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A signal-detection analysis of sex differences in the perception of emotional faces

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Abstract

A signal-detection task was used to assess sex differences in emotional face recognition under conditions of uncertainty. Computer images of Ekman faces showing sad, angry, happy, and fearful emotional states were presented for 50 ms to thirty-six men and thirty-seven women. All participants monitored for presentation of either happy, angry, or sad emotional expressions in three separate blocks. Happy faces were the most easily discriminated. Sad and angry expressions were most often mistaken for each other. Analyses of d' values, hit rates, and reaction times all yielded similar results, with no sex differences for any of the measures.

1. Introduction

Although women are commonly reported to be superior to men in the recognition of facial affect, sex differences are not robust, and seem to be influenced by a number of procedural factors including sex of face, specific emotion, and type of task (for a review, see McClure, 2000). We suggest that sex differences in emotion recognition are most likely to emerge under conditions of rapid visual presentation, when participants have high levels of uncertainty (e.g., Kirouac & Dore, 1984). The evolutionary argument for a sex difference in facial affect recognition is generally linked to the greater physical vulnerability of women, which affords an advantage to those who can make very rapid decisions about facial expressions that warn of danger, or signal intimacy (e.g., Geary, 1998). Furthermore, women may have a bias toward interpreting all facial expressions as angry or fearful, as these expressions may have the greatest informational value. The use of a signal-detection paradigm allows one to tease apart the contributions of discriminability and response bias to the sex difference in facial affect recognition.

To our knowledge, only one study has previously used a signal-detection analysis to assess facial emotion recognition (Goos & Silverman, 2002). In that study, male and female faces expressing anger, fear, sadness, and disgust—all negatively valenced emotions—were presented for 30 ms, and participants determined which of the four emotions was shown. Overall, sadness was the most discriminable emotion, followed by fear, anger, and disgust. The authors found women to be more sensitive than men for the perception of anger and sadness, but only in female faces. The present study differs in that happy facial expressions were included in the stimulus set, along with sad, angry, and fearful expressions, and the task was to detect one of three target expressions: happy, sad, or angry.

2. Method

Thirty-six men and thirty-seven women enrolled in Introductory Psychology classes at the University of Waterloo took part in the experiment for partial course credit. All were right-handed as indicated by their scores on the Waterloo Handedness Questionnaire.

The stimuli consisted of sixteen black and white photographs featuring two male and two female posers exhibiting each of the following facial expressions:

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Angry, Fearful, Happy, and Sad (Ekman & Friesen, 1976). The experimental session involved 16 practice trials and 96 experimental trials for each of three blocks. In each block, participants were given as a target one of 3 emotional expressions, Happy, Sad, or Angry, and were instructed to press one computer key to indicate 'yes,' and a different key to indicate 'no' for each trial. For practice trials, the face was presented until the subject responded. For experimental trials, each stimulus face was shown for 50 ms, and was preceded by a 1000-ms central-fixation cross; once the participant had responded, a new trial commenced. Equal numbers of target and non-target trials were presented in each block, with the non-targets in each block equally distributed among the other three expressions. Roughly equal numbers of men and women received the blocks in each of the six possible orderings.

3. Results

Hit rates, false alarms, d' values and mean response times were calculated for each target emotion, and are presented in Table 1. We note that a number of studies in the literature have examined interactions between sex of the subject and sex of the poser of the facial expression (e.g., Goos & Silverman, 2002). Given that the present study employed only two posers of each sex, any analysis involving sex of poser seems inappropriate. Therefore all analyses were based on recognition accuracy collapsed across the four posers. Because initial analyses found interactions between block order and emotion (that mainly reflected an increasing accuracy as the experimental session progressed), block order was entered as a covariate in all analyses.

Table 1
Performance on target face detection task for men and women

Target	Dependent measure			
	Hit rate	False alarm rate	d'	RT (ms)
Happy				
Men	.96	.04	3.53	564
Women	.94	.04	3.38	599
Total	*.95*	*.04*	*3.45*	*581*
Angry				
Men	.83	.10	2.78	665
Women	.83	.16	2.43	721
Total	*.83*	*.13*	*2.60*	*693*
Sad				
Men	.90	.17	2.57	652
Women	.92	.23	2.43	651
Total	*.91*	*.20*	*2.50*	*652*

Each dependent variable was analyzed in a 3 (Emotion) $\times$ 2 (Sex) mixed analysis of variance with Emotion as a within-subjects variable. Each of these analyses revealed only a main effect of emotion, with happy faces producing higher hit rates, $F(2,140) = 6.167; p = .003$, lower false-alarm rates, $F(2,140) = 6.377; p = .002$, higher d' values, $F(2,140) = 12.013; p < .001$, and faster response times, $F(2,140) = 15.062; p < .001$, than either angry or sad faces, which did not differ from each other on any of these measures.

The false-alarm patterns were examined for each target separately, in order to determine which facial expressions were most easily confused under these conditions of rapid presentation. When angry faces were the targets, false alarms were made more often to sad (false alarm rate = .18) or fearful faces (FA = .15) than to happy faces (FA = .04), $F(2,140) = 6.761; p = .002$. Similarly, when sad faces were targets, false alarms were made more often to angry (FA = .26) or fearful faces (FA = .32) than to happy faces (FA = .03), $F(2,140) = 17.180; p < .001$. Although very few false alarms were made to happy faces, there was a trend for those false alarms to be greater to fearful (FA = .06) than to angry (FA = .04) or sad faces (FA = .03), $F(2,140) = 2.45; p = .09$. No main effects or interactions involving Sex were observed.

4. Discussion

The primary purpose of this study was to evaluate sex differences in the perception of facial expressions of emotions. If sex differences in the discriminability of facial expression are real, they have the greatest potential to be revealed using a signal-detection paradigm with brief visual displays. Notably, no sex differences were observed on any of the measures produced in this study. This failure to replicate previous studies that have found sex differences suggests that sex effects may be heavily dependent upon procedural variables that can influence task performance, and not on sex differences in face perception per se.

The most striking finding in the current study is that happy faces were more discriminable than either angry or sad faces, and that happy faces rarely produce false alarms to angry or sad targets. Furthermore, perception of angry and sad faces did not differ on any measure. This finding contrasts with that of Goos and Silverman (2002) who found sad faces to be more discriminable than angry faces. It should be noted that their study involved only negative facial expressions (anger, fear, sadness, and disgust) whereas the present study involved both positive (happy) and negative (angry, sad, and fearful) expressions. It seems likely that the perception of a facial expression is highly dependent on the context in which that expression occurs.

A strong test of this hypothesis would require the use of a wide variety of facial expressions. The fact that anger, sadness, and fear were the most commonly confused expressions suggests that, under conditions of uncertainty produced by rapid displays, the valence of an emotional expression remains salient. It would be interesting to determine whether happy faces are as discriminable when the distractors include other positive emotional expressions.

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