Sex Differences in Recognition of Face Expressions

Albandri Alotaibi, Abeer Aljuhani, Manal Alqahtani, & Nadia Alahmari
King Saud University, Saudi Arabia

Abstract: Emotional facial expressions are a crucial non-verbal communication skill for humans' interactions. The current study assessed the impact of sex on emotional face recognition. A total of 125 individuals per-formed an online emotional face recognition task. The stimuli were created recutting male and female Saudi volunteers. Results showed that, except of the male participants having faster responses compared to fe-males in general, no main significant differences between the sex group in accuracy nor any significant in-teraction between participant sex and the sex of the faces. Our findings suggests that the effect of sex on emotional face recognition needs further investigation with well calibrated stimuli. Limitations and the di-rection of future research in this area were discussed.

Keywords: facial expressions, emotional faces, sex differences, accuracy, response time, recognition task.

الفروق بين الجنسين في القدرة علي التعرف على التعابير الانفعالية في الوجوه

البندري العتيبي، وعبير الجبهي، ومنال القحطاني، ونادية الأحمري
جامعة الملك سعود، المملكة العربية السعودية

الملخص: القدرة على قراءة تعابير الوجه من المهارات الأساسية في التفاعل الإنساني. اهتمت الدراسة الحالية بدراسة تأثير نوع المفحوص: ذكرا أم أنثى على التعرف على تعابير الوجه الانفعالية المختلفة. 125 مشارك أكمل أداء مهمة التعرف على الوجوه أون لاين. من خلال تصميم تجريبي تم من خلاله عرض صور لوجوه تُظهر انفعالات مختلفة وعلى المشارك اكمال التجربة من خلال تحديد الانفعال الصحيح المناسب لصورة الوجه المعروض. أظهرت النتائج في المجمل أن الذكور كانوا أسرع من الأناث في التعرف على الوجوه بالانفعالات المختلفة، ولكن ذلك لم يمتد إلى درجة الدقة في التعرف على هذه الانفعالات، كما لم تظهر النتائج أية تفاعلات محتملة بين جنس المشارك ونوع الجنس المعروض في الصورة. نوقشت هذه النتائج في ضوء الأدبيات المتاحة، كما نوقشت بعض جوانب القصور في الدراسة الحالية لأخذها بعين الاعتبار في الدراسات اللاحقة ذات الصلة.

الكلمات المفتاحية: التعابير الانفعالية، الوجوه، مهمة التعرف، ادراك الوجوه، زمن الاستجابة، الفروق بين الجنسين.

aaljuhanay@ksu.edu.sa

Introduction

The ability to recognize facial expressions is crucial for human social interaction. It allows us to decide whether we should stop the conversation when we notice angry expressions or to keep it going if we see happy or even neutral expressions. The study of emotional facial expression recognition has attracted attention for a long period (Ekman & Friesen 2003). Decoding emotional facial expressions is considered universal, and females' superiority in decoding emotional faces have been found in literature. For example, a study conducted by McClure (2000) found that female participants were better than male participants in recognizing happy and angry faces, similarly, Schulte- Ruther et al., (2008) found that women outperformed men in recognizing fearful and sad faces, another study con-ducted by Thompson and Voyer (2014) found that female participants were better than their male counterparts at recognizing emotional faces. Other studies have confirmed this finding (Sawada et al., 2014; Sullivan et al.,2017; Olderbak et al., 2018).

A number of factors were proposed explaining the detected sex differences in emotional facial recognition in the relative literature, one of which is that the better performance for female participants is due to their higher level of social sensitivity (Herlitz & Rehnman, 2008). Also, the female's superiority might be related to biological factors such as that they have higher levels of oxytocin – the hormone that is associated with social bonding (Fischer, 2000), or social and environmental factors as women are in general raised to be more attentive to emotional expressions in comparison to men (Schulte-Rüther et al., 2008). However, one should note here that although several studies have been able to find sex differences in this specific cognitive task, some studies have shed the light on the inconsistency of the role of sex on emotional facial recognition. for instance, a study has found that women advantage in emotional facial recognition is only true for certain emotions, such as anger expression (Abbruzzese et al., 2019) other studies found it only in dis-gust expression (Connolly et al., 2019) at a certain age (middle age) (Abbruzzese et al., 2019; Demenescu et al., 2014).

