

**PERCEIVED DEGREE AND DETECTABILITY OF FACIAL
HAPPINESS AND ANGRINESS:
THE ROLE OF THE PARTICULAR STIMULI**

Tonya S. Pixton, Mats P. Englund, and Åke Hellström

*Department of Psychology, Stockholm University, SE-106 91 Stockholm, Sweden
tonya.pixton@psychology.su.se, mats.englund@psychology.su.se, hellst@psychology.su.se*

Abstract

The purpose of the present study was to elucidate further Pixton's and colleagues (2007, 2008, 2009) results with a between-group study. Two groups (happy, angry) viewed pictures of facial expressions (Tottenham et al., 2009) with three presentation times (12.50, 18.75, 25.00 ms) and completed a detection (Part 1) and a rating (Part 2) task. In Part 1, participants answered "yes" if they thought the face was happy (happy-group) or angry (angry-group) and "no" if not. In Part 2, they rated each face stimulus on each of three scales (angriness, happiness, emotionality). "Neutral" faces were not rated equally neutral by either group. Taking this into account, adjusted d' values were higher for the happy-face group than for the angry-face group for the two longest times. Together with Pixton and colleagues' results, when investigating the detectability of emotions, account must be taken of the particular stimuli used, which has now been demonstrated in a between-groups and a within-participants study.

Pixton (2007) used signal detection analysis to test the manner in which shifts in sensitivity (d') occur across presentation time, emotional expression, and gender of facial stimuli. Pixton reported a happy-superiority effect and an angry-male superiority effect, but did not discuss the potential effect of the particular stimuli. In a follow-up study, Pixton (2008) asked participants to rate each face stimulus used in the 2007 study on three different scales *happiness*, *angriness*, and *emotionality*. Results (2008) showed that there was a greater distance on the relevant judgment continua between happy and neutral expressions than between angry and neutral expressions. Therefore, d' values for all emotion-gender face combinations were adjusted using the mean difference scale values (*MDs*) for an emotion face and its neutral counterpart on each of the scales. These adjusted d' values for the emotion-gender faces were similar except for angry-female faces.

A potential problem with Pixton's (2008) results was that the original d' values (2007) and the *MDs* (2008) used to calculate the adjusted d' values reported in 2008 are based on different groups of participants. Therefore, Pixton, Englund, and Hellström (2009) investigated whether the results from 2008 could be replicated with each participant performing both a signal detection task and a rating task. Results (2009) showed that a male-superiority effect occurred: It was more difficult for participants to detect emotion in female faces than in male faces, regardless of emotion. The task in the 2009 study was to detect emotion; therefore, the purpose of the present study was to replicate the 2007, 2008, and 2009 studies with a between-group design where two groups performed both a detection task of the specific emotion (angry, happy) and a scaling task of the specific emotion and its neutral counterpart on *happiness*, *angriness*, and *emotionality*.

Method

Participants. Sixty psychology students (12 men, 48 women) ranging in age of 19 to 41 ($M_{age} = 26.23$) were divided into two groups, H and A, 30 each. All participants gave informed written consent and had normal or corrected-to-normal visual acuity, which was controlled using the Bailey and Lovie (1976) LogMar 3-meter eye chart. The groups did not differ in age ($p = .156$) nor visual acuity ($p = .999$).

Stimuli. Ninety (30 angry, 30 happy, and 30 neutral) faces were used from the NimStim Set of Facial Expressions (Tottenham et al., 2009). For each emotion, there were 15 male and 15 female faces, the same poser for each emotion. The faces were closed-mouthed, in color, and included the entire face with hairstyles and without facial hair and eyeglasses. The pictures consisted of 500 x 650 pixels and were presented on a black background, measured at 0.35 cd/m². On the monitor, the pictures measured 12.3 x 16.0 cm, a viewing angle of 8.39° x 10.91° at a distance of 84 cm held constant by a chin rest.

Design and Procedure. The experiment consisted of one 60 minute session, which was divided into two parts: detection (approx. 25 min) and rating (approx. 25 min). The detection part of the experiment was designed as a *yes-no* experiment and the stimuli were presented across three exposure times (12.50, 18.75, and 25.00 ms) and were succeeded by a mask presented for 125 ms.

For the first part of the experiment, each of the 30 neutral faces and each of the 30 happy or 30 angry faces (group-dependent) was presented four times for each presentation time, giving a total of 720 trials. Participants were instructed to answer *yes* if the face was happy (Group H) or angry (Group A) and *no* if it was not happy or not angry (group-dependent). Each trial consisted of either a happy or an angry face (group-dependent) or a neutral face; a mask; and a 500 ms pause, after which the response alternatives appeared on the screen. The next trial began 500 ms after the participant had made a response.

