THE IMPACT OF FACE MASKS ON EMOTIONAL RECOGNITION ACCURACY: DIFFERENCES AMONG EMOTIONS AND BETWEEN MEN AND WOMEN

A thesis submitted in partial fulfilment
of the requirements for the degree of

MASTER OF ARTS

to the faculty of the

DEPARTMENT OF PSYCHOLOGY

of

ST. JOHN'S COLLEGE OF LIBERAL ARTS AND SCIENCES

at

ST JOHN'S UNIVERSITY
New York

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ABSTRACT

THE IMPACT OF FACE MASKS ON EMOTIONAL RECOGNITION ACCURACY: DIFFERENCES AMONG EMOTIONS AND BETWEEN MEN AND WOMEN

Khaled Jamal Alharbi

Emotional recognition is central to social interactions. This study aims to explore the impact of face masks on the recognition of six emotions, including a neutral emotion condition. In addition, the impact of face masks on the well-established superiority of women at emotion recognition is investigated. A total of 135 college age participants (106 women and 29 men) were recruited. Participants were shown five replications of male and female targets exhibiting 6 emotions in masked and unmasked conditions for a total of 120 stimuli, and the six emotions included Anger, Fear, Disgust, Happiness, Sadness and Neutral. After each stimulus was presented, the participants were given a list of the six emotions and asked to choose the one that the target was displaying. The data were collected online using Qualtrics Survey software. For each stimuli the participants' response was scored as correct (1) or incorrect (0) and the responses were summed across the five replications in each condition. This result is a 6(emotion) x 2(Actor Gender x 2 (Masked or Unmasked) x 2(Participant Sex) mixed design with repeated measures on the first 3 factors. Overall, women were more accurate than men at emotion recognition and masking had the expected overall negative effect on emotion recognition, but men were more negatively impacted by masks than women. Accuracy also differed among the

emotions with Fear the most accurately detected and Sadness the least. However, men and women did not differ in their relative accuracy across the six emotions (women were always superior). Some higher order interactions were also found but these did not change the above overall conclusions about our primary hypotheses.

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1.0 Introduction

The Covid-19 pandemic necessitated the wearing of facial masks, which is thought to have caused difficulties in social interactions including the basic identification of faces (Nestor et al., 2020), and the recognition of emotions. Masks do not cover the whole face, but they cover some features that may be used to make judgements on emotions. The compromising effect of face masks on the detection of individuals' emotions was reported by Kastendieck, Zillmer and Hess (2022), who cited studies by Carbon (2020) and Grundmann *et al.* (2021). The impact on social communication which requires a combination of verbal and non-verbal cues was documented by Tsantani et al. (2022). The purpose of the research reported here is to replicate and extend these findings by examining the effect of masks on the accuracy of the detection of six different emotions expressed by male and female actors by male and female participants.

Facial features and their contribution to successful emotional recognition

Wegrzyn et al. (2017), documented which facial features are related to successful emotional recognition. Although the mouths and eyes are always a key part in decoding facial expressions, the study further investigated which specific physical features are the most relied on when we decode facial expressions. In the experiment individual faces expressing basic emotions were shown and systematically hidden behind 48 tiles that were uncovered sequentially. The participants were asked to stop the sequence as soon as they thought they identified an emotion and to state the emotion. The parts of the face that contributed to the correct identification of an emotion were reported. Overall, observers were mostly relying on the eye and mouth regions when successfully recognizing an emotion. Furthermore, the eyes and mouth were most important for

different emotions. Sadness and fear relied primarily on the eyes and disgust and happiness relied primarily on the mouth Anger seemed to require both parts of the face for successful identification (Wegrzyn, 2017).

1.1 Basic Emotions and Their Role in Social Interaction

Mancini *et al.* (2018) posited that there are six recognized emotions, which are fear, anger disgust, happiness, sadness, and surprise (Ekman, 1992). These emotions may be used to predict behavior during social interactions. This will in turn guide adjustments in behavior and communication to ensure effective communication. Tsantani et al. (2022) also demonstrated the relationship between emotions and behavior, with the former determining the latter. Emotional identification is said to develop from childhood, and failure to successfully identify and understand emotions is associated with psychological disorders. The process of emotional recognition is explained by Bandyopadhyay *et al.* (2021) as universal and effective in enhancing communication. The facial features that play an important role in making expressions are the lips, nose, chin, eyes, forehead, and eyebrows. Carbon and Serrano (2021) also identified the eyes as critical features in portraying emotions. People learn to identify and interpret emotions through these features from early in life. Without visuals of these features, it might be difficult to identify the emotions being expressed. However, the overall implication is that the correct reading of emotions is obtained through natural social interactions and is universal across all societies and cultures.

1.2 Gender Differences in Emotion Recognition and Emotional Expression

There is clear evidence that women are generally better at accurately recognizing emotions than men for example, Wingenbach Ashwin and Brosnan (2018) conducted an experiment with 51 males and 60 females to investigate the accuracy that the different sexes had in the identification of emotions. The study made use of expressions that showed the six emotions mentioned earlier. They found that females were both faster and more accurate compared to their male counterparts. However, there was no significant difference between the sexes at identifying a neutral (no emotion) emotional expression in contrast to this finding, Fischer, Kret, and Broekens (2018), initially hypothesized that "women would be more sensitive to subtle cues of emotional expressions" (p.2), no significant difference in the sensitivity to emotional identification between men and women. Their study had a larger sample size but also focused on how sensitive men and women were to emotional expression and not their accuracy at identifying emotion. And many other studies have also emphasized the differences between men and women in processing emotional expressions. A unique study by Collignona, Girarda, Gosselin, Saint-Amour, Lepore, and Lassonde (2009) asked participants to categorize the emotions of fear and disgust displayed visually, auditorily, and audio-visually. The researchers focused on investigating the multisensory processing of emotional expressions utilizing dynamic visual and non-linguistic clips of affective expressions. Their results illustrate a clear discrepancy between women and men in terms of the ability to express and process emotions across all modalities. The study also showed evidence from previous studies that women are not only better at processing emotions but at integrating facial and vocal expressions (Collignon et al., 2008). Further studies have also shown evidence that

women are better than men at recognizing their emotions and expressing these emotions. A study done by Rattel et al. (2020) suggested that women had the tendency to display better concordance between the emotion they are feeling and how they express it compared to men. To elicit emotions the participants watched 15 short video clips, as the researchers recorded the participants' respiratory, autonomic, and facial-muscular responses. In addition, participants were asked to report their subjective emotional experience immediately after watching each of the 15 clips. Women's subjective self-reported emotions tended to better mirror their objective responses. These findings provide strong support that emotions are made of multiple response systems, such as self-report, behavior, and physiology, that are merged and resonate across multiple situations (Rattel, 2020). Their results also revealed a higher response concordance in women than men across the different types of responses. Overall, the evidence clearly suggests that women are better than men at both recognizing emotions and expressing emotions.

2.0 The Impact of Masks on Emotion Recognition

Masks are commonly known as a protective item in healthcare. Clinicians use them during practice. However, in response to the Covid-19 pandemic, everyone was required to wear a mask every day in public to protect themselves and others from getting infected. However, Martinelli *et al.* (2021) noted that this practice is not limited to healthcare or the pandemic. In some cultures, masks are worn by members of society as a cultural practice, and they have a significant meaning. Carbon (2020) reported that face masks cause distortion of facial configuration making it difficult for recognition. This study also associated masks with blocking non-verbal communication. Many important features that enhance emotional and non-verbal communication are covered when a mask is worn Mheidly *et al.* (2020). Specifically, half the face is covered when the mask is properly worn (Kastendieck, Zillmer & Hess, 2022). For example, Carbon and Serrano (2021), found that the expression of sadness was misinterpreted as neutral when a person was wearing a mask Similarly, in a study by Fitousi *et al.* (2021), disgust was mistaken for anger and another study established that "fearful faces were mislabeled as surprise" (Tsantani et al., 2022, p.11). Even a very expressive emotion such as happiness was mistaken for neutrality (Marini *et al.*, 2021).