Recent research by Bonassi et al., (2021) have failed to detect any behavioral differences between Japanese female and male participants when conducting a facial expression recognition task. This inconsistency in research findings emphasizes the need for further research to be conducted in this area, using samples from different populations to explore different aspect of emotional facial expression recognition other than what have been studied in the related literature. Studying this possible effect in Arabic culture using Saudi faces is highly important since in a meta-analysis study on the universality and cross-cultural specificity of emotion perception published in 2002 that compiled 87 articles using over 22,000 test subjects sampled from countries all over the world. They report an average agreement rate at just below 80% when test subjects are categorizing photographs of anger, sadness, fear, disgust, happiness, and surprise faces that are posed by members of their own culture, and an average of 68% when test subjects are categorizing photographs of people from other cultures (Elfenbein & Ambady 2002). This "in-group" advantage happen as results of greater experience with the structural features of faces from their own culture and develop relatively greater perceptual expertise with those faces.

The main objective of the current study is to ex-amine the role of sex on the recognition of emotion-al facial in Saudi Arabia. In addition, relevant literature has suggested that the interaction between face sex and participant sex in decoding facial expressions is un-clear (Tipples, 2022). For instance, Hugenberg and Sczesny (2006) found that male and female participants are faster and more accurate to detect happy female faces more than happy male faces, they have also found in one of their experiments that female participants took longer reaction time than male participants to decode the emotional female and male faces. Other studies, however, have failed to detect any interaction between participant sex and face sex (Craig & Lipp, 2018; Smith et al., 2017). Investigating the interaction between face sex and participant sex is an important aim of the current study as it might help us to understand what can contribute to the inconsistency in the findings.

The outcome of the current work could have significant implications to advance our understanding of the underlying mechanisms of this effect – if it is there-and can add to the literature related to the gender differences in cognition and social behavior in general. If the sex differences in emotional face recognition is evident, this result can have several practical implications in several fields such as education applications, security, and social interactions. For instance, when conducting a training course for security purposes, the materials and methods should be designed with sex difference in consideration sensitive to this difference. Sex differences in face recognition should

also be considered when designing or improving education and learning applications, as well as communication and social interaction skills training programs.

Stimuli are usually used in emotional faces research such as the Pictures of Facial Affect (POFA; Ekman & Friesen, 1976) and NIMstim set (NIM; Tottenham et al., 2009) used models that represent certain ethnicities. Faces in these databases are usually Caucasians. As other race bias (ORB) is evident which means Adults are typically more proficient at recognizing faces from their own-ethnic group, as opposed to faces from other-ethnic groups (Bothwell et al., 1989; Meissner & Brigham, 2001), we created a database with Saudi (Arab) faces to avoid such effect, and to build up and develop the Saudi (Arab faces) database with Arabic emotional faces.

To summarize, the current work aims at exploring the role of sex in emotional face recognition and whether there is any interaction between the sex of participant and the sex of face as it suggested by some studies, using Emotional Face Recognition Task with Arab faces. Examining the interaction between face sex and participant sex in Saudi Arabia can also add more understanding on the nature of to this interaction if it exists, as it is until recently, most women in Saudi Arabia were covering their faces as part of their religious believe (as a part of Hijab), and the Saudi sociality in general used to segregate women and men in every aspect of their lives. This segregation is still ongoing in many aspects of life and in some government sectors such as the ministry of education. This case could lead to less experience on how other sex is expressing their emotions resulting in more difficulty in recognizing the other sex facial expressions. The second aim of this paper is to explore the interaction between face sex and participant sex.

Methodology

Ethical statement

The study was conducted in accordance with the ethical guidelines of the king Saud University and the American psychological association (APA) and was approved by the king Saud university ethics committee. Ref No: KSU-HE-20-498

Participants

Actors: Eighty- five volunteers were asked to pose for the basic 6 facial emotional expressions. The actors were young Saudi adults (49 male, 36 female) with age ranged between 19 – 30 years in the creation

of this Saudi digital photographs of faces with a total of 575 images.

Raters: A total of 132 Saudi participants took part in this study via snowball method. The inclusion criteria are Saudi citizen, and ages between 18- 60. Participants were divided into two groups, based on their sex. The number of male participants was 62, mean age was (M= 26.1 years, SD= 7.13), ranging from 18-52, and 91.80% of them were right-handed. The number of female participants was 70, mean age was (M= 27.27 years, SD= 8.85), ranging from 18- 58, and 92.96% of them were right-handed. Data collected between February – April 2021.

