pixels at a time (1 pixel for each eye). The resultant images were then retouched to create natural-looking shadings (see figure 1). From each target face, 9 new versions with a wider interocular distance were created for the eyes-out condition, and 9 new versions with a smaller interocular distance were created for the eyes-in condition. Hereafter, these new versions will be referred to as 'Target $+X$' or 'Target $-X$', where X indicates the number of pixels (from 2 to 18) by which the distance between the eyes of the new version differed from that of the original target face. The original face will be referred to as 'Target'.

2.3 *Procedure*

Participants were tested individually. Stimuli were displayed on a 17-inch monitor at a viewing distance of 50 cm. The stimulus presentation and data recording were controlled by the E-prime software (Psychology Software Tools Inc., Pittsburgh, PA). Each participant in the recognition task saw 19 different pictures of her/his own face and 19 different pictures of a same-gender colleague (the 9 versions of the eyes-out condition, the 9 versions of the eyes-in condition and the original face, for each target person). Each picture was presented a total of 20 times. Thus, during the experiment itself, each participant saw a total of 760 stimuli (ie 20 trials $\times$ 19 different pictures per target face $\times$ 2 target faces). Trials were grouped into two main blocks: trials on own face/trials on the colleague's face. Half of the participants saw the 380 pictures of their own face first. The remaining participants saw the 380 pictures of their colleague's face first.

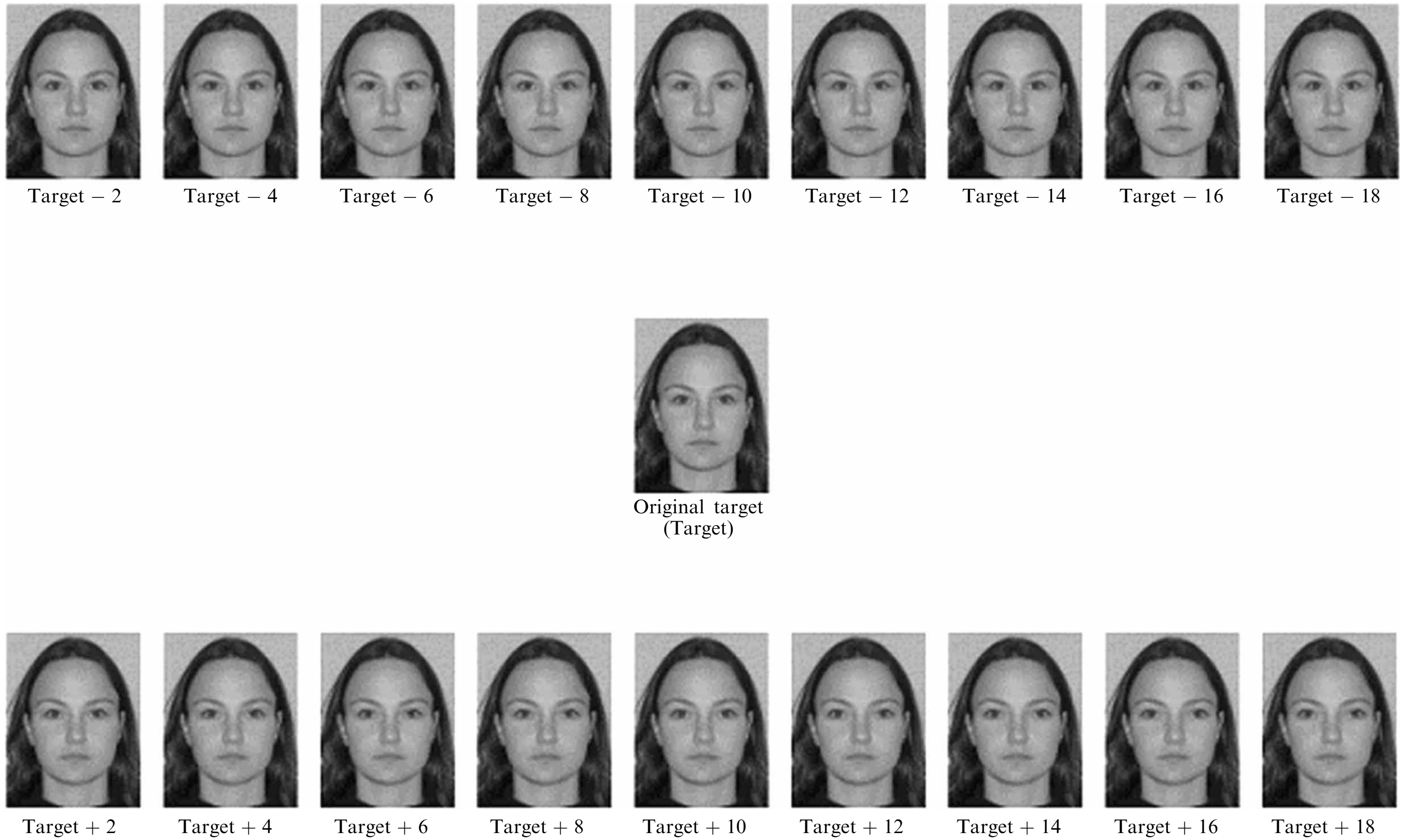

Figure 1. An example of stimuli used in the experiment. The original target was manipulated on one single dimension: the interocular distance was either decreased (Target − X) or increased (Target + X).