Due to the near universal use of masks during the COVID-19 pandemic there was an increase in research on the effect of masks on face recognition, the identification of emotions and social interactions. However, research on masks also predates the pandemic. Grundmann, Epstude and Scheibe (2021) investigated the general effect of the mask on facial emotional recognition accuracy in a sample of 191 participants. They based their research on social cognition theory and the rapidity with which people form

impressions of personality. They found that the mask reduced the capability of the individual to categorize and identify emotions. Del Zotto and Pegna (2015) investigated the effect of different attention conditions on the recognition of both masked and unmasked faces. They found that participants were generally more sensitive to negative emotions, whether masked or unmasked. Negative emotions were processed faster than positive emotions. Higher sensitivity to negative emotions was also reported by Kastendieck, Zillmer and Hess (2022).

Face masks were also found to affect the confidence of individuals in identifying emotions Grenville and Dwyer (2021). In this study they recruited 100 students from a university in the UK, who were tasked to view pictures of different people with or without masks. The people in the picture were made to pose with one of six standard emotions. Consistent with other studies they found that accuracy of recognition of emotions on faces without masks was relatively high as compared to masked faces. However, they also found that for the emotions of fear and anger, the accuracy was higher compared to other emotions. In addition to these findings, they found out that without mask, the confidence of participants in their accuracy was higher compared to their confidence in the masked condition

2.1 The Present Study

The present study was designed to investigate the differences in the accuracy of emotion recognition as a function of type of emotion, sex of the actor, masking, and sex of the participant in the same sample of individuals. Thus, the data collect in this study will not only allow us to replicate previous research in the context of several variables,

but also determine if previous results may be conditionally different as a function of the other variables included in this research condition, we proposed the following primary hypotheses:

H1: Emotions exhibited by masked actors would be perceived less accurately than emotions exhibited by unmasked actors, (Main effect for mask).

H2: Female participants will be more accurate than male participants in their accuracy at detecting emotions (main effect for participant sex). However, this superiority will be reduced in the masked versus the unmasked condition (participant sex x mask interaction).

H3 Emotions Displayed by Female Actors will be more accurately detected than those displayed by Male Actors (main effect for Actor Sex).

H4 Emotions that are expressed by the mouth and lower part of the face will be less accurately detected in the masked compared to the unmasked conditions (emotion x mask interaction).

In addition to these primary hypotheses, we will explore the limitations of our findings in the context of higher-order (2, 3, and 4-way) interactions.

3.0 Method

3.1 Participants

Our sample consisted of 135, predominantly college-age participants over the age of 18, from St. John's University (106 women and 29 men). Based on self-identification, our participants are ethnically diverse, with 19 Asians, 31, Hispanic/Latino, 49 White, 27 Black/African American, and 9 unspecified.

3.2 Measures

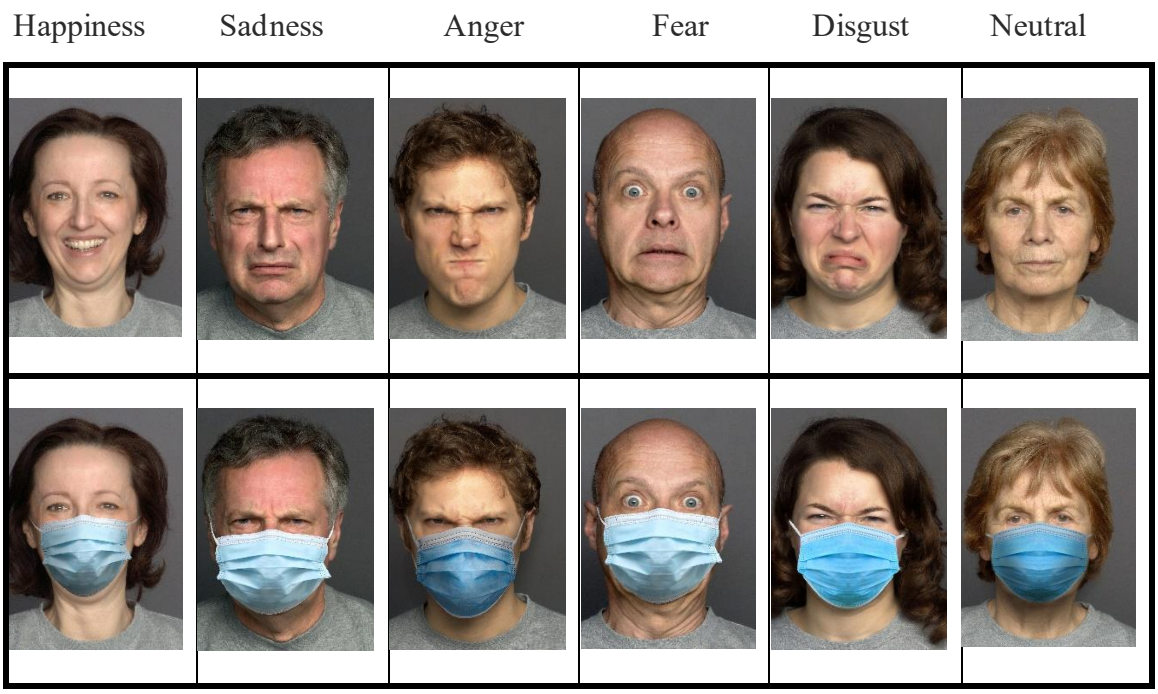
3.2.1Emotion Stimuli

We created a survey using the Qualtrics platform tools and services (Home | Qualtrics Experience Management). The original stimuli were obtained from the MPI FACES Database (Ebner et al., 2010). The stimuli consisted of 5 replications of Caucasian adult male and female actors displaying 6 different emotions (anger, Fear, disgust, happiness, Sadness, and neutral) for a total of 60 stimuli. Masks were then applied to the faces using Adobe Photoshop. We used an image of a typical surgical mask that was applied to the different stimuli. Enhances of dark shadows and contrasts were applied to create a realistic overall image (Figure 1). Thus, each participant responded to 120 total stimuli that were presented in random orders. The response was the selection of the one emotion from a list of 6 emotions that the participant thought was the one portrayed by the actor.

Openness to Emotions: We included the 10 items from the Openness Emotionality facet from the International Personality Item Pool (IPIP) version of the NEO (Goldberg,1999) Participants responded to these items on a 7-point Likert Scale. All measures are shown in the appendix section.

Figure 1

Sample of faces derived from the MPI FACES database.



Illustrates a sample of faces used from the database, showing six different emotions in two different conditions, without a mask and with a mask. The stimuli used in the first row are derived from the MPI FACES database (Ebner et al., 2010).

3.3 Procedure

The experiment was administered online using the Qualtrics survey platform. Our participants were recruited through the SONA research system (sona-systems.com) and received course credit for participation. Participants could only proceed to the study after reading an informed consent form and agreeing to participate in this study by clicking on the "I consent" checkbox. The study comprised two main parts; the primary survey was the set of 120 emotion stimuli. The second part was the 10 items from the Openness

Emotionality NEO facet. We also inquired about the participants' age, gender, and ethnicity. The study generally took 30 - 40 minutes to complete.