In the second part of the experiment, the 90 pictures were presented individually in three blocks. Within each block, the participants rated each stimulus on angeriness (Block A), happiness (Block H), and emotionality (Block E). The rating scales for Block A and for Block H were 11-point scales (5 = *friendly*, 0 = *neutral*, 5 = *angry* and 5 = *sad*, 0 = *neutral*, 5 = *happy*, respectively). For Block E there was a 6-point scale (0 = *not at all emotional*, 5 = *very emotional*). The stimuli were presented in pseudorandom order within each block, and block order was counter-balanced across participants. At the beginning of each block, instructions appeared on the monitor to inform the participants which block was beginning. Each trial consisted of one face and a scale below the face.

Table 1. Mean Scale Values for Emotion Face Types of Rated Emotional Expression and Perceived Emotionality in Three Block Types for two Emotion Groups

Face Type	Block Type					
	Block A: Angeriness		Block H: Happiness		Block E: Emotionality	
	Ang. Grp.	Hap. Grp.	Ang. Grp.	Hap. Grp.	Ang. Grp.	Hap. Grp.
Happy-Female		-3.10		2.92		3.15
Happy-Male		-2.91		2.78		3.04
Neutral-Female	-0.15	0.79	-0.40	-1.28	0.80	1.38
Neutral-Male	-0.32	0.70	-0.09	-0.90	0.62	1.00
Angry-Female	3.05		-2.53		3.62	
Angry-Male	2.92		-2.21		3.46	

Results

Mean Difference Scale Values (MD). The mean difference scale values (*MD*) between each emotion face type were calculated and submitted to paired-sample *t*-tests. The difference between the *MDs* of angry/neutral male (ANMale) faces in Block A, Group A ($M_{ANMale} = 3.24$) and happy/neutral (HNMale) Block H, Group H ($M_{HNMale} = 3.94$) was significant, $t(29) = -3.25, p = .003$; there was a lesser distance between angry and neutral male faces in Block A than between happy and neutral male faces in Block H, and the same pattern of results was found for female faces ($M_{ANFemale} = 3.19$; $M_{HNFemale} = 4.20$), $t(29) = -3.68, p = .001$.

Additionally, there was a difference between the overall scale values (see Table 1) of neutral faces in Block A, Group A and in Block H, Group H, $t(58) = -7.99, p < .001$, and the same pattern of results was shown for Block H, $t(58) = 6.60, p < .001$. There was, however, not a significant difference in overall scale values between angry faces in Block A, Group A and happy faces in Block H, Group H ($p = .459$), showing that the greater mean difference between angry and neutral faces than between happy and neutral faces is based mainly on a difference in scale values for neutral faces in Block A and Block H and not between angry faces in Block A and happy faces in Block H for the respective groups.

Interestingly, regarding the *MD* values of angry/neutral faces, Group A, was greater than the *MD* values for happy/neutral faces, Group H, Block E, $t(58) = 4.28, p < .001$, and this difference was driven also by the difference in overall emotionality scale ratings for neutral faces, $t(58) = -2.86, p = .006$, and by the difference between angry and happy faces in Block E, $t(58) = 2.55, p = .013$. In Block E, there was a greater distance between angry and neutral faces than between happy and neutral faces.

Adjusted d' (d'_A). The d' values [$d' = z(H) - z(FA)$, Macmillan & Creelman, 2005] were recalculated and adjusted by dividing the d' values for each participant with the *MD* between each emotional face type and its corresponding neutral face (see Figure 1). The d'_{AS} were calculated as d'/MD for emotional-gender face and presentation time and then submitted to a 2 x 3 (Gender-of-Face [female, male] x Time [12.50, 18.75, 25.00 ms]) repeated measures ANOVA. The d'_{AS} increased with presentation time, $F(2,57) = 253.71, p < .001, \eta_p^2 = .90$. This increase was greater for Group H than for Group A, $F(2,57) = 32.77, p < .001, \eta_p^2 = .54$, and greater for male than for female faces, $F(2,57) = 13.18, p = .001, \eta_p^2 = .19$.

In paired-samples *t*-tests for each presentation time within each group showed that there was no difference between happy-male and happy-female faces for each presentation time ($ps > .058$). For angry faces at 18.75 ms and 25.00 ms, male faces were more easily detected than female faces ($ps < .001$).

