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The Impact of Facial Coverings on Emotion Recognition Accuracy and Confidence During the COVID-19 Pandemic: An International Comparison

Fatima Zahera Nayani
William & Mary - Arts & Sciences

The impact of facial coverings on emotion recognition accuracy and confidence during the COVID-19 pandemic: An international comparison

Fatima Zahera Nayani

Highland Springs, VA

Bachelor of Science in Psychology, George Mason University, 2020

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Department of Psychological Sciences

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APPROVAL PAGE

This Thesis is submitted in partial fulfillment of
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Fatima Zahera Nayani

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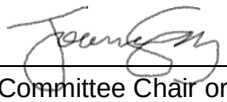
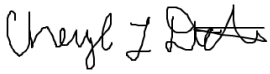


Committee Chair or Co-Chair
Joanna Schug, Associate Professor, Psychological Sciences
College of William & Mary



Cheryl Dickter, Associate Professor, Psychological Sciences
College of William & Mary

Adrian Bravo, Assistant Professor, Psychological Sciences
College of William & Mary

COMPLIANCE PAGE

Research approved by

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ABSTRACT

With increased face mask usage globally following the onset of the COVID-19 pandemic, it is important to understand factors that influence mask wearing behavior. One factor that may influence mask wearing behavior is the degree to which people believe masks potentially impair emotion recognition. Previous research that has suggested that there may be cultural differences in facial regions that people in Japan and the United States attend to when inferring a target's emotional state, whereby Japanese are more likely to look to the eyes and Americans are more likely to look at the mouth (Yuki et al., 2006 & Jack et al., 2012). Based on this prior research, we predicted that facial coverings concealing the mouth region would serve to impair emotion recognition, whereas in Japan facial coverings that conceal the eye region would serve to impair emotion recognition more so than for Americans. In Study 1, we examine whether people in Japan and the United States expect that they would have difficulty understanding others' emotional expressions when the target wore a facial mask, or sunglasses. The results showed that Japanese participants reported higher mask wearing willingness and mask wearing norms compared to Americans. Additionally, results indicated that Americans reported higher perceived difficulty in emotion recognition when targets are wearing a face mask, while Japanese reported the reverse effect. In Study 2, we examined actual recognition rates, and found that while there were only small country differences in the degree to which mask-wearing impaired emotion recognition, Japanese emotion recognition was more impaired by sunglasses. We discuss implications and directions for future research.

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Introduction

In March 2020, COVID-19 was declared a global pandemic, changing the lives of billions of people around the world. While we, as a global society, adjusted our daily routines to navigate the world safely during this time, we incorporated new behaviors to maintain our physical well-being. We began taking precautionary measures to prevent the spread of disease, such as social distancing, increased hand washing, and wearing a face mask. Collectively, we learned how to operate while incorporating social distancing and other safety guidelines into our lives.

One precautionary measure to help prevent the spread of disease is wearing a face mask. Wearing a well-fitting face mask over the mouth and nose when in public helps to prevent the spread of disease by withholding respiratory droplets released by the wearer to surrounding people. Individuals should wear a face mask in conjunction with other measures, such as social distancing, to prevent the spread of disease until they are fully vaccinated.

Wearing multilayered face masks are shown effective in preventing the spread of disease, blocking upwards towards 80% of respiratory droplets by the wearer, limiting the spread of the remaining droplets, and potentially protecting the wearer from disease as well. Advice from the Centers for Disease Control (CDC) was consistent from March 2020 onwards regarding the original strain, encouraging Americans to wear face masks when in public in conjunction with social distancing guidelines (CDC, 2020). Likewise, this advice was consistent with advice given by the Ministry of Health, Labour, and Welfare of Japan (MHLW) and the World Health Organization (WHO) - there was consistent evidence globally of the effectiveness of wearing face masks to prevent the spread of disease (MHLW, 2020; WHO, 2020). Additionally, as increasingly contagious variants continue to spread, multinational research in the US, Europe, and Japan suggests individuals should wear surgical face masks in conjunction with vaccination to lower community transmission (Brüssow & Zuber, 2021; Christie et. al, 2021;

Mahase, 2021; Song & Karako, 2021; Wang & Han, 2022). Despite this evidence, there is still reluctance in some regions to adapt face mask wearing into daily life.

Factors Influencing Willingness to Wear a Mask

One factor that might explain the reluctance to wear a face mask is whether people think that masks impede emotion recognition. Non-verbal communication, such as displaying emotions, is heavily impaired with the introduction of mask wearing. Previous research has shown that wearing masks can impede people's ability to correctly identify emotions based on facial expressions (Grundmann et al., 2021; Marini et al., 2021). This is because there is less of the face to interpret emotions from, making it take longer to accurately interpret emotion (Schlögl & Jones, 2020; Williams et al., 2021).