4.0 Analysis

For our primary analysis, we began by aggregating the 5 replications of the 24 stimuli by summing the number correct for each participant. This created a 6 emotions x 2 mask x 2 actor repeated measures design. To this, we added the sex of the participant (male or female) as a between-subjects factor. We analyzed these data using a (2 x 2 x 6) x 2 multivariate repeated measures analysis of variance with one between-subjects factor. We report Wilk's Lamda as our test statistic. Secondarily we report the most frequent incorrect emotion for each of the 6 emotions, and the test of this incorrect emotion differs by sex of participant x sex of actor x mask. Finally, we explored the relationship between individual differences in Openness to Emotions and emotion accuracy.

5.0 Results

The primary analysis for the data collected in this research was a (6 emotions x 2 masks x 2 actors) repeated measures analysis of variance with the sex of the participant as a between-subjects factor.

Descriptive Statistics for All Conditions: The means and standard deviations from the 48 cells in this design are shown in (Table 1).

Table 1

Means and Standard Deviations of the Percentage Correct (Out of 5 Replications) for all 48 Cells of the Design.

5.1.1 Descriptive Statistics

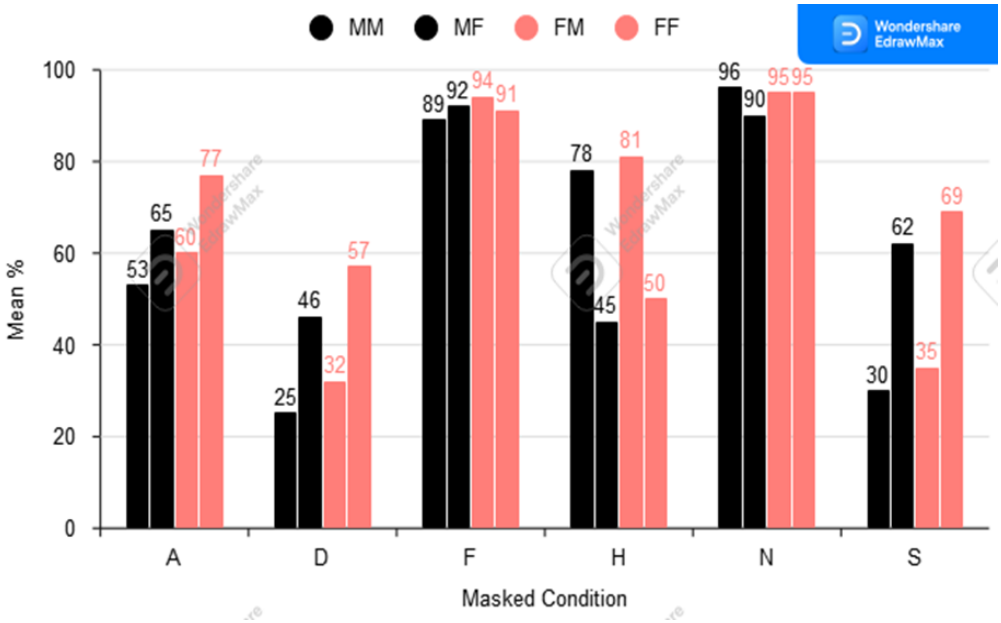
	Participants	Masked		Unmasked	
Actor		Female	Male	Female	Male
Fear	Male	.917 (.173)	.889 (.181)	.862 (.214)	.862 (.214)
	Female	.913 (.143)	.937 (.144)	.915 (.163)	.915 (.163)
Neutral	Male	.896 (.211)	.958 (.154)	.931 (.187)	.689 (.189)
	Female	.954 (.100)	.949 (.123)	.930 (.151)	.728 (.135)
Happiness	Male	.455 (.184)	.779 (.235)	.965 (.151)	.965 (.131)
	Female	.503 (.151)	.805 (.212)	.973 (.107)	.969 (.113)
Anger	Male	.648 (.248)	.531 (.263)	.634 (.227)	.786 (.184)
	Female	.771 (.212)	.592 (.230)	.705 (.221)	.784 (.176)
Disgust	Male	.462 (.221)	.248 (.242)	.903 (.189)	.903 (.189)
	Female	.569 (.218)	.318 (.240)	.979 (.061)	.979 (.061)
Sadness	Male	.620 (.330)	.296 (.182)	.613 (.297)	.434 (.278)
	Female	.692 (.269)	.347 (.189)	.666 (.262)	.452 (.236)

Note. Standard deviations are represented in ( ).

The statistical evaluation of the results shown in the table used a multivariate repeated measures analysis of variance using Wilk's lambda and the resulting F statistic and partial eta squared as the effect size (Table 2).

Figure 2

A 4-way interaction with masked condition on each of the 6 emotions displayed x actorsex x sex.



Note. Black highlights the male participants and pink represents the female participants.

Figure 3

4-way interactions in the unmask condition.

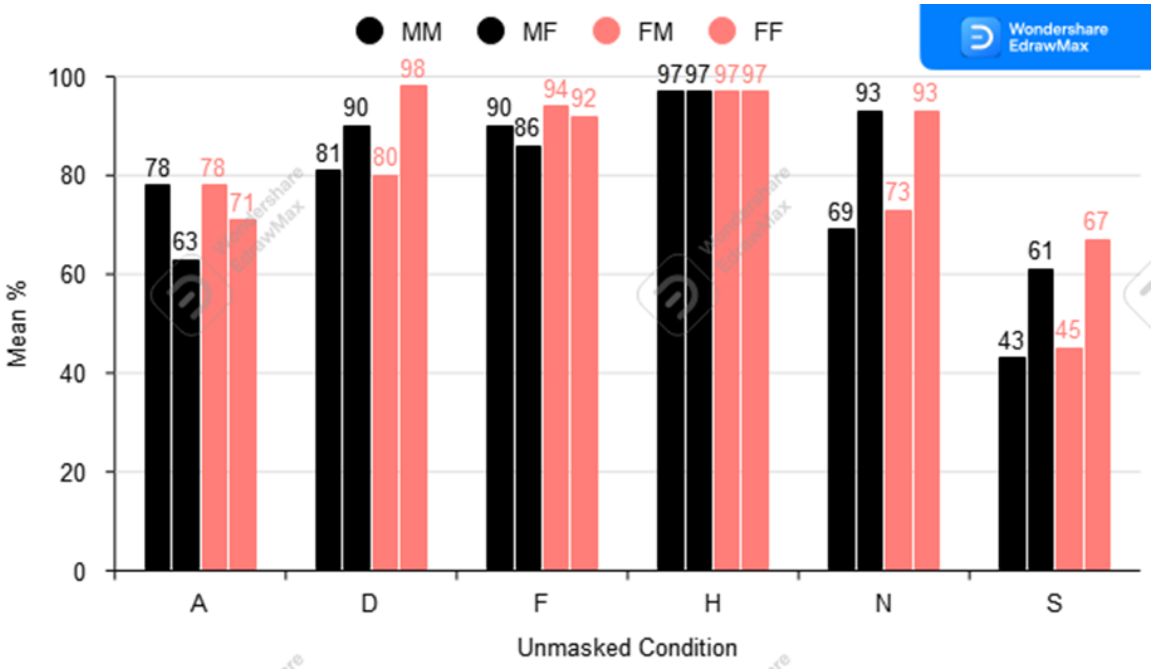


Table 2

Statistical Evaluation of the Results shown in Table 1

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
emotion	Wilks' Lambda	.123	184.035[b]	5.000	129.000	<.001	.877
emotion * SexMF12	Wilks' Lambda	.975	.655[b]	5.000	129.000	.659	.025
mask	Wilks' Lambda	.232	439.862[b]	1.000	133.000	<.001	.768
mask * SexMF12	Wilks' Lambda	.973	3.681[b]	1.000	133.000	.057	.027
ActorSex	Wilks' Lambda	.539	113.574[b]	1.000	133.000	<.001	.461
ActorSex * SexMF12	Wilks' Lambda	.965	4.766[b]	1.000	133.000	.031	.035
emotion * mask	Wilks' Lambda	.112	205.206[b]	5.000	129.000	<.001	.888
emotion * mask * SexMF12	Wilks' Lambda	.960	1.073[b]	5.000	129.000	.378	.040

