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Gender Is a Dimension of Face Recognition

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In an experiment, the authors investigated the impact of gender categorization on face recognition. Participants were familiarized with composite androgynous faces labeled with either a woman's first name (*Mary*) or a man's first name (*John*). The results indicated that participants more quickly eliminated faces of the opposite gender than faces of the same gender than the face they were looking for. This gender effect did not result from greater similarity between faces of the same gender. Rather, early gender categorization of a face during face recognition appears to speed up the comparison process between the perceptual input and the facial representation. Implications for face recognition models are discussed.

A long-standing question in face recognition concerns the relationships between the different kinds of information one can extract from a face. From a single stimulus (e.g., a passport photograph) a great deal of information can be drawn (e.g., identity, gender, race, and approximate age) and many inferences can be made (e.g., honesty, attractiveness). Despite this abundance of information, many aspects of a face can be processed in less than 1 s. This is true of gender and identity. Furthermore, each piece of information can be processed independently of the others. For example, we can determine the gender or age of a person whether or not we know that person. Similarly, we can recognize the same emotional state in the faces of different people, whatever their gender, age, race, or familiarity. The relationships between these different kinds of information vary. For identity, for instance, some information is highly relevant whereas other information is not relevant at all. Accordingly, for a given person, gender and race are constant, that is, the person always has the same gender (with a few rare exceptions). Age is less stable, but its changes are slow, gradual, and predictable. Emotional state, however, is highly variable and changes frequently and rapidly. Thus, some information is irrelevant to identity (e.g., expression), and the cognitive system must be able to rule it out to achieve effective identification. Other information (e.g., gender and race) is highly correlated with identity and can be expected to help the cognitive system correctly and rapidly recognize a person. It is even conceivable to consider this kind of information to be part of a person's identity.

Differing views of the relationship between face recognition and gender categorization have given rise to various types of models (Bruce & Young, 1986; Ellis, 1986; Hay & Young, 1982). This issue is still unresolved, however. Laboratory and neuropsychological data clearly rule out the possibility that gender categorization is a prerequisite to face recognition. The time taken to access familiarity does not depend on the masculinity (or potentially, the femininity) of a face (Bruce, Ellis, Gibling, & Young, 1987). Moreover, gender and face identification are processed in distinct regions (Sergent, Ohta, & MacDonald, 1992) that may be selectively damaged (e.g., Bruyer et al., 1983; Humphreys, Donnelly, & Riddoch, 1993; Mattson, Levin, & Grafman, 2000; Schweich & Bruyer, 1993; Tranel, Damasio, & Damasio, 1988). Furthermore, it is not necessary to be able to categorize gender in order to recognize it (see Wild et al., 2000). However, these observations do not demonstrate that gender never has an impact on face recognition. It is likely that gender categorization does act on face recognition, but without being essential. This hypothesis is conceivable, since gender categorization is performed faster than face recognition (Bruyer, Galvez, & Prairial, 1993; Sergent, 1986). From the timing standpoint, then, gender could influence recognition. Suppose we are searching for a specific person in a crowd by looking at everyone's face. We can eliminate any person whose gender is not the same as the person we are searching for, without processing identity. In the Bruce and Young (1986) model, the viewing of a face leads to a structural encoding that is compared with the face units. When we search for a specific person, his or her unit is preactivated and the cognitive system compares the result of the structural encoding with the unit to decide if they match. According to a strict modular conception (e.g., Fodor, 1983), the comparison is made no matter what operation is taking place in the other module (encapsulated processing of information). Thus, the comparison continues even if the gender categorization process indicates that it is not the right gender, and consequently, not the right person.

