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The Effects of a Facial Covering on Human Emotional Perception

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Abstract

Given the ubiquity of masks in the current climate, this study was critical in understanding the population's well-being. The COVID-19 pandemic and quarantine periods demonstrated the need for research on emotional satisfaction for individuals interacting with face coverings. Understanding how humans interpret emotions was the foundation for the previous research conducted on this subject. In this study, we analyzed the research on human emotional perception and whether face coverings negatively affected it. The present study included participants from two different universities ($N = 190$). Participants viewed specific stimuli and then responded to them. The stimuli were two middle-aged individuals either wearing or not wearing masks, and they displayed the six universal emotions plus two additional expressions. Participants tended to misinterpret emotions when viewing masked stimuli, was an observation further evidenced through statistical analyses. In-person research would be critical for replications of our research. Given this, further research needs to be conducted on cultural differences that could impact a participant's ability to interpret emotion correctly.

Keywords: emotion perception, face covering, survey, emotion, emotion valence, masks

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"Face masks are unhelpful in slowing the spread of COVID-19, and they cause cancer and respiratory issues." These types of absurd claims have been circulating since the arrival of face mask mandates across the United States. This research attempts to clarify whether there are any ill effects to wearing masks, at least in one domain. There seems to be a social disconnect that may stem from mask-wearing and other local authorities' safety precautions. Emotional perception is perhaps inhibited by wearing masks. Being patient with others while wearing face masks is imperative. The current events suggest that the general public would benefit from explanations of the actual shortcomings of masks. The purpose of this study is to identify if masks inhibit facial emotional perception. Past research confidently identifies how humans perceive emotion through visual and verbal cues (Martinez & Du, 2012; Norman & Wheeler, 2020). It is possible that face coverings adversely affect emotional perception, and there may be cultural differences, too. This research study will further replicate previous research and attempt to broaden the understanding of facial occlusion and emotional perception.

Literature Review
Understanding emotion

Past research has found that humans understand emotions through facial and vocal cues. Martinez & Du (2012) found that the interpretation of emotions is subconscious to a degree because the brain maps facial features to be in a certain physical plane. However, they also found that we need to see facial cues manipulated to a specific shape to differentiate between negative, positive, and neutral emotions. Calvo and Esteves (2005) conducted research on emotional recognition in both foveal and parafoveal vision. Anger, happiness, and sadness had better recognition accuracy than neutral or other facial expressions across the board. Such research is further evidence for emotion recognition having a subconscious element for speed of processing.

Emotions are not processed only in the visual plane. They are interpreted differently depending on the brain region activated (Cheshire, 2020). In some cases, seeing a negative emotion, such as anger, activates the insula. An fMRI study showed the frontal operculum was also active, which could highlight how humans can feel what they see displayed in others.

Vocal cues are also helpful for correctly interpreting emotions. A study by Rigoulot and Pell (2014) suggested that vocal inflections, when not correctly aligned with facial expressions, demonstrated negative effects. Participants struggled to determine the emotion of the confederate when the voice did not match the displayed emotion. In addition, participants' eyes tracked certain areas of the face depending on the verbal cue received, which was useful in distinguishing emotion. Furthermore, neutral or expressionless faces are confused with frowning ones, and teeth exposure helps identify ambiguous emotions (Park et al., 2015).

Covering the teeth influences where an individual focuses their attention on the face (Blanco & Vazquez, 2017). Teeth coverage forces more attention to the eye region of the face. Thus, humans observe the face and listen to the voice of another to make judgements on what emotion is being expressed. Grasping how humans understand and interpret emotions in a normal environment is key to understanding the pitfalls of an obscured face.

Face Coverings and Emotion

Some research has been done on face coverings and their effects upon human emotion perception. Eye coverings, for instance, are not as detrimental as mouth coverings when accurately identifying emotions. Roberson et al. (2012) studied varying age groups and the effects that sunglasses and mouth coverings had on emotional perception. They used children aged six to ten years, as well as adult student participants. The researchers tested the effects of both eye and mouth coverings, as well as varying levels of the target emotions. Testing for varying shades of anger, sadness, and happiness implemented a nuance into the study that allowed for greater depth of data. The results of the study negatively correlated mask covering and emotion perception. The children showed increased accuracy in emotion when shown faces with sunglasses, which is attributed to being forced to look at the mouth. For all age groups, the mouth covering significantly hindered the accuracy of judging displayed emotions.

