The Perception of Gender in Human Faces

Samantha Haseltine
Gustavus Adolphus College
Faculty Advisor: Patricia Costello

Abstract:

When we look at a face we often have no difficulty determining the person's gender despite the fact that male and female faces are quite similar. The first study in this experiment was to investigate how participants would gender categorize a gender neutral face. Participants categorized 60 faces as either male or female when in fact, there were three versions of faces (male, female, ambiguous). Ambiguous faces were rated as males significantly more than they were rated as females. Male faces were also faster classified than ambiguous faces. In the second study in this experiment, we found that the face inversion effect (FIE) disrupted gender perception. Ambiguous faces were classified as male only by chance. Similarly because of the FIE females were classified as females no better than chance. Male faces were not affected as so. Again participants were significantly faster in classifying the male faces than they were the ambiguous faces. Despite the possible affect the baldness of all the heads had on the data, this study begins a new area of research examining the gender category boundaries of human faces.

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Categorization refers to the ability to react similarly to stimuli when they are physically distinct, and to react differently to stimuli that are physically similar (Freedman, Riesenhuber, Poggio, & Miller, 2001). For example, we recognize an orange and a coconut to be in the same category (food) even though they look different, and we consider an orange and a billiard ball to be in different categories even though they look the same is shape, size, and sometimes color. Similarly, male and female faces often look very similar yet we are able to discern between the two correctly with little or no effort. Adults have even been referred to as face experts (McKone, Kanwisher, & Duchaine, 2007). Willis and Todorov (2006) showed that the judgments made of a person after being exposed to a face for 100ms were no different than the judgments made when there was no time constraint. Similarly, most of us have no difficulty identifying a face as male or female but cannot explain how we make that judgment. Most of us even think we have a clear concept of what makes a face male or female. It is a decision we make without even being aware of it and can perform efficiently with little or no attentional resources available (Reddy, Wilken, & Koch, 2004). There have been many studies aimed at explaining the differences between male and female faces and the ways we process the differences. Despite decades of research by psychologists, the complexity of this process has left much to be learned about the human visual system.

Configural information has empirically been shown to play a major role in facial processing (Baudouin & Humphreys, 2006; Baudouin & Tiberghien, 2002; Wilson, Loffler, & Wilkinson, 2002). Configural cues refer to the information about the relations between facial components. Although the research has made evident the importance of configural information in facial processing, it is not the only type of information we use to process faces. Another way of processing researchers have generally looked to explain facial differences is featural cues. Featural cues refer to the properties of individual parts of the face (texture, color, size). Of these two processes, it has been shown that it is the configural processing that is especially slow to develop (Mondlock, Le Grand, & Maurer, 2002). Mondlock et al. (2002) also showed that adults were better at processing faces than children, suggesting that the configural information carries most of the face information. Although there is empirical evidence about there being a role for featural information in facial processing, the individual results have been mixed. Shepard (1989) suggests that women's fuller cheeks are what people use to classify faces as female. Enlow (1982) suggested the larger nose and consequences of it (more prominent brows, more sloping foreheads, more deep-set eyes) are what make male faces perceivable as male. These results were supported by Roberts and Bruce (1988) who found that subjects were slowest to classify a face as male or female when the nose was concealed. Contrary to these results, Brown and Perrett (1993) discovered that prototypical male and female facial features, except the nose, carried some information about gender when seen in isolation. Bruce et al. (1993) also reports findings contradictory to Roberts and Bruce (1988) when they found that masking the eyes (including eyebrows) had the greatest effect on sex judgments. Despite the ease of this perceptual classification, we still don't know for certain what information in faces is used to make this decision with such speed and accuracy.

Most of the research to date whether it is configural or featural has examined facial gender categorization by averaging male or female faces to create a prototypical male or female face. Whereas I agree that this type of research contributes important information to our knowledge of face perception, using a prototypical face has a major limitation: nobody has a prototypical face in real life. Instead of examining the masculinity and femininity of prototypical faces, my aim in this study is to shed light on the male-female category boundary by looking at how participants gender categorize three different versions (male, female, and ambiguous) of the same face. Study one examines this by looking at faces upright. Study two examines this by looking at inverted faces. Although most objects are more difficult to recognize upside down that right side up, many studies have shown that face recognition is disproportionately impaired by inversion (Barton, Keenan, & Bass, 2001; Leder & Bruce, 2000; Farah, Tanaka, & Drain, 1995). This is the phenomenon known as the face inversion effect (FIE). Discovering what's disrupted by the FIE will provide much insight into how we process faces. The goal of my second study was to examine whether the FIE severely impairs gender as well.