There is an alternative explanation: Gender categorization and face recognition are achieved by distinct processes that have different processing speeds, in such a way that the fastest process is able to influence the computations of the slowest when it has finished its own computations. In a pilot research in our laboratory, participants had to search for the face of a specific celebrity among pictures of unknown women and men presented one after the other. The results indicated that participants more quickly eliminated faces of the opposite gender than the face they were looking for. However, the results obtained in this study do not improve our understanding of how gender affects the comparison process. Two explanations are possible. The first is that the effect is merely a

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similarity effect. It seems legitimate to assume that a given woman's face is more similar to another woman's face than to a man's face. Women share some facial characteristics that are "typical" of their gender, such as the vertical distance between the eyelids and the eyebrows, which is greater than in men (Campbell, Benson, Wallace, Doesbergh, & Coleman, 1999). Thus, when we are searching for a woman, female distractors are probably more similar to the target than male ones. The longer time taken to reject distractors with the same gender as the target can therefore be explained by a simple similarity effect. A second explanation is a *categorical effect*. The time needed to determine the gender of a face is generally shorter than the time needed to identify a specific person (Bruyer et al., 1993; Sergent, 1986). Thus, the output of the prior gender categorization process may either stop or speed up the face recognition process when the stimulus and target genders differ. These two hypotheses are not mutually exclusive. It is conceivable that the decision that a perceived face is not the face of a specific person may be speeded up when that face is very different, especially if the gender does not match. The fact that face similarity/dissimilarity affects recognition is well established (Valentine, 1991). The fact that prior categorization of gender influences recognition has never been observed. To test this assumption, we designed one experiment. The paradigm consisted of searching for composite androgynous faces labeled with either a woman's first name or a man's first name in a series of faces presented one by one. The distractor faces were of women and men, and all were unknown to the participants. The general hypothesis was that distractor faces that do not have the same gender as the searched-for person will be rejected faster.

Experiment

Method

Participants. The participants were 22 women and 26 men who volunteered to participate in the experiment. They were between 18 and 39 years old ($M = 22.5$). All had normal or corrected-to-normal vision.

Materials. Fourteen sets of composite faces were generated using a morphing software package. Each composite face was a mixture of a pair of faces (a woman's face and a man's face from the University of Stirling, Stirling, Scotland, and personal face databases). Different mixing percentages were used, ranging from 0% of the woman's face and 100% of the man's face, to 100% of the woman's face and 0% of the man's face, in steps of 10% (10% and 90%, 20% and 80%, and so forth). This made a sequence of 11 composite faces for each pair. The sequences were presented to 10 control participants (5 women and 5 men, ages 21 to 29 years, $M = 25.9$), who were instructed to indicate when the composite face changed gender. Their answer could be one of the composite faces in the sequence or an interval between two composite faces. We selected the six pairs where the standard deviation was the lowest (i.e., the control participants agreed the most). The means of these six pairs were used to generate 6 composite faces (see Figure 1). The composite faces were considered androgynous. A different composite androgynous face was used in the training session.

Forty-eight photographs of unknown persons (24 women and 24 men) were used as distractors. They were divided into two sets of 24 (12 women

Figure 1. Composite androgynous faces learned: Mary or John? Retrieved from University of Sterling database: http://pics.psych.stir.ac.uk

and 12 men). All faces (composites and distractors) were put in medallions of the same shape and size (10 cm high, 7.8 cm wide).

Design and procedure. Before the experiment, the participants were informed that the photograph of a person would be displayed for 30 s, and that they would then have to search as quickly as possible for that person among a series of faces presented one by one. After a training session, the experimenter said, “The person to search for now is John/Mary. Let me show you his/her face.” Then the experimenter showed a composite androgynous face. The name the experimenter had stated was written above the face. After 30 s, the search session began. It consisted of 12 presentations of the composite androgynous face and one set of distractors, each presented once. The participants had to scroll down with one key on wrong faces and press another key when they saw the right person’s face. A trial began with the display of a fixation point for 500 ms, followed by a white screen for 500 ms. Then a face appeared and remained on the screen until the participant responded. The interval between two trials was approximately 1 s. Each participant had to search for two androgynous faces, one labeled *John* and the other labeled *Mary*. The name given to the androgynous face, the order of the two sessions, and the set of unknown target faces used were counterbalanced across participants. This procedure allowed us to strictly control the similarity between the search face and the distractors, because exactly the same photographs were used in the female and male target conditions. Any statistical difference between the two conditions could only result from the label given to the (androgynous) target face.