Stimuli and Procedure

Each actor was asked to sign a written informed consent document, in which it explained the main purpose of the research and the use of the photos in psychological research. The actor's names were not linked to their pictures. Prior to photographing an expression, the researchers provided the model with a definition and image of the target emotional expression for him/her to express the specific emotional expressions, and when it is required, the researchers provided a hypnotical scenarios that would elicit the specific emotional expression, such as imagining that they meet a dear friend who was absent for a while and read it out loud for each emotional expression. After giving informed consent, each actor was then asked to stand in front of a neutral background to perform a neutral, happy, sad, fearful, angry, disgust expression while looking directly into the camera. Photographs were taken with a digital camera 10-megapixel canon power shot E 1. The camera was stabilized on a tripod approximately six feet away from the actor. All images were then downloaded to a computer and edited in Adobe Photoshop (Version 21) to produce greater uniformity across pictures taken in two different locations, the images were grey scaled and resized to a 400X500 pixels, resolution 300 pixels/ inch and saved in bitmap format. The original images in jpeg format were also kept.

The three researchers examined all images in order to decide if the actors had successfully expressed the target emotions, 48 images had been excluded due to the disagreement on the expressed emotion. Due to the covied-19 looked down, the decision was made to run the current study as an online-based experiment (see https://cppafs.com/ server). The website was created using the Laravel framework and php programming language.

- Html-css -js was used as the system interface

- My mysql database was used

- The domain http://cppafs.com/ was created through the https://ae.godaddy.com/ platform, and a subscription was made for one year

- A subscription has been made to a server for a full year on the platform https://www.hostinger.ae/

Participants were recruited via snowball method using this link https://cppafs.com/ to rate the expressions of the images. Each participant was presented with an image in the center of the screen with the 6 emotion labels underneath the image, and they were instructed to choose the best label that fit the expressed emotion. Participants had an unlimited time to respond as the image stayed on the screen until the response was provided, however participants were instructed to give a quick response. The order of the images was randomized for each participant. Participants provided a consent form online before they rated the emotional facial expressions.

Results

Performance for each participant was summarized by the proportion of correct identification of emotional expression and the mean response times (RTs) of the accurate responses. Before analysis, and since a serious number of actors asked later to remove their photographs, the study has stopped, and the quality of the acquired data was examined. Authors have decided to remove all photographs that received less than 50% of correct emotional expression identification as it might mean that the emotion expression is ambiguous (Jaeger, 2008; Kubiszyn & Borich, 2010)), resulting in removing 215 photographs. Additionally, photographs that received less than 10 rates was removed resulting in removing 4 extra photographs. Means and standard deviations of the measured variables are reported in Table 1. We present the proportion of correct identification of emotional expression first, and then we present the mean response time of the accurate responses.

Table 1: Means and standard deviations of the male and female groups in the measured variables

|	Male group			Female Group		
	Mean*	M.M.Faces**	M.F.Faces***	Mean	M.M.Faces	M.F.Faces
Accuracy	0.74 (0.16)	0.75 (.18)	0.72 (0.20)	0.77 (0.12)	0.78 (.16)	0.77 (0.16)
Response Time	4.52(2.28)	4.39 (1.85)	4.44(2.39)	5.48(2.48)	5.05(2.03)	5.30(2.48)

Note. *Mean accuracy & RT in all stimuli, ** mean accuracy & RT in male faces, *** mean accuracy & RT in female faces, Numbers in prentices represents standard deviation

In order to detect and effect of sex of the participant on emotional facial recognition or any interaction between participant sex and face sex, a two (sex of the participants: male/ female) as a between subject variable x two (the face sex presented in the stimuli: male/ female) as a within subject variable, mixed design analysis of variance ANOVA was conducted on the accuracy measured by the proportion of the correct identification of expression and the mean response time as dependent variables.

The proportion of the accurate identification of emotional expression

The mixed design ANOVA revealed no significant effect of the gender of the face presented in the photographs on the accuracy, $F_{(1, 128)}, = 0.61$, p= 0.44, and no significant interaction between the face sex presented in the photographs and the sex of the participants, $F_{(1, 128)}, = 0.06$, p= 0.81. Additionally, the analysis did not reveal a main effect of groups, $F_{(1, 128)}, = 2.06$, p= 0.15 as figure 1. shows.