Additionally, covering certain areas of the face may hinder accurate perception of certain types of emotions more than others. Guarnera et al. (2018) found young adults in the 18-34 year age range were the best at recognizing all but one emotion: anger. They excelled at interpreting disgust and predominantly used the eye region the most to decipher the emotional stimuli. Also,

when neutral emotions were involved, all participants gravitated toward the eyes for understanding. Fischer et al. (2012) studied a mixed-gender group of university students and their ability to perceive emotions while looking at varying levels of facial obscurity. Full face covering (only eyes were visible) had a more significant negative impact on accurately defining the emotions of the viewed individual. Partial face covering (nose and mouth covered) seemed only to have a negative effect on correctly interpreting positive emotions, such as happiness. Thus, face coverings could not only hinder accuracy in determining emotion, but could also cause people to default to identifying a negative emotion.

Research conducted by Park et al. (2015) with students from Chung-Ang University in South Korea had similar findings. The researchers found that neutral and expressionless faces were more likely to be confused with negative emotions. Moreover, both Spitzer (2020) and Carbon (2020) found that masks are tied to an increase in misinterpretation of emotions, specifically positive ones. A person is perceived to be less happy because the observer cannot see the mouth smiling. Carbon (2020) also noted that several emotions were misinterpreted as neutral, and that one-third of their reported findings confused disgust with anger.

Genuine versus Fake Happiness

There is not a great deal of literature exploring facial coverings and any effects Duchenne or non-Duchenne smiles have on increasing emotional perception accuracy. A Duchenne smile is "a full, or genuine, smile in which the eyes squint as the corners of the lips are drawn upward" (Cheshire, 2020, p.189). However, some research may be sufficient for drawing conclusions. Gunnery and Ruben (2016) found Duchenne smiles were perceived to be more positive overall when compared to fake ones. Additionally, naturally-portrayed genuine smiles fared more favorably. Sheldon et al. (2021) analyzed participants' social and Duchenne smile perception when viewing masked or unmasked images taken from an older dataset. Their findings were that masks predisposed social smiles to be heavily biased toward disgust, with Duchenne smiles slightly affected.

All of the previous research that focused on facial coverings was either extreme full-face covering or only a darkened circle covering the lips and mouth cavity, except for one study conducted recently (Fischer et al., 2012; Spitzer, 2020). The masks ubiquitous in society today are a middle ground that cover the bottom half of the face. The social problems that could stem from everyone wearing masks was not a focus of past research. The possible cognitive and relational ramifications for diminished emotional perception accuracy is also not covered (Carbon, 2020). The differences in the intensity of emotion and cultural effects were also measured. Past research has not focused on the effects of the type of mask that people wear in 2021. These masks vary in size, and they cover faces differently than masks in past studies. Furthermore, these types of masks are associated with COVID-19, which may impact current findings.

The present study examined medical-type masks' effect on emotional perception and attempted to connect with cultural differences. The current study did not use computer-generated images for the image stimuli, but instead used images of actual humans for a more accurate representation of reality. The current research design is as follows: University students were asked to interpret the emotion on a face. Different variations of a face were shown to test for accuracy and possible patterns to emerge. Our hypotheses were similar to previous research, and we sought to further substantiate it:

1. Medical-type masks reduce emotional perception accuracy.
2. An observer of a mask-wearing person will be more likely to misinterpret a genuine or fake smile for a negative emotion.

Methods

Participants

Our sample pool was drawn from both Huntington University—a small private university in the Midwest—and a large public university in the western United States. This study involved a total of 190 participants, including 132 females, 56 males, and 2 participants who preferred not to specify their gender. Participants' ages ranged from 17 to 52 (M = 22.5; SD = 6.04) years. The demographics of the study were White (94%), Black or African American (2%), Asian (<1%), American Indian or Alaskan Native (2%), Middle Eastern or North African (1%), and Native Hawaiian or Pacific Islander (1%). Participants chose from a list of prepopulated demographics with an option to write in an answer if they preferred. Participants from both universities were undergraduates and ranged in grade level from freshman to senior. The sample was obtained through convenience sampling in the university undergraduate student pool

from both universities. All participants gave informed consent and were either entered into a drawing for a $20 Amazon gift card or received course credit for their participation. The study was approved by Huntington University's Institutional Review Board.