emotion * ActorSex	Wilks' Lambda	.229	86.731[b]	5.000	129.000	<.001	.771
emotion * ActorSex * SexMF12	Wilks' Lambda	.957	1.165[b]	5.000	129.000	.330	.043
mask * ActorSex	Wilks' Lambda	.998	.303[b]	1.000	133.000	.583	.002
mask * ActorSex * SexMF12	Wilks' Lambda	1.000	.003[b]	1.000	133.000	.959	.000
emotion * mask * ActorSex	Wilks' Lambda	.220	91.299[b]	5.000	129.000	<.001	.780
emotion * mask * ActorSex * SexMF12	Wilks' Lambda	.920	2.249[b]	5.000	129.000	.053	.080

Estimated Marginal Means for the Results are Shown in Table 2.

Below we report all the marginal means, standard errors, and 95% confidence intervals for the tested main effects, two-way, and three-way interactions. The values for the four-way interaction are already shown in Table 1. For the results that are not likely to be zero at the p <.05 level ("significant" (sic)), we also show a graphical representation of the results below each table.

5.1.1 Main Effects

The marginal descriptive results are reported as (mean, standard error, and 95% confidence interval)). The overall grand mean = 74% standard error = .046). For participant sex, men had a mean of 71.9 % (1.6%, 68% to 75.2%), whereas women had a mean of 76.5% (0.9%, 74.8% to 78.2%) for actor sex. Male actors had a mean of 71.4% (1.0%, 69.5% to 73.2%), whereas female actors had a mean of 77% (1.0 %, 75% to 79%). For the overall effect of the mask, masked actors had an accuracy of 67% and unmasked

actors had an accuracy of 81%. The mean percentage correct and their standard errors and 95% confidence intervals for the six emotions are shown in Table 3.

Figure 4

Represents the main effect of sex of the participants and their mean scores.

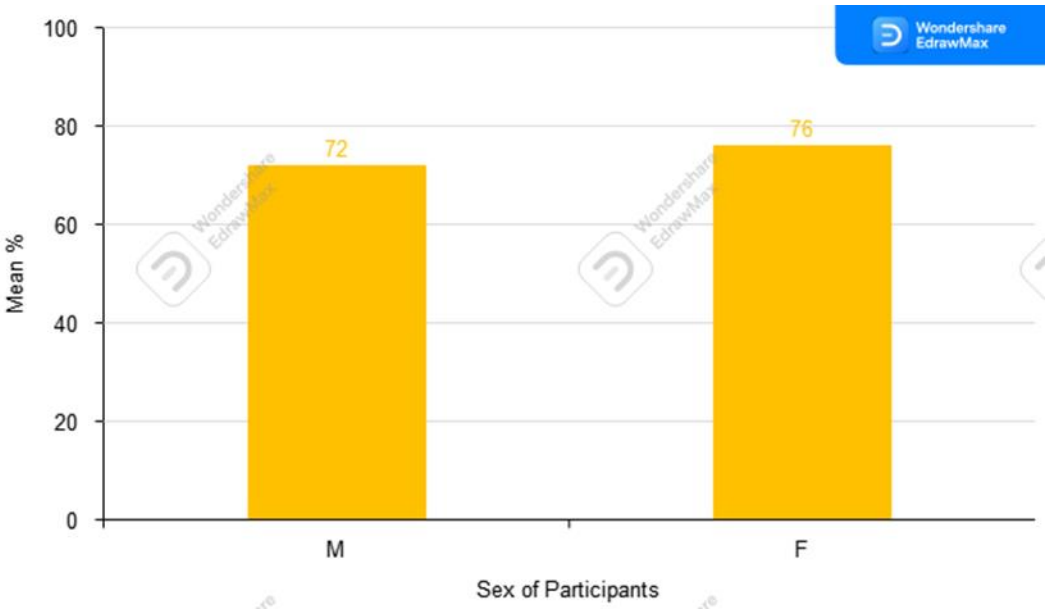


Table 3

Mean Percentage Correct, standard error, and 95% Confidence Interval for the six emotions.

Emotion

Measure: MEASURE_1

Emotion	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1 Anger	.682	.017	.649	.715
2 Disgust	.671	.012	.647	.694
3 Fear	.902	.014	.874	.929
4 Happiness	.802	.013	.778	.827
5 Neutral	.880	.012	.856	.904
6 Sadness	.516	.019	.477	.554

Note. The emotions are represented in this order (1= Anger, 2= Disgust, 3= Fear, 4=Happiness, 5=Neutral, 6=Sadness).

Figure 5

Represents the main effect of emotion, with a significant mean score of 91% correct for decoding the emotion fear followed by neutral. Sadness was the least accurate or most difficult to recognize.

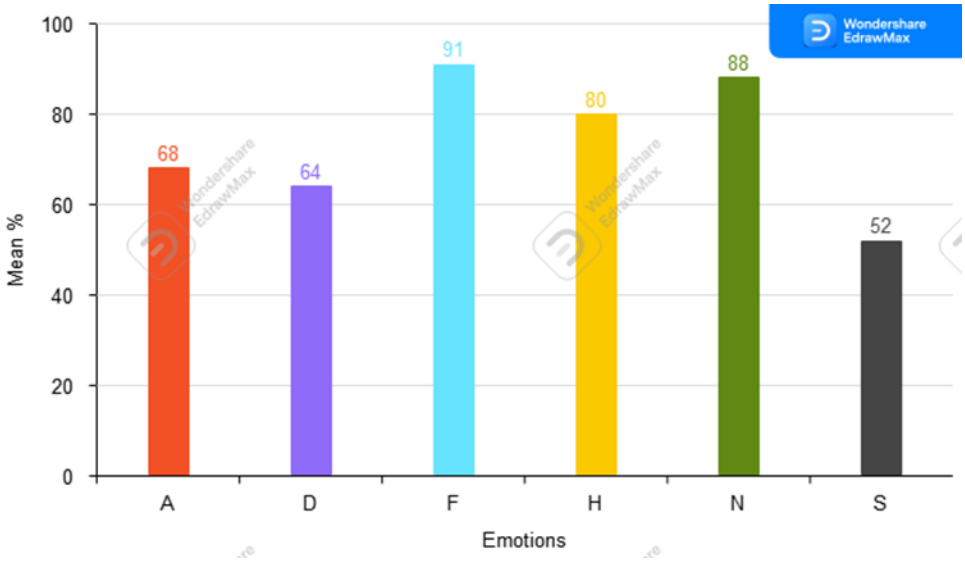


Figure 6

Represents the main effect of mask and their means.