The variables analyzed were target gender (woman or man) and distractor gender (woman or man). These two variables were within-subject variables. The dependent variable was the correct rejection latency on distractors. For each participant in each condition, responses more than two standard deviations away from the mean were discarded.

Results

The means in the various conditions are presented in Table 1. A two-factor (Target Gender × Distractor Gender) analysis of variance was carried out.

Neither target gender nor distractor gender had a significant effect, $F(1, 47) = 0.21$ and $F(1, 47) = 3.02$, respectively. The interaction between target gender and distractor gender was significant, $F(1, 47) = 20.76$, $p < .01$, and indicated that male distractors were rejected faster than female ones when the participants searched for a woman (471 ms vs. 505 ms), $F(1, 47) = 16.92$, $p < .01$, whereas female distractors were rejected faster than male ones when the participants searched for a man (476 ms vs. 488 ms), $F(1, 47) = 4.11$, $p < .05$. Moreover, female distractors were rejected faster when the participants searched for a man rather than for a woman (476 ms vs. 505 ms), $F(1, 47) = 5.21$, $p < .05$, but male distractors were not rejected significantly faster when the participants searched for a woman rather than for a man (471 ms vs. 488 ms), $F(1, 47) = 2.05$, $p > .15$.

Table 1
Mean Response Latency (in ms) on Correct Rejections of Female and Male Distractors When the Composite Androgynous Target was Labeled as a Woman or as a Man

	Target gender	
Distractor gender	Female	Male
Female	505	476
Male	471	488

The results of this experiment indicate that the rejection speed on distractors depended on whether the first name given to the androgynous face to search for was a man’s or a woman’s name. Given that the similarity between the target and the distractors was strictly equal in the two target gender conditions, these results argue in favor of a categorical effect of gender in face recognition.

General Discussion

To summarize the results obtained in this experiment, a face is rejected faster when its gender is not the same as the gender of the searched-for person. This phenomena was observed when the participants searched for a composite androgynous face arbitrarily labeled either with a woman’s or a man’s first name. These results allow us to conclude that this gender effect did not result from greater similarity among faces of the same gender. Rather, the gender effect reported here can be ascribed to earlier gender categorization. This last conclusion does not rule out the possibility that similarity between faces influences their recognition or rejection but suggests that this influence alone cannot account for the gender effect.

The data reported here are inconsistent with a strictly modular and parallel conception of face recognition and gender categorization. Nevertheless, a sequential explanation is not the best one to account for this effect. There are sufficient data in the literature, either from laboratory studies or brain-damaged patients, to rule out this possibility (e.g., Bruce et al., 1987; Humphreys et al., 1993). We suggest instead that gender categorization and face recognition are interrelated and communicate whenever possible.

How can we account for the gender effect? In the experiment reported here, we can suggest that the cognitive system preactivates not only the facial representation but also semantic information about a specific person. Thus, the cognitive system still expects the activation of a specific representation but also the activation of face-specific semantic information. When the gender categorization process tells the cognitive system that the gender is not the expected one, the decision to reject the face is made without identifying the person. Baudouin, Gilibert, Sansone, and Tiberghien (2000) found still another source of information that the cognitive system takes into account in addition to the output of the face representations. They showed that smile information facilitates the decision and the feeling of familiarity of the face. One may also explain the gender effect in the framework of face-space models (e.g., Valentine, 1991; see also Valentine, 2001). Valentine (1991), for example, contended that a familiar face is represented by a point in a multidimensional space. He did not define the dimensions of this space but suggested that they may correspond to the different facial features (e.g., distance between the eyes, hair color). One possibility is that gender categorization helps locate a perceived face in the space. The gender categorization process may reduce the space to the area corresponding to one gender. Whenever the gender of the perceived face does not match the gender of the searched-for face, the area where the perceived face is located does not enclose the location of the searched face. The system can then respond without having to find a more precise location for the perceived face in the space (as it has to when the gender is the same). Another explanation, not so different from the last one, consists of seeing gender as one of the dimensions of this multidimensional space. A face is coded along multiple dimensions, such as distance between the eyes, hair color, . . . , and gender.

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