Materials/Measures

We used one type of facial covering worn by humans during the COVID-19 pandemic, which was the blue disposable type. The stimulus images were taken via an Apple iPhone® XR in Portrait Mode. The survey was displayed on the participant's own device (e.g., phone, laptop, tablet) through a Google Form.

Sample Stimuli

Participants were shown images of two models, a human cisgender male and a human cisgender female wearing or not wearing a facial covering. The demographics of the people displayed were White and middle-aged. In the masked photographs, the models wore their masks properly covering their face and nose. Unmasked photographs included the models wearing no mask at all. Stimuli examples from the survey are shown in Figure 1, and they both depict happiness. Each participant viewed a total of 21 photo stimuli. The breakdown was as follows: female model stimuli for accuracy of all six emotions (6x), male model stimuli for accuracy of all emotions (6x), female model of intensity of 'fake happy,' 'happy,' 'neutral,' 'fear,' 'sadness' (5x), and male model of intensity of 'fake happy,' 'happy,' 'neutral,' 'fear,' 'sadness' (5x).

Emotion Questionnaire

Participants completed an online questionnaire containing two questions for each stimulus. First, they were asked to indicate the intensity of the emotion through the prompt, "Select the intensity of the emotion shown in this image." Answers range from 1 (very negative) to 7 (very positive). Second, they were asked to choose between the six universal emotions through the prompt, "What emotion is displayed below?" Responses options include: 1. Anger, 2. Sadness, 3. Disgust, 4. Happiness, 5. Surprise, 6. Fear. Participants were given a score of "0" if they answered incorrectly and "1" if they identified the emotion correctly. Participants were given a score of "0" if they answered incorrectly and "1" if they identified the emotion correctly.

Design

The specifics of the study involved a relatively simple two-group experimental design. The independent variables were the presence of a facial covering and the emotion displayed. There was one level to the facial covering as follows: mask covering the nose and the mouth. Six emotions were displayed with happiness being broken into two expression sets. One happiness stimulus would depict a genuine (Duchenne) smile, while the other would be a fake (social) smile. The primary between-groups independent variable was the presence of a facial covering with a within-groups independent variable being the type of emotion displayed. The dependent variables were the accuracy of emotional

Figure 1

Sample Stimuli of Both Masked and Unmasked Genuine Happiness

Note. The stimuli images were taken by the author. Participants were randomly assigned to the masked or unmasked stimulus group.

perception and the accuracy in distinguishing between positive and negative emotions. Participants were randomly assigned to view either masked or unmasked stimuli, and the order in which stimuli were presented was randomly determined.

Procedure

Advertisements were placed in an electronic newsletter and a mass email communication through a faculty member. Some participants were also recruited through their university's online participant pool system. The participants signed up through a Google Forms document. Since the study was conducted remotely and digitally, the participants were given instructions via email and a hyperlink. The participants were encouraged to find a quiet place to start the study, and they were advised to finish the study in one sitting. The hyperlink redirected students to their web browser to begin the survey via Google Forms. An informed consent statement was displayed first, and it needed to be accepted by the participant before continuing. An example of the questionnaire is as follows: The laptop read, "Study this set of images of people wearing or not wearing masks," "After each image, use the response box to select the perceived emotion," and "When finished with the image set, press 'continue' to the next survey." The participant then proceeded through the images. At the end, a thank you message with a debriefing summary was displayed. The course credit and optional gift card information was displayed at the end of the conducted survey.

Results

Both of our hypothesis results are discussed below. Our two hypotheses were tested via chi square and t-test

analysis methods. The results are displayed in Table 1 and Table 2. The first hypothesis is detailed in Table 1 and the second in Table 2.