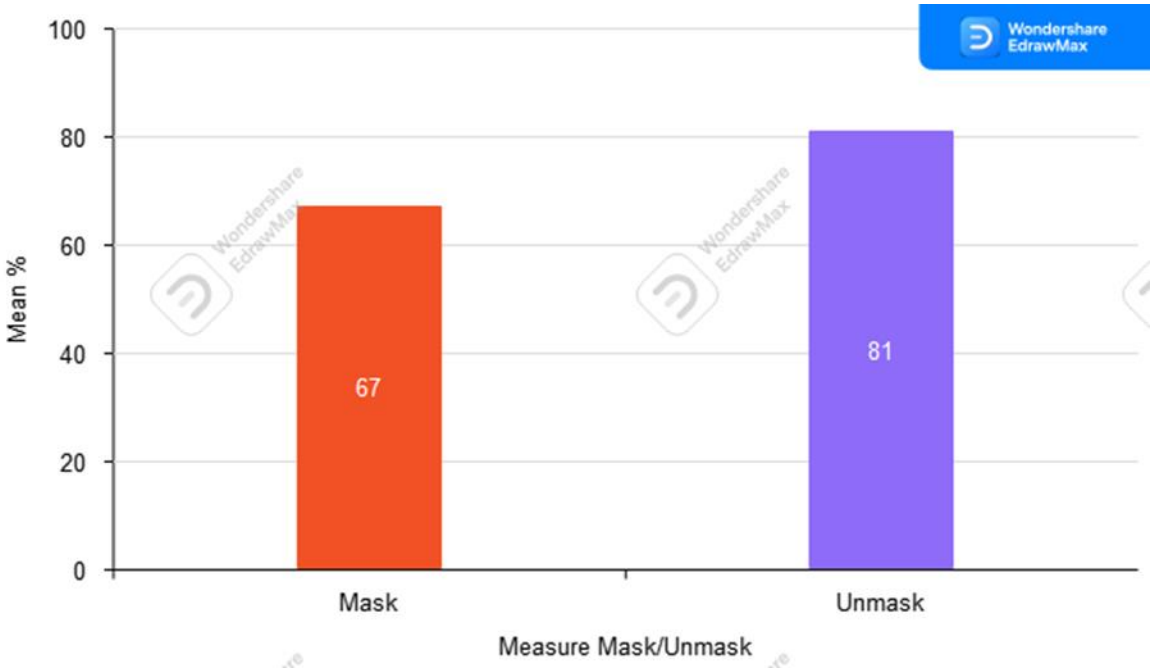


Figure 7

Represents the main effect of ActorSex (TargetSex) and their means.

Two-Way Interactions**:** The marginal means for the six two-way interactions and their associated standard errors and 95% confidence intervals are shown in Tables 4 through 9.

Table 4

Mean Percentage Correct, Standard Errors, and 95% Confidence Intervals for the emotion x mask interaction.

emotion * Mask

Measure: MEASURE_1

emotion	Mask	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	.636	.021	.595	.677
	2	.728	.017	.694	.762
2	1	.400	.019	.362	.438
	2	.941	.011	.920	.963
3	1	.914	.014	.887	.942
	2	.889	.018	.852	.925
4	1	.636	.017	.602	.670
	2	.969	.012	.945	.992
5	1	.940	.012	.916	.963
	2	.820	.014	.791	.848
6	1	.489	.021	.447	.531
	2	.542	.023	.497	.587

Figure 8

This figure also shows a two-way interaction estimate for mask x emotion.

Note. The emotions are represented in this order (1= Anger, 2= Disgust, 3= Fear, 4=Happiness, 5=Neutral, 6=Sadness).

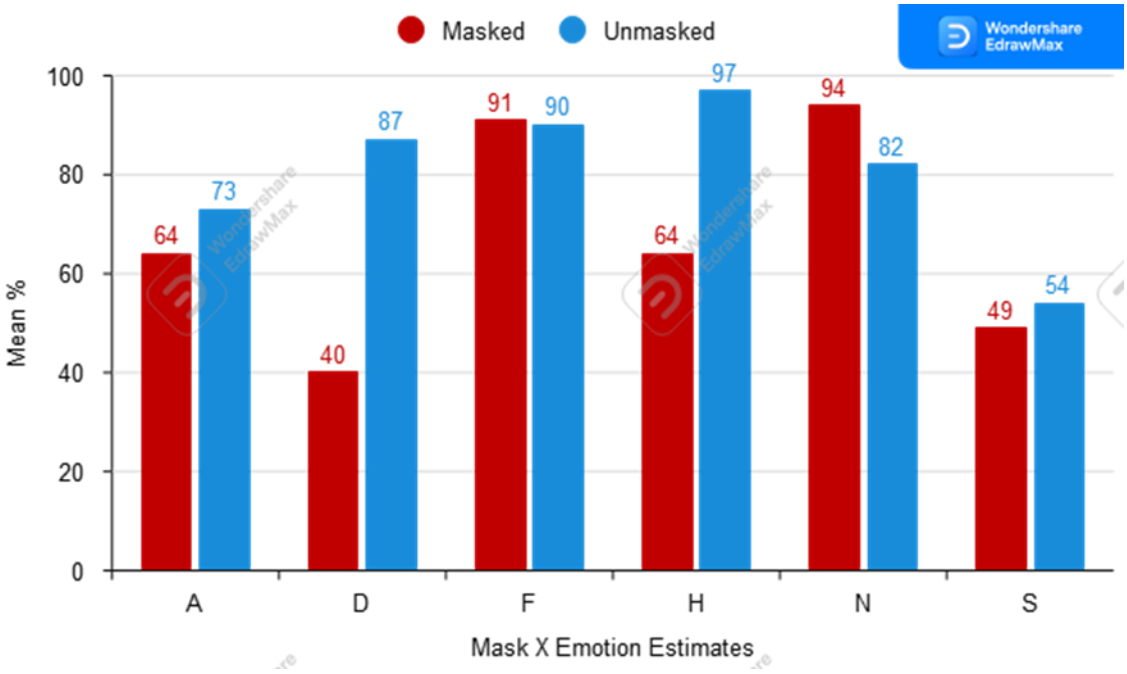


Table 5

Mean Percentage Correct, standard error, and 95% Confidence Interval for Mask x Actorsex effect.

11. Mask * actorsex

Measure: MEASURE_1

Mask	actorsex	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	.700	.010	.680	.721
	2	.638	.011	.616	.659
2	1	.840	.012	.817	.863
	2	.789	.010	.769	.809

Note. Actorsex 1= female actress, 2= males

Figure 9

This figure displays a mask x actor sex and its means.

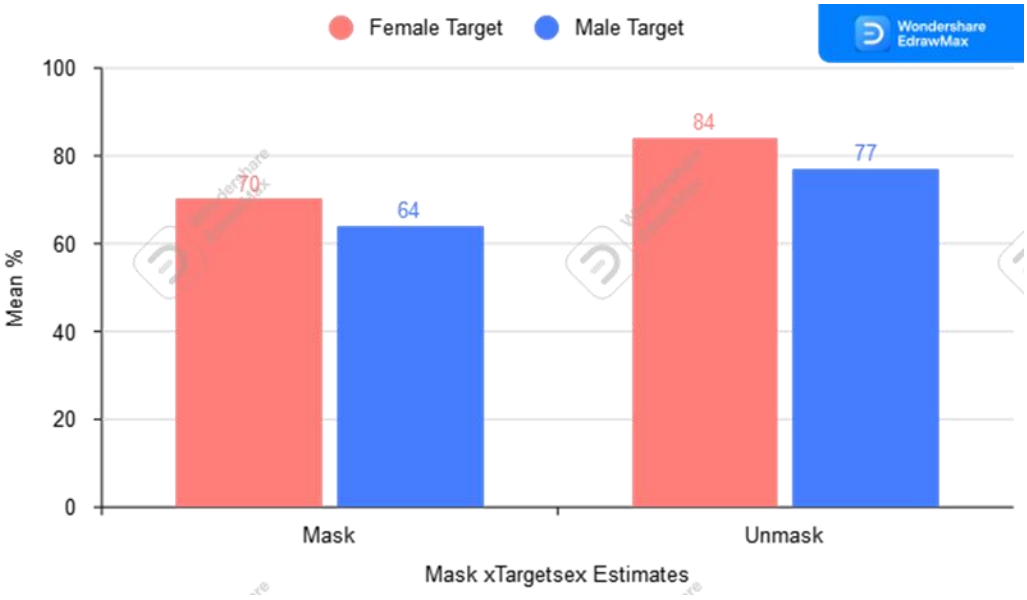


Table 6

Sex x Emotion effect.