Cultural Differences in Mask Wearing

While people in the United States and other countries adapted to mask wearing, the mask wearing custom existed in Japan and other countries for many decades. Upon the onset of the Omicron variant, mask wearing rates in the US and Japan differed, with Japanese mask wearing rates continuing to near 100%, meanwhile American mask wearing rates varied greatly depending on mask wearing mandates on the state level (Song & Karaoke, 2021; Liu & Arledge, 2022). This difference in practice shows a difference in attitudes towards wearing masks, which could occur for a variety of reasons.

When assessing the emotions of others in a group setting, White Americans are more likely to gain their information from the faces of a main target. Japanese are more likely to use a diverse set of context clues, such as the emotions of others surrounding the main target and situational factors. In an eye-tracking study by Masuda and colleagues (2008), Japanese participants were likely to give their attention to more of the scene within the first two seconds

than Americans when determining the emotions of a target figure. With the introduction of wearing face masks, Americans may have more difficulty in interpreting the emotions of others because the main source of information to identify emotion is mostly covered.

Other western countries also show difficulty in interpreting emotions of others as a result of mask wearing. In a German study (Grundmann et al., 2021), researchers found that participants were more likely to accurately identify the emotion of the stimuli when they were shown without a face mask. Difficulty in emotion recognition can differ depending on what emotions are being displayed, as expressing some emotions requires more emphasis on the eyes than the mouth, and vice versa. For example, when the target is wearing a face mask, observers are more likely to confuse surprised expressions with anger (and vice versa), happy expressions with sadness (and vice versa), and surprised expressions as sadness (Williams et al., 2021).

Yuki and colleagues investigated the difference in emotion recognition in Americans vs. Japanese by looking at whether participants made their judgment based on cues from the mouth or eyes of a stimulus. Using this information, it was hypothesized that Americans' judgements are affected more strongly by facial cues around the mouth compared to Japanese, and Japanese judgements are more strongly affected by facial cues in the eyes compared to Americans (Yuki et al., 2006). To test this, they used both emoticon-based and photograph-based stimuli to have participants judge emotion. Stimuli were created with both consistent emotion (e.g., happy eyes and happy mouth) and inconsistent emotion (e.g., happy eyes sad / neutral mouth). This study was replicated by Jack and colleagues (2009) with the addition of eye-tracking. This study showed that when interpreting the emotions of a target, White participants fixated on the whole face equally, meanwhile East Asian participants spent a significant amount of time fixating on the eyes as opposed to the mouth. These results further support the idea that Americans and Japanese assess different parts of the face during emotion recognition.

Display Rules and Universality of Emotions

Ultimately, the results of the study conducted by Yuki and colleagues were consistent with previous cultural theories about emotion expression. Based on display rules for emotion expression, individuals may have differing understandings on interpretation of emotional intensity. When asked to rate high emotionally intense faces, both American and Japanese observers perceived the faces to have higher external display than internal experience. However, when shown low emotionally intense faces, Japanese observers were more likely to perceive the faces to have greater subjective experience when compared to American observers (Matsumoto et al., 2002; Matsumoto et al., 2018). This difference helps us better understand the information individuals' use to recognize emotions - if individuals are more accustomed to intense emotional expressions, covering parts of the target face could have a more negative effect on emotion recognition than if they are accustomed to more subtle expressions. In a study conducted in over 30 countries, higher emotional expressivity norms were found positively correlated with individualism, specifically with positive emotions (happiness and surprise) and negatively correlated with sadness (Matsumoto et al., 2008).

Our understanding of display rules is based on the idea that there are cultural differences in norms that regulate the expression of emotion. For example, individualistic cultures emphasize direct and explicit emotion expression, while collectivist cultures emphasize the importance of controlling emotional expression to maintain harmonious relationships. When individuals are more prone to control their facial expressions to hide emotional expression, it is most effective to focus on parts of the face that are more difficult to control intentionally when considering emotional recognition. Muscles surrounding the mouth are inherently more expressive because they take up more of the face, meanwhile the muscles around the eyes take up less of the face but are more difficult to consciously control. Individualistic cultures (such

as the US) are more likely to have a positive view of outward expression of emotion compared to collectivist cultures (such as Japan), thus shaping individuals' expectation of what an emotion is supposed to look like, in turn shaping display rules for expression (Karabuschenko et al., 2016; Mishra et al., 2016; Matsumoto, 1990).