Hypothesis One

Our first hypothesis—that medical-type masks would reduce emotional perception accuracy in participants—was supported through statistical analyses. Table 1 shows the sample size for both unmasked and masked stimulus groups, as well as the percentages for both samples that identified the correct emotion. We also ran a chi-square test of independence to test for significance of the data. In calculating the chi-square values, we converted the participants' answers to a "0" and "1" format. The correct scoring per emotion was "1" and the incorrect scoring was "0." Table 1 presents the sample sizes to be almost identical for both groups, except for "Fear." As evidenced in Table 1, five of the six universal emotions were confused or misinterpreted more often when the participant viewed a masked stimulus. Sadness, when viewed as a masked stimulus, was misinterpreted around 40% of the time, and anger over 50% of the time. Fear was difficult for both the groups to discern, though the difference between them was significant. Disgust is an excellent example of how inaccurate the masked stimuli participant group was when completing the survey. They had the lowest accuracy score out of any of the other emotions listed. Overall, the accuracy level was generally much lower for participants who viewed the masked stimuli, and these differences were statistically significant for all emotions except happiness. Oddly, those who viewed the masked happiness stimuli did not make a single error in their responses. Besides happiness, those who viewed the unmasked control stimuli had greater accuracy.

Table 1

Emotional Perception Chi Square Results

Emotion	n[a]	%	n[b]	%	X^2	p
Happiness	95	97.8	95	100	0.51	.4751
Sadness	95	85.26	95	60	14.01	<.001***
Anger	95	87.36	95	47.36	34.57	<.001***
Fear	95	50.52	94	15.95	25.4	<.001***
Disgust	95	72.63	95	5.26	90.66	<.001***
Surprise	95	96.84	95	80	13.16	<.001***

Note. $N = 190$ ($n = 95$ for each condition, with exception of "Fear").
[a] Refers to sample size viewing unmasked stimuli
[b] Refers to sample size viewing masked stimuli
***$p < .001$

Hypothesis Two

Our second hypothesis, which was that "an observer of a mask-wearing person will be more likely to misinterpret a genuine or fake smile for a negative emotion," was partially supported. Table 2 shows the t-test results comparing participants who viewed masked stimuli versus those who viewed unmasked stimuli along with the means and standard deviations. The neutral emotion was used as a baseline indicator for "Happy" and "Fake Happy." The scale range was 1 (very negative) to 7 (very positive). Table 2 shows that the means for both participant groups were nearly equal when viewing "Happy" stimuli (Duchenne smile), which demonstrates that this emotion is easily recognizable and a face mask does not detract from interpretation. Conversely, there was a significant difference between the two group means when viewing the "Fake Happy" smiles, with the masked stimuli group rating the smile as more negative, though not as much as we hypothesized. Our findings here coincide with previous literature, which states that fake smiles are viewed more negatively (Gunnery and Ruben, 2016; Sheldon et al., 2021). Interestingly, the group viewing unmasked stimuli rated the smile as more neutral than positive. Although it was not a direct part of our hypothesis, we also tested both groups for the other emotions listed in Table 2. Fear, when viewed as a masked stimulus, was rated as more neutral than negative. Sadness was partly significant because participants who viewed masked stimuli gave more neutral responses than those who viewed unmasked stimuli.

Discussion

We found that participants confused masked emotions more than unmasked. Masked anger and disgust were the most difficult emotions to read, as evidenced by a high percentage of inaccurate scores. Happiness was not misinterpreted for a neutral emotion (as we had hypothesized), when participants were viewing a masked Duchenne smile, likely because eyes are so useful. However, non-Duchenne ("fake happy") smiles were more likely to be evaluated as less positive expressions when participants viewed a masked stimulus. This result correlates well with previous literature (Gunnery & Ruben, 2016; Sheldon et al., 2021). Given the results of our research, we see a few implications for possible continuing research opportunities. Mask-wearing may have a negative side effect among the benefits it provides. In-person research may have different results than a purely online experiment. It would be intriguing to research Eastern and Western cultural differences with emotional perception and expound on previous findings.