6. SexMF12 * emotion

Measure: MEASURE_1

SexMF12	emotion	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	.650	.030	.592	.708
	2	.629	.021	.588	.671
	3	.883	.025	.833	.932
	4	.791	.022	.747	.835
	5	.869	.021	.827	.911
	6	.491	.034	.423	.559
2	1	.714	.015	.683	.744
	2	.712	.011	.690	.734
	3	.920	.013	.894	.946
	4	.813	.012	.790	.836
	5	.891	.011	.868	.913
	6	.540	.018	.504	.575

Figure 10

Illustrates the two-interaction Sex x Emotion mean estimates.

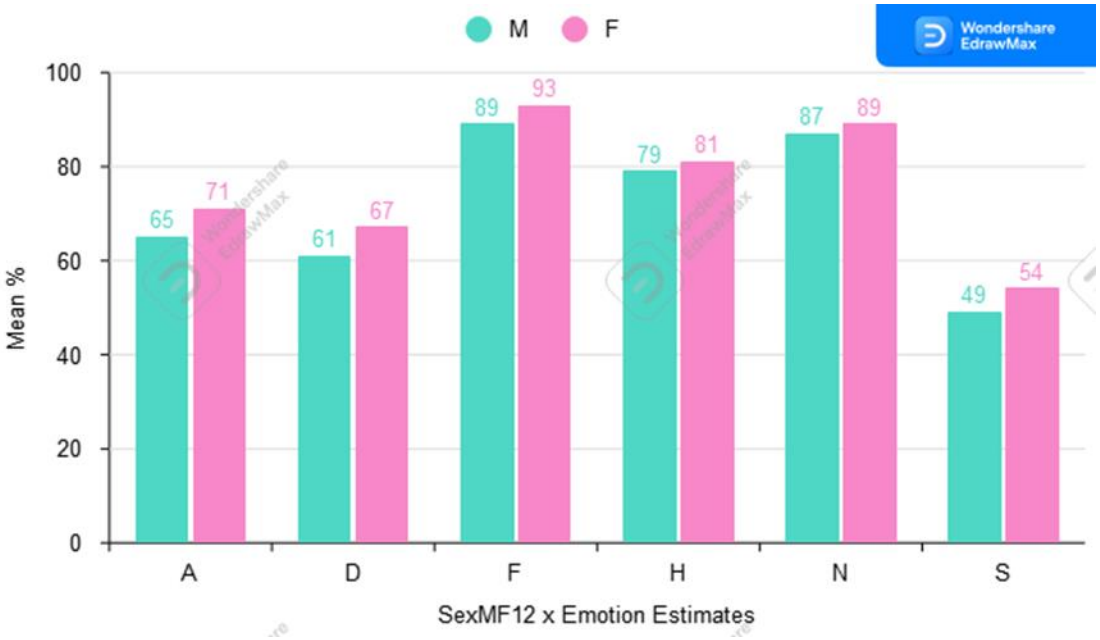


Table 7

Means of the interaction effect sex x actor sex.

8. SexMF12 * actorsex

Measure: MEASURE_1

SexMF12	actorsex	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	.743	.018	.707	.778
	2	.695	.017	.662	.729
2	1	.798	.009	.780	.816
	2	.732	.009	.714	.749

Table 8

The effect between (Emotion x ActorSex)

10. emotion * actorsex

Measure: MEASURE_1

emotion	actorsex	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	.690	.020	.650	.730
	2	.674	.018	.638	.710
2	1	.729	.014	.701	.756
	2	.612	.014	.584	.641
3	1	.902	.014	.874	.929
	2	.901	.015	.871	.932
4	1	.725	.012	.701	.748
	2	.880	.015	.850	.911
5	1	.928	.013	.902	.954
	2	.831	.013	.806	.856
6	1	.648	.025	.599	.698
	2	.383	.020	.344	.421

Figure 11

Emotion x Actorsex and their scored means.

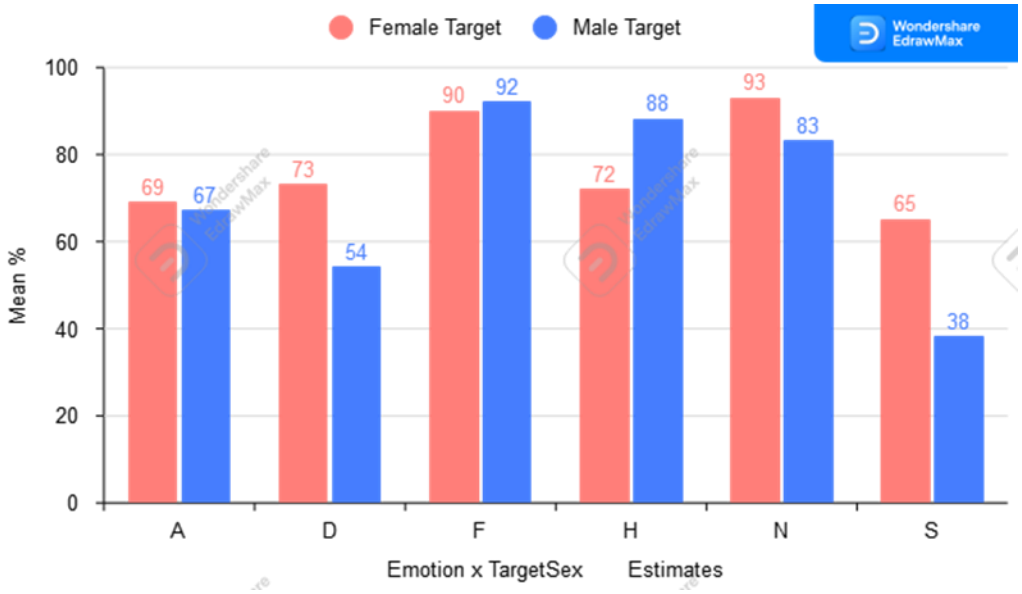


Table 9

A Sex x Mask effect.

7. SexMF12 * Mask

Measure: MEASURE_1

SexMF12	Mask	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	.642	.017	.608	.675
	2	.796	.018	.760	.832
2	1	.696	.009	.679	.714
	2	.833	.009	.815	.852

Figure 12

A Sex x Mask and their mean estimates.

Three-Way Interactions: The marginal mean percentage correct and their associated standard errors and 95% confidence intervals for the four three-way interactions are shown in Tables 10 through 13.

Table 10

A Sex x Emotion x Mask effect.