Figure 1. The proportion of accurate identification of emotional expression for male and female groups.
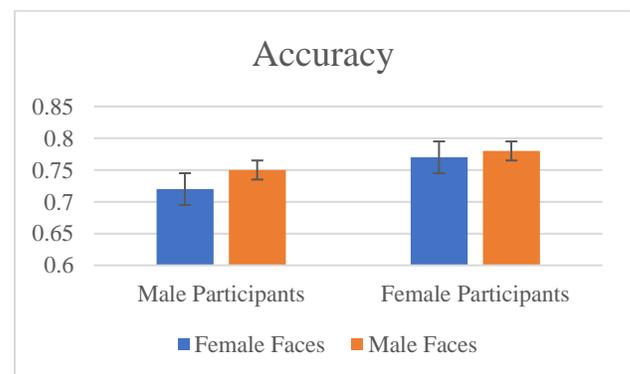
The mean response times on the correct identification of emotional expressions photographs.

The mixed design ANOVA revealed no significant effect of the sex of the face presented in the photographs on the response times, $F (1, 129), = 0.48, p= 0.44$, and no significant interaction between the sex of the face presented in the photographs and the sex of the participants, $F (1, 129), = 0.4, p= 0.4$ However, the analysis revealed a main effect of group, $F (1, 129), = 5.20, p= 0.02, \eta p2\ 0.35$, as female participants took in general longer mean response time ($M= 5.48, SD= 2.48$) compared to male participants ($M= 4.51, SD= 2.30$), as figure 2 shows.

Figure 2. The mean response time for accurate responses for male and female groups.
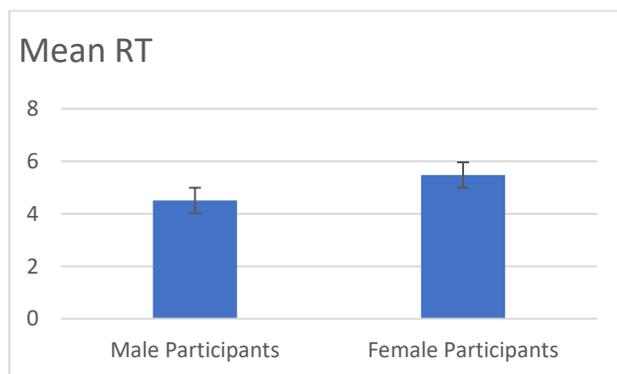
Note. *Error bars represent standard error

Discussion

In the present study, we explored the role of sex on emotional facial recognition, and whether there is any interaction between face sex and participant sex. Our results showed no significant differences between male and female participants on their accuracy performance on the recognition task nor there is an interaction between face sex and participant sex. Additionally, we found that male participants were faster at decoding emotional faces compared to female participants. These findings might challenge the idea that females are in general better than males in reading facial emotions, and it is in contrast with studies that found such female superiority (e.g., Sawada et al., 2014; Sullivan et al., 2017). However, it has some agreements with other studies that failed to detect such a difference which found that Japanese male and female participants did not significantly differ in their ability to properly recognize the emotions expressed (Bonassi et al., 2021) and the study that found young females did not differ from young males in this task (Abbruzzese et al., 2019). In the literature of reaction time, several studies have found that male individuals in general outperform females (e.g., Der & Deary,

2006; Nikam & Gadkari, 2012; Jain et al., 2015) mainly due to their stronger motor responses.

Accuracy results suggest the effect of facial expressions found in our current experiment are comparable for both sex groups. The different nature of the stimuli, as drawing lines, has been suggested for this contradiction (Saylik et al., 2018). However, this explanation cannot be true in this study as we created stimuli with real people expressing different emotions. The intensity of emotions expressed by the models might be indeed one of the possible reasons for finding no significant differences between male and female participants. Although expressing emotions in an intensive way would make it easier to be detected, one should emphasize that we weren't able to detect a flooring effect regarding accuracy findings, in addition to that, a study conducted by Wingenbach et al., (2018) was able to find female advantage in decoding emotional faces under different intensity levels using video stimuli. To put this possible explanation under test, future research should vary the degrees of emotional intensity expressions and investigate the effect of sex on these different levels of emotional intensity in the Arab world.