Conclusion and Summary

The aim of the present study was to examine, with a refined method, how the detectability of an emotional expression (as measured by d') shifts in relation to emotion type (angry, happy) and gender of the face. This was done in order to replicate and combine the methods of Pixton and colleagues' (2007, 2008) studies to overcome the potential confounders that results came from different samples (2008), as well as from one group (2009) all of which the task was to detect emotion and not a specific emotion.

As found in the previous studies by Pixton and colleagues, the results of the present study indicate that presumably neutral facial stimuli may not be really neutral. 'Neutral' expressions were judged as being more towards angry when rating anger and as being more towards sad when rating happiness; therefore, the difference between happy and

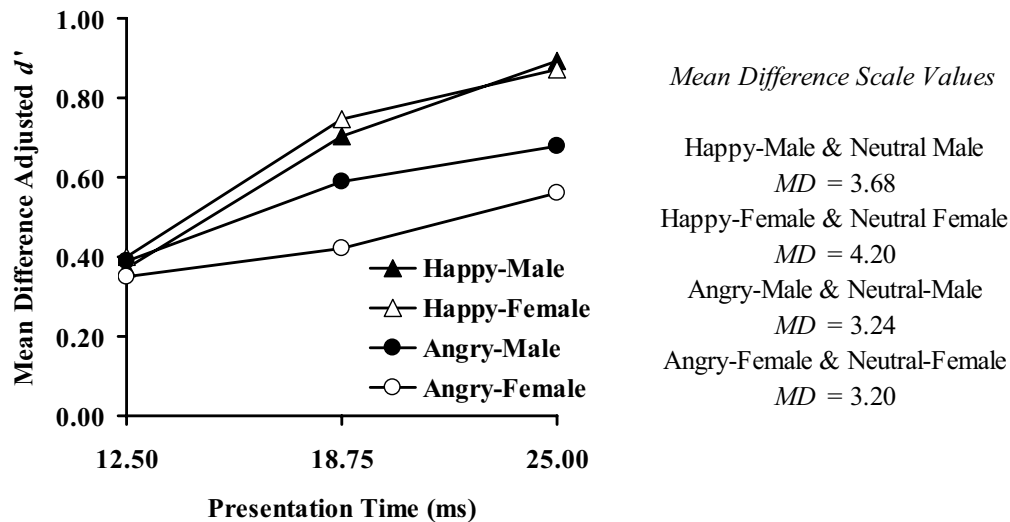


Figure 1. Mean Adjusted d' (d'_A) Values Across Presentation Time in Milliseconds (ms) for Female and Male Faces in Two Emotion Groups.

adjusting d' , a happy-superiority effect remains. An angry-female inferiority effect was found, as was found in 2007 and in 2008. In 2009, an overall male-superiority effect was found that was not found in the present study. As found in the previous studies, the d'_A values for angry-female faces remained lower than for the other face combinations.

In summary, when combining the results from the present study with the results from Pixton and colleagues' (2007, 2008, 2009), overall results shift as a function of the type of stimuli used, the type of task, and the design of the study, whether there is a within-subject or between group design. That which did remain constant throughout the studies is that the angry-female faces remained more difficult to detect than the other gender-emotion face combinations. This result could reflect a confidence that angry women are not threatening.

References

- Macmillan, N. A., & Creelman, C. D. (2005). *Detection theory: A user's guide* (2nd ed.). Mahwah, NJ: Erlbaum.
- Pixton, T. S. (2007). Signal detection analysis of the perception of happiness and anger in briefly presented faces. In Mori, S., Miyaoka, T., Wong, W. (Eds.), *Fechner Day 07. Proceedings of the 23rd Annual Meeting of the International Society for Psychophysics* (pp. 421-426). Tokyo, Japan: ISP.
- Pixton, T. S. (2008). Discriminability and perceived emotionality of facial expressions: The role of the particular face stimuli. In Schneider, B. A., Ben-David, B. M., Parker, S., & Wong, W. (Eds.), *Fechner Day 08. Proceedings of the 24th Annual Meeting of the International Society for Psychophysics*, (pp. 123-128). Toronto, Canada: ISP.
- Pixton, T. S., Englund, M. P., & Hellström, Å. (2009). Detectability and perceived degree of facial happiness, anger, and emotion: The role of the particular face stimuli. In Elliott et al. (Eds.), *Fechner Day 09. Proceedings of the 25th Annual Meeting of the International Society for Psychophysics*, (pp. 393-398). Galway, Ireland: ISP.
- Tottenham, N., Tanaka, J. W., Leon, A. C., McCarry, T., Nurse, M., Hare, T. A., Marcus, D. J., Westerlund, A., Casey, B. J., & Nelson, C. (2009). The NinStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research*.