Within each block, trials were presented in a random order. There was a 2 min break every 190 trials. Each picture was presented until the participant responded, or until a maximum of 10 s had elapsed. Participants were told that they were going to see pictures of their own face and pictures of a colleague (the name of the colleague was given), and that some of these pictures had been manipulated so that the interocular distance was either increased or decreased while some of them were intact (not manipulated). Participants were instructed to judge whether each presented picture was intact ("Yes" response) or manipulated ("No" response).

Participants responded by pressing a response key on a computer keyboard. No feedback was given. The experiment took about 70 min. Before each of the two main blocks of items, the participants were shown the complete set of the 19 pictures that were to be presented in the block, once and in a random order. No response was required during this pre-experimental phase.

Since people are usually more familiar with the mirror-reversed view of their own face than with the normal view, and, conversely, more familiar with the normal view of other people's face than with the mirror view, participants were shown their own face in a mirror orientation and their colleague's face in a normal orientation.

In the discrimination task, each participant was shown pairs of pictures of a same-gender unfamiliar face (ie the face of an individual who participated in the recognition task). Each pair of pictures consisted of the original picture of the target face and one manipulated picture of the same face (from Target − 18 to Target + 18), or two copies of Target. Pictures had the same size as those presented in the recognition task. Participants were asked to judge whether the pairs of pictures were identical or different from each other in any way. As in the recognition task, they were told that the interocular distance had been manipulated on some pictures. Moreover, before starting the experimental trials, they were shown the 19 pictures to be seen later in the experiment. During the experiment itself, each participant saw a total of 380 pairs of pictures (20 trials × 19 different pairs). The face of each participant in the recognition task was shown to one participant in the discrimination task.

3 Results

The rate of absence of response within the allowed 10 s was very low (0.12% in the recognition task and 0.57% in the perceptual discrimination task, ie less than 1% in both tasks). Figure 2 shows the mean proportions of trials in which participants judged that the presented face was altered in the recognition task. This figure also shows the mean proportion of trials in which participants judged that the two presented pictures of a face were different, in the discrimination task.

As in the Ge et al study, each participant's threshold value in pixels was determined by interpolating the 75% correct response point. In the recognition task, the threshold value was calculated separately for each target face (own face or colleague's face).

In the recognition task, the proportions of correct responses to the original target pictures were similar for the person's own face ($M = 0.82$; $\mathrm{SD} = 0.15$) and for the colleague's face ($M = 0.85$; $\mathrm{SD} = 0.15$), $t_{11} < 1$. In addition, a 2 (target face: self versus colleague) × 2 (condition: eyes-in versus eyes-out) ANOVA with repeated measures on both factors was carried out on the JNDs. This analysis revealed no main effect of the target face, no main effect of the condition, and no interaction effect (all ps > 0.10). In other words, the participants' performance was similar for their own face and for the colleague's face, on the one hand, and for increases and decreases in the interocular distance on the other hand. Descriptive data are presented in table 1.

A 2 (target face) × 9 (decreasing distance) ANOVA with repeated measures on both factors showed no main effect of the target face ($F < 1$) and no interaction effect ($F < 1$) but revealed a significant effect of decreasing distance ($F_{8,88} = 79.64$, $p < 0.001$): as the

Table 1. Means (standard deviations) of just noticeable differences in pixels (JNDs in min of arc are presented in italics) in the eyes-in and eyes-out conditions, for own face and a close colleague's face (recognition task) and unfamiliar faces (perceptual discrimination task).

Task	Eyes-in condition		Eyes-out condition	
Recognition				
own face	7.22 (2.78)	*17.40* (*6.71*)	9.59 (4.08)	*23.10* (*9.84*)
colleague's face	7.23 (2.61)	*17.43* (*6.29*)	8.65 (2.95)	*20.86* (*7.12*)
Discrimination	7.42 (3.40)	*17.89* (*8.20*)	7.71 (3.76)	*18.58* (*9.08*)

deviation from the target increased, participants' detection of alteration increased (see figure 2). Similarly, a 2 (target face) $\times$ 9 (increasing distance) ANOVA showed no main effect of the target face ($F < 1$), no interaction effect ($F_{8,88} = 1.85$, $p > 0.05$), but revealed a significant effect of increasing distance ($F_{8,88} = 63.46$, $p < 0.001$): again, as the deviation from the Target increased, participants' detection of alteration increased.