It is important to note that even though there may be a cultural difference in individuals learning to attend to facial cues does not mean that facial expressions are not universal. Indeed, a large body of research has demonstrated the existence of universal facial expressions of emotion, shared by all human populations. Although facial expressions are universally innate within humans, literature on display rules suggests that there are widespread cultural differences in when and to whom it is socially acceptable to express emotions. The literature suggests that individuals from different cultures assess facial cues from the mouth and eyes differently, thus increasing familiarity with the cues most often used can help improve accuracy in emotional decoding (Elfenbein & Ambady, 2003). One of the first studies conducted looking at the universality of emotion expression and display rules was conducted by Ekman and colleagues (1972) to investigate the differences between American and Japanese emotion expression when presented with a stressful stimulus. When alone, both American and Japanese participants displayed equivalent emotion expression. However, when in the presence of a highly regarded experimenter, Japanese participants were more likely to smile due to a Japanese display rule to conceal negative emotions. Due to differences in display rules of emotion expression, we propose that individuals may have learned to understand emotion expression within their cultural contexts, thus affecting their ability to pick up on facial cues to identify, or recognize, emotion.

Context variables surrounding emotion recognition cross-culturally

To understand differences in emotion recognition cross-culturally, we need to consider context variables that could influence cross-cultural perceptions of emotion. Context variables we are considering include relational mobility (RM), individualism-collectivism (IC), regulatory focus (RF), and generalized trust (referred to as "trust" throughout this paper). These factors are often related, for example higher RM is related to higher trust (Yuki et al., 2018). Previous research investigates the relationship between these variables and emotion recognition.

Relational mobility. Emotional expression amongst strangers is more common in higher relational mobility societies as compared to lower relational mobility societies due to the increased likelihood that strangers may become new relationships (Niedenthal et al., 2019). The understanding that emotion expression is less restricted in higher relational mobility societies suggests that individuals within these societies would find it more advantageous to accurately decode emotional expressions.

The notion that it is more advantageous to freely express emotions in higher relational mobility societies is present in the literature. In societies with lower relational mobility, emotion recognition accuracy is related to positive perceptions of interactions with close others (e.g. family and close friends) more so than others. Meanwhile, in higher relational mobility societies, emotion recognition accuracy is related to positive perceptions of interactions with all groups (Hess et al, 2016). The understanding that accurate emotion recognition has different consequences depending on the relational mobility of the society suggests that it is more imperative for those in lower relational mobility societies to accurately assess emotions of close others rather than all groups regardless of closeness. Meanwhile, in higher relational mobility societies, such as the US, emotion recognition accuracy is necessary to make new close relationships.

Individualism-collectivism. Previous research suggests that individuals within collectivist cultures report lower emotion recognition accuracy when assessing individuals from individualist cultures (Matsumoto, 1992; Wood et al., 2016). Individualistic society members are more likely to accurately assess emotion when compared to collectivist society members (Beaupré & Hess, 2005; Matsumoto, 1992; Matsumoto et al., 1997; Mishra et al., 2018). The difference in emotion recognition accuracy in individualistic vs. collectivist cultures may be due to differences in display rules in emotion expression (Karabuschenko et al., 2016; Mishra et al., 2016; Matsumoto, 1990).

Regulatory focus. Regulatory focus relates to approach and avoidance strategies deriving from individual motivation (Crowe & Higgins, 1997). Previous research suggests that with increased promotion-focused regulatory focus, individuals report higher rates of emotion recognition (Sassenrath et al., 2014). In the literature, cross-cultural studies have shown that collectivist cultures (such as Japan) tend to be prevention focused, meanwhile individualistic cultures (such as the US) tend to be promotion focused (Kurman & Hui, 2011).

Generalized trust. The degree to which people are able to infer emotions of others from their emotional expressions has been associated with generalized trust, whereby people in countries where people express themselves with more clarity and consistency show higher levels of trust (Schug, Atreya & Yoo, 2017). Other studies have shown that people use emotional expressions to infer whether someone is trustworthy. For instance, people who express sadness are trusted more than those who show anger and fear (Dunn & Schweitzer, 2005; Marini et al., 2021), likely due to anger and fear being caused by a person more often than a situation. Meanwhile, happiness has the strongest positive relationship with trust (Dunn & Schweitzer, 2005; Marini et al., 2021), likely because observing expressions of happiness enhances activation of the same emotional regions responsible for mirroring emotion, known as the “mirror mechanism”, for smiling and laughter (Rymarczyk et al., 2018; Caruana et al., 2020; Caruana et al., 2017).