Our results were confirming Abbruzzese et al., (2019) findings, which showed that male and female participants (between 28-54 years age) did not differ in their exploring strategies (focusing on the eye area) when exploring emotional faces using eye-tracking technique. The similarities between male and female individuals may be more pronounced in collectivism cultures, which might be the reason for not detecting any sex differences in decoding emotional faces with Japanese participants (Bonassi et al., 2021). One should note here that we could not test the suggested sensitivity in the relative work for females to detect angry expressions due to the withdrawal of female volunteers and collapsing all face expressions in one condition.

Limitations of the Study

The current findings should not be considered without emphasizing several limitations. Female participants in our sample outnumbered the male participants. Moreover, and due to the widespread withdrawal from most of the female actors in time of carrying out the study, in order to achieve good quality of our data, we choose stimuli that receives 10 or more rates and receives more than 50% of accurately recognizing the right emotional expres-sion to be analyzed. This process led to losing 219 stimuli and for

that the decision was made to col-lapse facial expressions in one condition. It should be noted here that mean response time for both sex groups were less than 6 seconds as reaching this time window could be considered as failing to recognize the emotions expressed (Saylik et al., 2018). Future studies should pay extra attention to build a well calibrated Arabic face database for individual assessments that pretested the stimuli on the cate-gory typicality and other factors which known to influence face recognition such as attractiveness, and to train the actors to express their emotions in a natural mean without any need to observe a model to avoid fakeness and be more ecologically valid. Finally, because of the COVID-19 pandemic, the study was conducted online. Although several studies have shown that online testing can have comparable reliability to laboratory testing (Chetverikov & Upravitelev 2016), we expected some degree of loss of control on online data which may affect its quality.

Conclusion

In conclusion, the current paper aims to investigate the role of sex on emotional face recognition and to explore any interaction between participant sex and face sex, for this, we compared male and female Saudi participants on the response time and accuracy when performing emotional face recognition task. Findings suggested that the effect of sex on emotional face recognition is not as evident as it is proposed in relative literature, and it still needs further investigations with different cultures and using well calibrated stimuli.

References

Abbruzzese, L., Magnani, N., Robertson, I. H., & Mancuso, M. (2019). Age and gender differences in emotion recognition. *Frontiers in Psychology, 10*, 2371. https://doi.org/10.3389/fpsyg.2019.02371

Bonassi, A., Ghilardi, T., Gabrieli, G., Truzzi, A., Doi, H., Borelli, J. L., Lepri, B., Shinohara, K., & Esposito, G. (2021). The recognition of cross-cultural emotional faces is affected by intensity and ethnicity in a Japanese Sample. *Behavioral sciences (Basel, Switzerland), 11*(5), 59. https://doi.org/10.3390/bs11050059

Bothwell, R. K., Brigham, J. C., & Malpass, R. S. (1989). Cross-racial identification. *Personality and Social Psychology Bulletin, 15*(1), 19-25. https://doi.org/10.1177/0146167289151002

Chetverikov, A., & Upravitelev, P. (2016). Online versus offline: The web as a medium for response time data collection. *Behavior Research Methods, 48*, 1086–1099. https://doi.org/10.3758/s13428-015-0632-x

Connolly, H. L., Lefevre, C. E., Young, A. W., & Lewis, G. J. (2019). Sex differences in emotion recognition: Evidence for a small overall female superiority on facial disgust. *Emotion, 19*(3), 455–464. https://doi.org/10.1037/emo0000446

Craig, B. M., & Lipp, O. V. (2018). The influence of multiple social categories on emotion perception. *Journal of Experimental Social Psychology, 75*, 27–35. https://doi.org/10.1016/j.jesp.2017.11.00

Demenescu, L. R., Mathiak, K. A., & Mathiak, K. (2014). Age- and gender-related variations of emotion recognition in pseudowords and faces. *Experimental aging research, 40*(2), 187–207. https://doi.org/10.1080/0361073X.2014.882210

Der, G., & Deary, I. J. (2006). Age and sex differences in reaction time in adulthood: Results from the United Kingdom Health and Lifestyle Survey. *Psychology and Aging, 21*(1), 62–73.https://doi.org/10.1037/0882-7974.21.1.62

Ekman, P., & Friesen, W. V. (1976). *Pictures of facial affect.* Consulting Psychologists Press

Ekman, P., & Friesen., W. (2003). *Unmasking the face: A guide to recognizing emotions from facial cues.* Ishq.

Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: A meta-analysis. *Psychological Bulletin, 128*(2), 203–235. https://doi.org/10.1037/0033-2909.128.2.203

Fischer, A. H. (Ed.). (2000). *Gender and emotion: Social psychological perspectives.* Cambridge University Press. https://doi.org/10.1017/CBO9780511628191

Herlitz, A., & Rehnman, J. (2008). Sex differences in episodic memory. *Current Directions in Psychological Science, 17*(1), 52-56. https://doi.org/10.1111/j.1467-8721.2008.00547.x

Hugenberg, K., & Sczesny, S. (2006). On wonderful women and seeing smiles: Social categorization moderates the happy face response latency advantage. *Social Cognition, 24*(5), 516–539. https://doi.org/10.1521/soco.2006.24.5.516

Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of Memory and Language, 59*(4), 434-446. https://doi.org/10.1016/j.jml.2007.11.007

Jain, A., Bansal, R., Kumar, A., & Singh, K. D. (2015). A comparative study of visual and auditory reaction times on the basis of gender and physical activity levels of medical first year students. *International Journal of Applied & Basic Medical Research, 5*(2), 124–127. https://doi.org/10.4103/2229-516X.157168

Kubiszyn, T., & Borich, G. (2010). *Educational testing and measurement: Classroom application and practice* (9th Ed.). John Wiley & Sons.

McClure, E. B. (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children, and adolescents. *Psychological Bulletin, 126*(3), 424-453. https://doi.org/10.1037/0033-2909.126.3.424

Meissner, C. A., & Brigham, J. C. (2001). Thirty years of investigating the own-race bias in memory for faces: A meta-analytic review. *Psychology, Public Policy, and Law, 7*(1), 3–35. https://doi.org/10.1037/1076-8971.7.1.3

Nikam, L. H., & Gadkari, J. V. (2012). Effect of age, gender and body mass index on visual and auditory reaction times in Indian population. *Indian Journal of Physiology and Pharmacology, 56*(1), 94–99.

Olderbak, S., Wilhelm, O., Hildebrandt, A., & Quoidbach, J. (2019). Sex differences in facial emotion perception ability across the lifespan. *Cognition and Emotion, 33*(3), 579–588. https://doi.org/10.1080/02699931.2018.1454403

Sawada, R., Sato, W., Kochiyama, T., Uono, S., Kubota, Y., Yoshimura, S., & Toichi, M. (2014). Sex differences in the rapid detection of emotional facial expressions. *PloS one, 9*(4), e94747. https://doi.org/10.1371/journal.pone.0094747

Saylik, R., Raman, E., & Szameitat, A. J. (2018). Sex differences in emotion recognition and working memory tasks. *Frontiers in Psychology, 9*, 1072. https://doi.org/10.3389/fpsyg.2018.01072

Schulte-Rüther, M., Markowitsch, H. J., Fink, G. R., & Piefke, M. (2008). Gender differences in brain networks supporting empathy. *NeuroImage, 42*(1), 393-403. https://doi.org/10.1016/j.neuroimage.2008.04.180

Smith, J. S., LaFrance, M., & Dovidio, J. F. (2017). Categorizing intersectional targets: An "either/and" approach to race- and gender-emotion congruity. *Cognition & Emotion, 31*(1), 83–97. https://doi.org/10.1080/02699931.2015.1081875

Sullivan, S., Campbell, A., Hutton, S. B., & Ruffman, T. (2017). What's good for the goose is not good for the gander: Age and gender differences in scanning emotion faces. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 72*(3), 441–447. https://doi.org/10.1093/geronb/gbv033

Thompson, A. E., & Voyer, D. (2014). Sex differences in the ability to recognise non-verbal displays of emotion: a meta-analysis. *Cognition & Emotion, 28*(7), 1164–1195. https://doi.org/10.1080/02699931.2013.875889

Tipples, J. (2023). Analyzing facial expression decision times: Reaction time distribution matters. *Emotion, 23*(3), 688–707. https://doi.org/10.1037/emo0001098

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 nimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research, 168*(3), 242–249. https://doi.org/10.1016/j.psychres.2008.05.006

Wingenbach, T., Ashwin, C., & Brosnan, M. (2018). Sex differences in facial emotion recognition across varying expression intensity levels from videos. *PloS One, 13*(1), e0190634. https://doi.org/10.1371/journal.pone.0190634