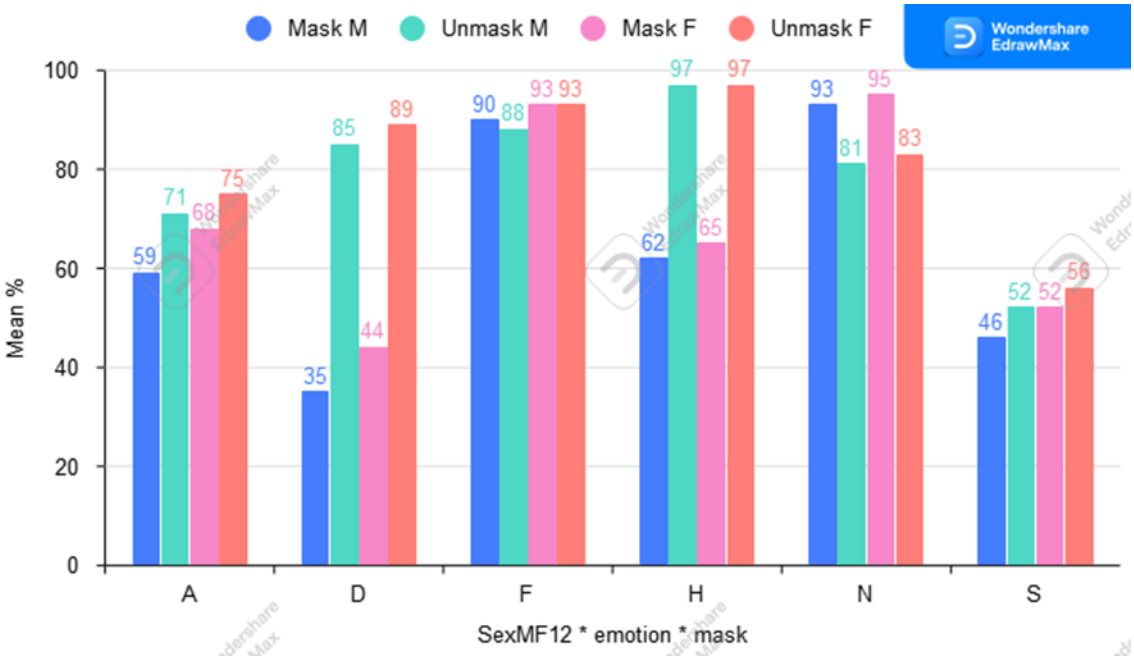
12. SexMF12 * emotion * Mask

Measure: MEASURE_1

SexMF12	emotion	Mask	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	1	.590	.036	.518	.662
		2	.710	.031	.650	.771
	2	1	.355	.034	.288	.422
		2	.903	.019	.866	.941
	3	1	.903	.024	.855	.951
		2	.862	.033	.798	.926
	4	1	.617	.030	.557	.677
		2	.966	.021	.924	1.007
	5	1	.928	.021	.886	.969
		2	.810	.026	.760	.861
	6	1	.459	.038	.384	.533
		2	.524	.040	.445	.604
2	1	1	.682	.019	.644	.720
		2	.745	.016	.714	.777
	2	1	.444	.018	.409	.479
		2	.979	.010	.960	.999
	3	1	.925	.013	.900	.951
		2	.915	.017	.881	.949
	4	1	.655	.016	.623	.686
		2	.972	.011	.950	.993
	5	1	.952	.011	.930	.974
		2	.829	.013	.803	.856
	6	1	.520	.020	.481	.559
		2	.559	.021	.518	.601

Figure 13

A three-way interaction represents a Sex x Emotion x Mask.



Note. Male participants are labeled as (M), and female participants are labeled as (F).

Table 11

A Sex x Emotion x ActorSex interaction.

13. SexMF12 * emotion * actorsex

Measure: MEASURE_1

SexMF12	emotion	actorsex	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	1	.641	.036	.571	.712
		2	.659	.032	.595	.722
	2	1	.683	.024	.634	.731
		2	.576	.025	.526	.626
	3	1	.890	.025	.841	.939
		2	.876	.027	.822	.930
	4	1	.710	.021	.669	.752
		2	.872	.027	.818	.927
	5	1	.914	.024	.867	.960
		2	.824	.022	.780	.868
	6	1	.617	.044	.530	.705
		2	.366	.035	.297	.434
2	1	1	.739	.019	.702	.775
		2	.689	.017	.655	.722
	2	1	.775	.013	.749	.800
		2	.649	.013	.623	.675
	3	1	.914	.013	.889	.940
		2	.926	.014	.898	.955
	4	1	.739	.011	.717	.760
		2	.888	.014	.859	.916
	5	1	.942	.012	.918	.967
		2	.839	.012	.816	.862
	6	1	.679	.023	.634	.725
		2	.400	.018	.364	.436

Table 12

Illustrates a sex x mask x actorsex interaction effect.

14. SexMF12 * Mask * actorsex

Measure: MEASURE_1

SexMF12	Mask	actorsex	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	1	.667	.018	.631	.702
		2	.617	.019	.579	.655
	2	1	.818	.021	.778	.859
		2	.774	.018	.738	.809
2	1	1	.734	.009	.716	.753
		2	.658	.010	.639	.678
	2	1	.862	.011	.840	.883
		2	.805	.009	.787	.823

Figure 14

A three-way interaction represents a sex x mask x actorsex with male participants.

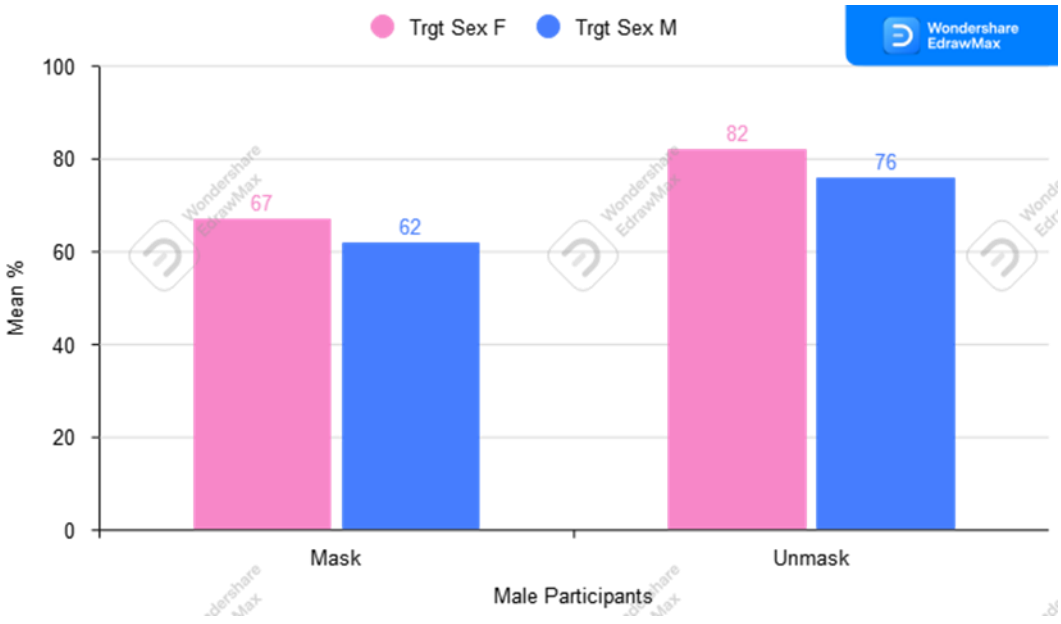
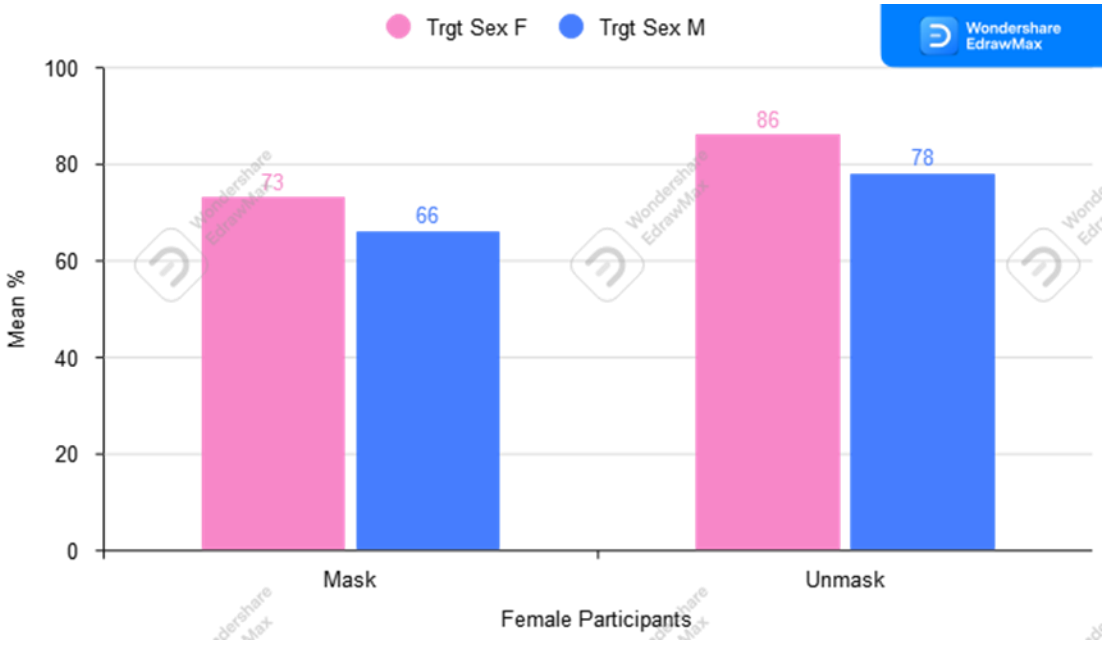