The Present Study

With the introduction of face masks to the United States and other countries, we have the opportunity to assess how accurately individuals in these countries can identify emotion with different facial coverings and lay beliefs regarding the degree to which masks impede one's ability to recognize emotion in others. In the same way face masks may affect emotion recognition in Americans, face coverings that obstruct from the eyes, such as sunglasses, may have a similar effect in Japanese. We suspect that cultural display rules influence not only emotional display, but also the degree to which specific facial movements correspond to underlying experienced emotion.

The research questions of this investigation are (1) To what extent do people's lay beliefs regarding face coverings, such as a mask or sunglasses, decreases their ability for emotion recognition cross-culturally? (2) Does this impact willingness to wear masks during COVID-19 cross-culturally? And (3) To what extent does wearing face coverings, such as a mask or sunglasses, affect accuracy of emotion recognition and confidence in emotion recognition ability cross-culturally?

We investigate these questions in two studies. Study 1 investigates questions 1 and 2, while study 2 investigates question 3. We hypothesize that Japanese participants will report higher difficulty in interpreting emotions of others wearing sunglasses more so than wearing a mask and that in Americans, there will be a higher difficulty in interpreting emotions of others wearing a mask more so than wearing sunglasses.

Study 1

Method

Participants

Two hundred and sixty-six (94 male, 169 female, 3 undisclosed) Japanese and 348 (195 male, 153 female, 0 undisclosed) American participants participated in the study. The ages of both Japanese (M = 39.4, SD = 10.3) and American (M = 39.6, SD = 12.2) participants were comparable. Japanese participants were recruited through Lancers.jp, a popular crowdsourcing platform in Japan. American participants were recruited through Amazon Mechanical Turk, a popular crowdfunding platform in the US.

Procedure

The study was approved by the university IRB. After signing up for the study, participants accessed the consent form and a brief Qualtrics questionnaire. The questionnaire contained measures pertained to mask wearing behaviors, mask wearing norms, difficulty of reading emotions, and demographic information.

Measures

Mask wearing behaviors were measured using a six-item questionnaire with the aim of gauging how likely participants were to wear a mask in different situations, such as in a crowded outdoor space and an uncrowded indoor environment. Participants rated how often they wear a mask in these settings from “1” (Never) to “5” (Always). This measure has high internal consistency in both American (α = 0.794) and Japanese samples (α = 0.728).

Mask wearing norms were measured using a five-item questionnaire with the aim of gauging participants’ personal and intersubjective norms about mask wearing. The question

relating to personal norms was “At the moment, I think people should wear masks in public spaces.” A sample question of the intersubjective norms measure was “people in my community think everyone should wear masks when in public spaces.” The items in this measure were rated from “1” (Strongly Disagree) to “5” (Strongly Agree). This measure has high internal consistency in American samples (α = 0.826) and moderate internal consistency in Japanese samples (α = 0.640).

Difficulty of reading emotions was measured using a four-item questionnaire with the aim of gauging the lay beliefs of participants regarding emotion recognition when others are wearing facial coverings. A sample question from this measure is “It is difficult for me to interpret feelings of other people when they wear a mask” and responses were rated on a scale of “1” (Strongly Disagree) to “5” (Strongly Agree). This measure has high internal consistency in both American (α = 0.849) and Japanese samples (α = 0.748).