Study 1

Method

Participants. Fifty undergraduate participants from a private, liberal arts college in the Midwest participated in this study. They received class credit in their Introductory Psychology course for participation in this study.

Materials. A high resolution digital camera was used to take pictures of the faces of 10 college-aged males and 10 college-aged females (20 faces total). Those pictures were then put into a desktop computer with a color monitor. A program called FaceGen was used to manipulate the facial photographs which resulted in 60 final pictures total. The 60 FaceGen pictures were presented to the participants using the computer program E-

Prime. The study was conducted using the same computer.

Stimuli. Ten pictures of male faces and ten pictures of female faces were captured using the digital camera. These pictures were taken with sufficient lighting and with a neutral background. The full face was viewable in all the pictures; hair was moved out of the face, facial jewelry was removed, the men had no facial hair, and the women were not wearing any make-up. Using the FaceGen software on the computer, three pictures were created of each face. This software allows for the change of gender in a face in that, a female face, a male face, and an ambiguous face was created for each picture (see Figure 1). The mechanism used to fluctuate the gender was anchored at one end with a value of 100% female and anchored at the other end with a value of 100% male. The female face was created by placing the bar at the typical female setting, the male face to the typical male setting. The ambiguous face was created by placing the marker directly halfway between the female and male settings. Each face was saved which resulted in a total of 60 faces (20 male, 20 female, 20 ambiguous). This process was repeated for the 10 pictures which made up the practice study. These faces were then presented to the participants in random orders using the computer program E-Prime.

Procedure. After filling out an informed consent form, participants took a seat in front of the computer. During the study, one of the FaceGen pictures came up in the center of the screen for one second. After that second, the face disappeared and the participant was prompted to press the “1" key on the keyboard if they thought the face was male or press the “2" key if they thought the face was female. They were forced to choose male or female as there was no third option. They had as much time as they needed to respond. The next picture would appear directly following their response. They first completed a practice study consisting of 10 practice-only pictures. After the practice study was complete and any questions were answered, the participant began the study and gender categorized the 60 FaceGen faces. The faces were presented in a random order for each participant.

Results

The results of a binomial distribution showed that participants classified the ambiguous fasces as males more than would be predicted by chance ($p<.005$) (see Figure 2). Ambiguous faces were categorized as males 67.7 percent of the time. The male faces were categorized as males 93.3 percent of the time. Females were categorized as females 76.4 percent of the time.

The average reaction time to categorize the ambiguous faces as males was 511 milliseconds. For categorizing the female faces as females the average reaction time was 489 milliseconds. For categorizing the male faces as males the average reaction time was 469 milliseconds. A one-way within subjects ANOVA revealed that it took participants significantly longer to classify the ambiguous faces than the male faces $F(2,49) = 8.1$, $p = .004$ (see Figure 3). The amount of time it took to classify the female faces fell between these two values, but there was no significant difference with either using a least significant difference to find out which ones were different. The data from both male and female participants followed the general trend of the overall data.

Discussion

The results of the current study support previous research that says participants can categorize the gender of a face when the face isn't seen for very long (Willis & Todorov, 2006). It also supports the findings that participants can make this classification rather fast

(Mangini & Biederman, 2004), and are almost always correct (O'Toole et al., 1998). The central finding of the current study shows that when a face's gender is not easily discernable and is without hair, people are more likely to classify the face as male.

Study 2

There has been much research to date on the face inversion effect (FIE) which is a strong phenomenon which shows that face recognition is severely impaired by inversion. The aim of this second study was to see if the FIE also affects gender classification.

Method

Participants. Fifty undergraduate participants from the same private, liberal arts college in the Midwest participated in this study. They received class credit in their Introductory Psychology course for participation in this study.

Materials. The same materials from study 1 were used again in study 2.

Procedure. Study 2 was ran the exact same as study 1 except each of the same 60 pictures were presented upside down.

Results

The results of a binomial distribution showed that participants classified the ambiguous faces as male at a level equal to chance (53.5%). Interestingly, the results were the same for categorizing the female faces as females (59.5%). Male faces however, were classified as male significantly higher than chance (68.9%) (see Figure 4).

The average reaction time to categorize the ambiguous faces as males was 632 milliseconds. For categorizing the female faces as females the average reaction time was 624 milliseconds. For categorizing the male faces as males the average reaction time was 601 milliseconds. All average reaction times were significantly longer for the inverted conditions than they were in the upright conditions. Similar to the results of study 1, a one-way within subjects ANOVA showed that participants were significantly faster in classifying the male faces than the ambiguous faces $F(1,49) = 11.05$, $p = .001$. The time it took to classify female faces was between the two but not significantly different from either. Again, the data from both male and female participants followed the general trend of the overall data.