Emotional perception seems to be negatively influenced by masks. Given the lack of lower facial cues, negative emotions were difficult to distinguish. This is a validation of Martinez & Du's (2012) research. Participants were much more accurate when they could see key facial features to aid in their decision making. The participants knew an emotion to be negative but inaccurately chose which one. Perhaps the nose and mouth

Table 2

Emotional Intensity T-test Results

Emotion	Mᵃ [SD]	Mᵇ [SD]	t	df	p	Cohen's d
Fake Happy	4.60 [0.84]	3.95 [0.89]	-5.11	185.39	<.001***	0.75
Fear	2.46 [0.71]	3.04 [0.99]	4.28	178.56	<.001***	0.63
Happy	6.35 [0.78]	6.23 [1.04]	0.90	169.93	.369958	0.13
Neutral	3.26 [0.85]	3.02 [0.94]	-1.59	184.13	.112	0.21
Sad	1.72 [0.78]	2.04 [0.74]	2.82	184.37	.005*	0.41

Note. Mean score range is 1 - 7 based on the emotional intensity scale.
ᵃ Refers to unmasked participant mean and *SD.*
ᵇ Refers to masked participant mean and *SD.*
*p<.05.***p<.001

play critical roles in distinguishing negative emotions. Also, we conducted our research in a university setting, which corresponds well with Spitzer's (2020) findings. It would be interesting to see if older adults would have the same issues with emotional perception. Continued research may further validate our studies, but it is also possible that humans could adapt if mask-wearing continues long-term. The population may become more in tune with perceiving subtle facial differences, which in turn may increase accuracy.

Hypothesis 2 Discussion

Since our second hypothesis was partially supported, it brought forth a minor inconsistency with previous research. Park et al. (2015) and Fischer et al. (2012) found evidence that masked smiles can be misinterpreted as negative or neutral emotions. However, we did not find this to be the case across the board, and participants were the most accurate in judgment when viewing happy emotions regardless of masked state. The intensity of the smile may positively affect accuracy, a conclusion which was partially supported by our results. The fake smile confused the participants because the eyes were not giving away any clues. Previous research did not test for smile intensity, which opens the door for a new hypothesis to be tested given our moderately anomalous findings. Therefore, further research may be necessary to reproduce findings and give a more definitive answer.

Research Limitations

Due to the global pandemic, during the spring of 2021 we were unable to conduct our research in-person as planned, so we migrated to a virtual format. Though it decreased our internal validity slightly, it increased the external validity of our study by giving us access to participants outside our local area. It would have been even more interesting research had we been able to sample a more diverse population and increase the diversity of our stimuli. Also, given our use of actual human models for our stimuli, the blurring and lighting surrounding the images had a mild degree of variance, which could be attributed to the photography software. However, we do not believe it introduced a significant confound.

Further Study

There may be an Eastern versus Western cultural component when interpreting emotions. Those who are from Asia seem to look toward the eyes instead of the mouth when interpreting emotions of other humans. Yuki et al. (2007) compared Japanese and American psychology students enrolled in Hokkaido University and Ohio State University. The researchers found that the Americans gravitated toward the mouth for determining the expressed emotion, while the Japanese students gravitated toward the eye. These phenomena were tested in two different experiments, one involving emoticons and the other real human faces. Koda and Ruttkay (2017) had near-identical results, but their participants were Japanese and Hungarian individuals with a mean age of mid-twenties. The Japanese participants used the eyes as the predominant focal point, and the Hungarians used the mouth. Hungary is considered a Western culture, so it is similar to the aforementioned study in terms of cultural relevance.

We had originally planned to conduct a three-hypothesis study, converting it to a mixed-subjects design. The other independent variable that would have been measured yet not manipulated was ethnic background. However, due to complications related to COVID-19, our contact in South Korea was not able to recruit participants in Korea. Thus, we were unable to develop the study in a way to test our third hypothesis and had to make modifications. Given this limitation, we hope to conduct future research on a hypothesis related to cultural differences and emotion perception.

Conclusion

On a large-scale basis, understanding the effects of wearing a mask in daily life could help us be more patient with one another. If masks make it difficult to understand emotions correctly, then it may, in turn, negatively affect empathizing with one another. This topic warrants further study. Hopefully, government and health organizations will seek out avenues to promote awareness of mask-wearing drawbacks like emotional perception and work to integrate them into daily life. The long-term effects of mask-wearing on children's emotional intelligence remains to be seen, and it may provide further research opportunities.

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