Figure 15

A three-way interaction represents a Sex x Mask x Actorsex with female participants.



The last of the three-way interaction was estimated to examine the overall effect it had on the accuracy of decoding the 6 emotions. An (Emotion x Mask x ActorSex) effect was also assessed to determine if each of the 6 emotions is affected by masked or unmask condition and if it relies on the displayed actor sex. These results are displayed in (Table 13).

Table 13

(Emotion x Mask x ActorSex) It displays the different emotions that are affected by the mask and unmasks condition, which also relies on the actor's sex that's been added.

15. emotion * Mask * actorsex

Measure: MEASURE_1

emotion	Mask	actorsex	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	1	1	.710	.023	.664	.756
		2	.562	.025	.512	.611
	2	1	.670	.023	.624	.716
		2	.786	.019	.749	.822
2	1	1	.516	.023	.471	.561
		2	.284	.025	.234	.333
	2	1	.941	.011	.920	.963
		2	.941	.011	.920	.963
3	1	1	.915	.016	.884	.946
		2	.914	.016	.882	.945
	2	1	.889	.018	.852	.925
		2	.889	.018	.852	.925
4	1	1	.479	.017	.446	.512
		2	.792	.023	.747	.838
	2	1	.970	.012	.945	.994
		2	.968	.012	.943	.992
5	1	1	.926	.014	.898	.953
		2	.954	.014	.927	.981
	2	1	.931	.017	.898	.964
		2	.709	.016	.678	.740
6	1	1	.657	.030	.598	.715
		2	.322	.020	.283	.361
	2	1	.640	.028	.584	.696
		2	.444	.026	.393	.495

6.0 DISCUSSION

This study aimed to evaluate the replicability of women's well-established superiority over men in recognizing emotions across six different emotions. In addition, we considered whether this sex difference was moderated by three different variables, precisely, type of emotion, sex of actor, and if the actor was wearing a mask. The results of the present study replicated the sex difference in emotion recognition, as women were generally superior to men for all emotions and across all conditions. However, the size of the sex difference did vary across the other conditions. However, our primary hypothesis that masks would reduce the sex difference was not supported as the superiority of women compared to men was larger in the masked compared to the unmasked condition. Other findings of note were that fear was the most accurate decoded emotion overall, and sadness was the least accurate and most difficult to recognize across both sexes. However, this also depends on whether it is in a mask or unmask condition. The most accurate emotion to recognize in the mask condition is neutral. The least accurate emotion when masks are on is disgust. The easiest emotion to recognize in the unmasked condition is happiness. What, then, are the implications of these findings?

6.1 The Impact of Masks on Social Interactions.

Recognizing emotions is crucially essential for the successful interpretation of social behavior. Surgical masks greatly impacted the recognition; this may lead to unsuccessful social communications. These results build on the existing evidence that emotional recognition provides new insight into the relationship between social interactions and predicting behaviors within these interactions Mancini *et al.* (2018). In addition, this study may also provide new insight into the relationship between failure to

identify emotions and psychological disorders. This study is also consistent with the findings that masks affect several recognition processes that included gender, identity, emotion, and age Fitousi et al. (2021). The masks affected the accuracy, speed, and categorization of the facial dimensions. Although masks had a negative effect on recognition, the impact varied across different conditions. Different contexts present different effects. Hence, the identification of facial emotions does not solely depend on the faces observed; other factors, such as the observer's disposition towards the observed, also play their roles. Thus, without knowing it, participants may evaluate one face as sad or angry, partly due to their negative attitudes to the face masks worn by the observed persons. Grenville and Dwyer (2022) established that face masks also create biases in how the wearers of face masks present themselves. Implicitly, face masks do not only influence how the face is perceived; they have a bearing on the holistic perception of a mask wearer.

6.2 Limitations & Future Directions

The number of male (29) participating in the study was small relative to the number of women. Although this is typical of psychological research that uses college students, a more significant number of men would enhance the strength of our conclusions. In addition to this limitation, there are potentially confounding variables that were not addressed, such as the displayed actor's specific age. For instance, older male actors displayed to the participants may affect the overall perception of the emotion. We believe that some female or male displayed actors have distinct facial features that might confuse participants in decoding certain emotions. Also, additional limitations are focusing solely on face masks and affecting the perception of emotions. Ross and George

(2021) argued that facial recognition with masks does not decrease if the whole body is exposed. They contended that the inclusion of the whole body eliminated the negative impact of masks on emotion recognition Fitousi *et al.* (2021) also asserted that body gestures helped in the determination of categorizing a face. Contextually, it is important to note that the experiments discussed above concentrated on facial recognition using faces only. However, human communication is not limited to faces. Even though emotions are often associated with the face, all the body parts jointly convey emotions. These findings and views from different scholars provide contrasting information. It might be due to the different stimuli used or the context of the previous experiments. Future research recommends that there be more variations of experiments in this area to gain an in-depth and more precise understanding of the effect of masks on emotion identification.

7.0 Conclusion

The spread of COVID-19 initiated the requirement to wear masks worldwide. This created an obstruction on the face of an individual, which as a result, showed the negative impact of perceiving these different emotions and how less accurate the individual is in detecting these emotions. Our results highlight the differences in the accuracy of recognizing these different emotions between the two genders. Women were slightly better at this due to several factors; it may be related to biological aspects such as regions of the brain responsible for processing emotions and evolutionary where their role as primary caretakers is embedded within them. This forces them to detect distressed emotions accurately and evade any danger that decreases the chances of survival for them and their offspring.

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