Discussion

The results of study 2 are consistent with previous research which shows that gender categorization is disrupted when faces are inverted (Bruce et al. 1993). This provides further support for the importance of configural information (the information about the relations between facial components) in face processing and more specifically, gender categorization. Even though the research shows that featural information (the properties of individual parts of the face) isn't affected by inversion (Searcy & Bartlett, 1996; Leder & Bruce, 1998), this isn't to say that featural information isn't important as evidenced by the aforementioned research.

General Discussion

Overall, participants were faster and better at classifying male faces as male than female faces as female. One possible explanation for this could be the effect of the baldness of all the faces. Since we are all used to seeing males with no hair but are not used to seeing females with no hair it's possible that this was the deciding factor for participants who were unsure about the gender of the face. The ambiguous faces weren't clearly male or female. When participants saw these faces it also took them more time to respond because they couldn't decide on the gender of the face. But because the face had no hair, it's possible the participant defaulted with the face belonging to a male. The slightly slower reaction time of the female faces than the male faces could have been due to the baldness as well. Perhaps they saw the face as a feminine face, but were distracted by the fact that the face had no hair; but because the face was still a feminine face, they were able to classify it as female.

In neither study was the sex of the participant significant. Contrary to research by Loven (2006) who found that women outperform men in face recognition and are especially good at recognizing other females' faces, there was no such effect when classifying gender. Both male and female participants followed the general trend of the overall data.

The field would benefit if future research on the topic investigated how configural and featural information work in relation to each other. Since previous data has shown that both obviously play a role in facial processing (Cabeza & Kato, 2000; Calder, Young, Keane, & Dean, 2000), it would be worth the efforts to learn how these two and possibly other forms of information are used by the visual system. Another research direction is to continue to look for the category boundary between male and female faces. Do female faces get categorized as male faces because they look like male faces? Or is it just because they no longer look like female faces? Does such a boundary even exist? Perhaps the perception of gender is subjective rather than absolute. Either way, it is evident that reliable discrimination between male and female faces requires information from multiple sources. Perhaps it should not surprise us to learn that all the available information appears to be used.

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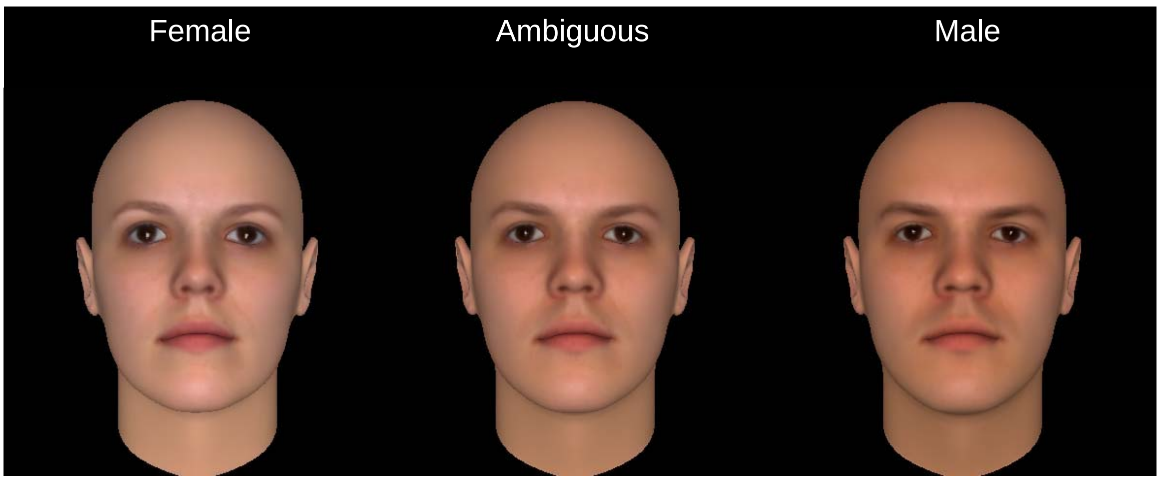
Figure Captions