Performance on the perceptual discrimination task was compared with performance on the recognition tasks. Independent *t*-tests showed that the proportion of correct "same" responses on the perceptual discrimination task ($M = 0.89$; $\mathrm{SD} = 0.16$) was not significantly different from the proportion of correct responses to the original version of the target faces in the recognition tasks ($t_{22} = 1.12$, $p = 0.27$ for own face; $t_{22} < 1$ for the colleague's face; see figure 2). Similar comparisons were performed on the JNDs by conducting two mixed two-way 2 (task) $\times$ 2 (condition: eyes-in versus eyes-out) ANOVAs with repeated measures on the last factor. In the first analysis, JNDs from participants involved in the own-face recognition task were compared with JNDs from control participants, ie participants judging the same faces (unknown to them) in the perceptual discrimination task. This analysis revealed no effect of the task, no effect of the condition, and no interaction (all ps > 0.20). In the second analysis, JNDs from the participants' responses to the colleague's face in the recognition task were compared with JNDs from control participants' responses in the perceptual discrimination task. This analysis revealed no effect of the task, no effect of the condition, and no interaction (all ps > 0.30).

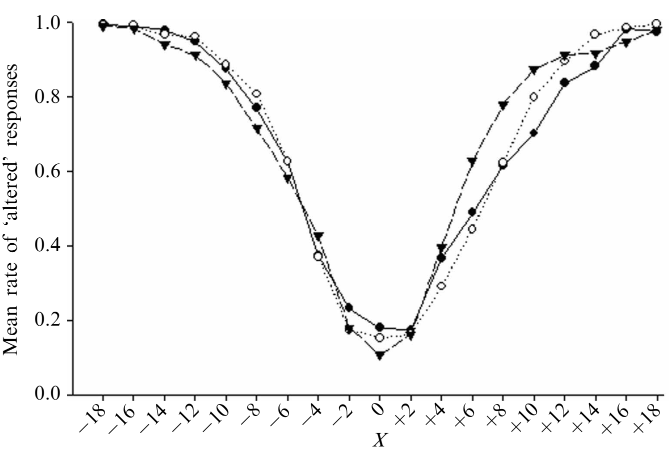

Figure 2. Mean rates of 'altered' responses as a function of face alteration (from Target − 18 to Target + 18) for own face and a close colleague's face (recognition task), and unfamiliar faces (perceptual discrimination task).

4 Discussion

Our aim was to evaluate whether the highly accurate recognition of very familiar faces that Ge et al (2003) found while using the standard portrait of a famous person (Mao) generalises to faces of personally known individuals. In the present study, Ge et al's procedure was used both with faces of the participants and of a close colleague of theirs. Results indicated that the mean proportion of correct recognition of the original face (whether it be one's own face or the colleague's face) in the recognition task was similar to the mean proportion of "same" responses in a perceptual discrimination task performed by control participants to whom the target faces were unknown. In addition, for both faces, JNDs in the recognition task were not significantly different from JNDs measured in the perceptual identification task. This pattern of results is identical to that reported by Ge et al (2003). Moreover, the values of the JNDs are rather similar across Ge et al's first experiment and the present experiment: their values were around 20 min of arc while those reported here were a little bit smaller.

Results also showed that, in the recognition task, participants' performance was similar for the own face and the colleague's face, both when the dependent measure was the proportion of correct identification of the original face or the JNDs. Therefore, the fact that the distribution of views from one's own face was restricted relative to other very familiar faces had no significant influence on the participants' performance. This is perhaps not so surprising since the task required participants to process pictures that presented faces in a full frontal view, ie a view that is easily available for one's own face as well as for other faces. On the other hand, no advantage for self-recognition was observed. This lack of advantage for the processing of own face is consistent with previous work (eg Kircher et al 2000, 2001). It seems that own-face recognition does not comply with the idea that people should be especially good at recognising stimuli that are relevant to themselves (Heatherton et al 2004).

It has been shown that the eyes are particularly important for the recognition of familiar faces (eg O'Donnell and Bruce 2001). In future work, the Ge et al (2003) procedure should be used to evaluate whether the high accuracy in detecting alterations holds even when other distances (eg the distance between the nose and the mouth) are manipulated.

In conclusion, the present results support the idea that high accuracy of memory for familiar faces is not limited to the recognition of famous individuals, or to their iconic portraits. It generalises to personally known individuals for whom we have a varied visual experience in that we encounter such faces under a variety of stimulus conditions and contexts.

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