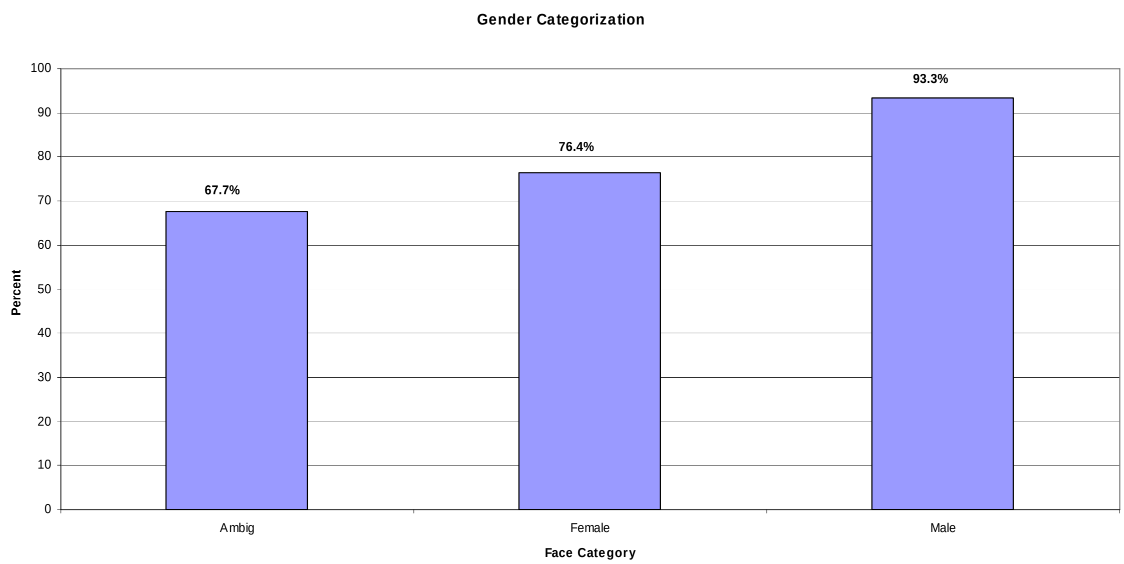
Figure 1. Example of the stimuli. The three versions (male, ambiguous, female) of the same face.

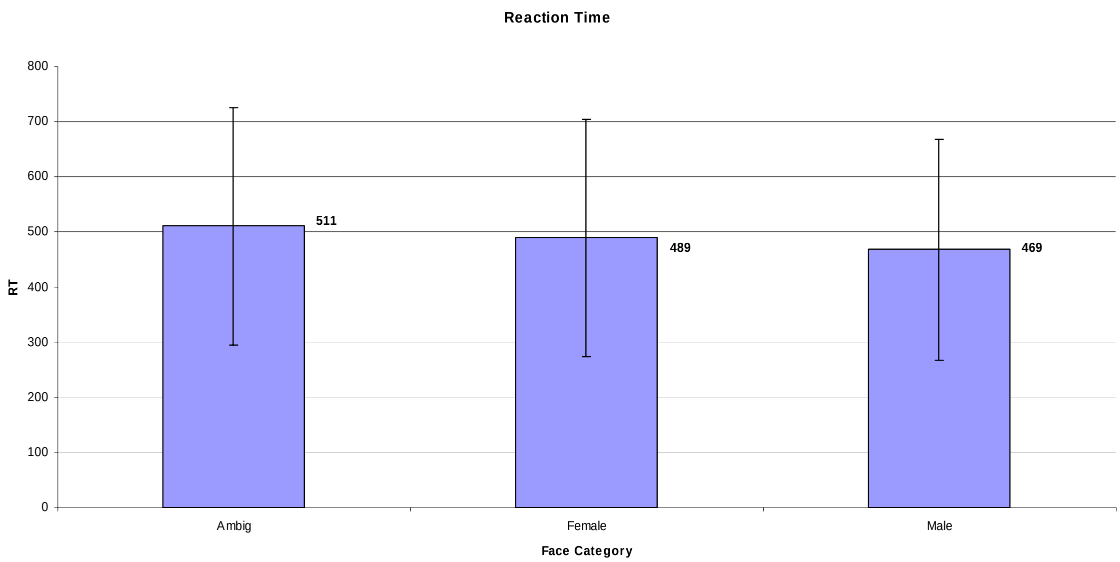
Figure 2. Percent categorized as perceived gender in upright condition. Shows percent of ambiguous faces categorized as males, percent of female faces categorized as females, and percent of male faces categorized as males.

Figure 3. Reaction time to gender classify the faces in upright condition. Error bars represent one standard deviation.

Figure 4. Percent categorized as perceived gender in inverted condition. Shows percent of ambiguous faces categorized as males, percent of female faces categorized as females, and percent of male faces categorized as males.


Female
Ambiguous
Male


Gender Categorization
100
90
80
70
60
50
40
30
20
10
0
Percent
67.7%
76.4%
93.3%
Ambig
Female
Male
Face Category


Reaction Time
800
700
600
500
400
300
200
100
0
RT
511
489
469
Ambig
Female
Male
Face Category

Inverted Gender Categorization