Results and Discussion

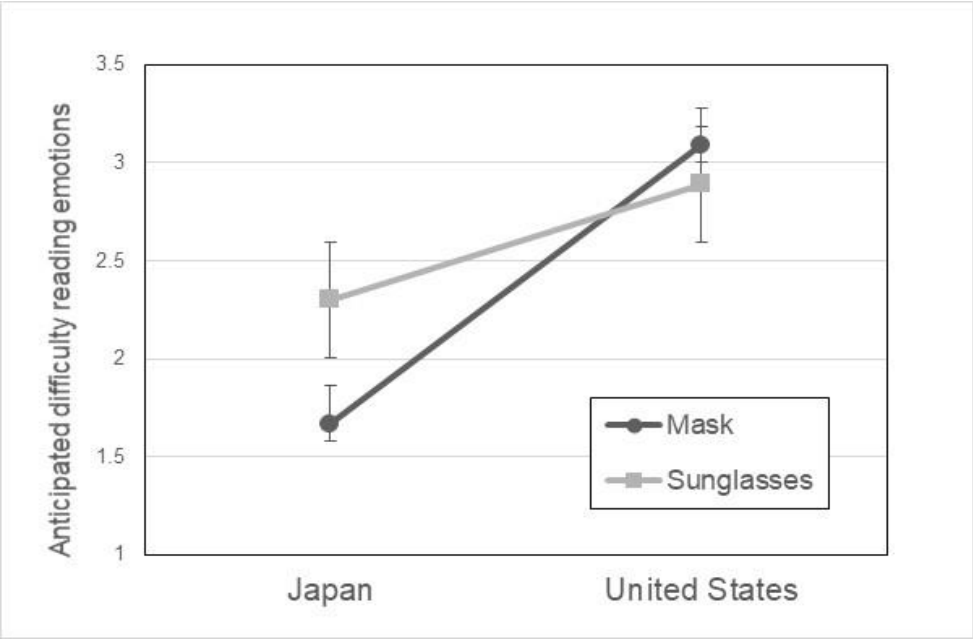
Preliminary Analysis

For our overall analysis we conducted a 2 (culture: Japanese vs. American) x 2 (type of difficulty reading emotions: difficulty with presence of face mask vs. difficulty with presence of sunglasses) mixed-model ANOVA. Results showed significant main effects for culture, $F(1, 612) = 196$, $p < .001$, $\eta^2 = .190$, and for lay beliefs regarding emotion recognition difficulty, $F(1, 612) = 31.3$, $p < .001$, $\eta^2 = .009$. There was a significant interaction between culture and lay beliefs regarding emotion recognition difficulty, $F(1, 612) = 113.3$, $p < .001$, $\eta^2 = .032$, (see Figure 1). Both Tukey and Bonferroni post hoc tests showed that each of these groups were significantly different from each other at $p < .001$.

Interestingly enough, there was not a significant main effect of any of our demographic variables, most notably gender, $F(1, 611) = .248$, $p = .619$, $\eta^2 < .001$; age, $F(1, 611) = .001$, $p = 965$, $\eta^2 < .001$; and educational attainment, $F(5, 602) = 1.29$, $p = .265$, $\eta^2 = .003$.

Figure 1.

Difficulty reading emotions by country

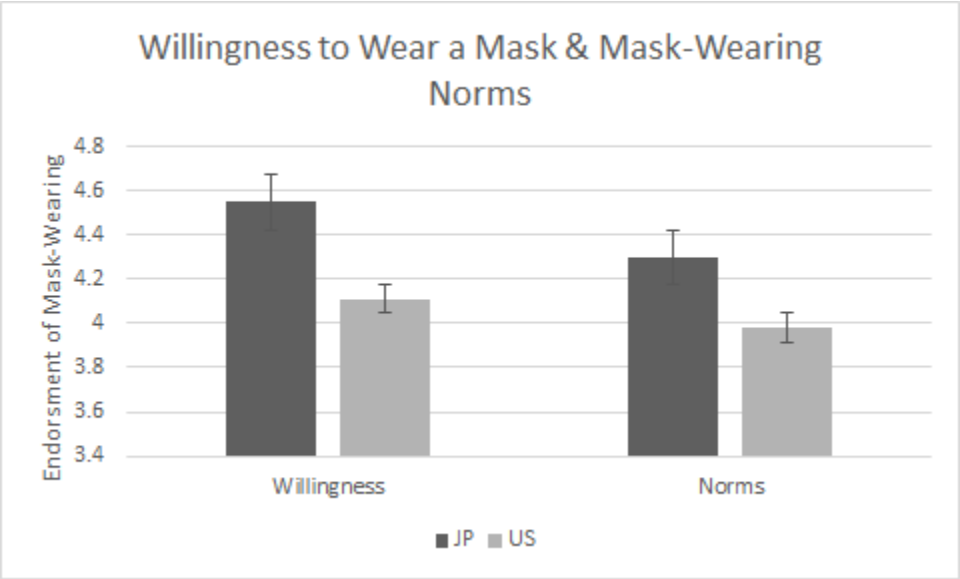


Willingness to wear a face mask and mask wearing norms

Using independent samples t-tests, we measured participants' willingness to wear a face mask and mask wearing norms of their societies. Overall, Japanese participants ($M = 4.55$, $SD = .561$) were more likely to report that they wore a face mask when compared to American participants ($M = 4.11$, $SD = .940$), $t(612) = 6.67$, $p < .001$, $d = 0.543$ (see Figure 2). Japanese participants (M = 4.30, SD = .467) also reported stronger mask wearing norms in their society when compared to American participants (M = 3.98, SD = .776), $t(612) = 5.95$, $p < .001$, $d = 0.484$.

Figure 2.

Willingness to Wear a Mask and Mask Wearing Norms by Country



Explaining cultural differences in mask wearing

To test for mediation, we ran a series of post-hoc models using the mediation package in R, including 5000 bootstrapped samples. More specifically, we wanted to see if lay beliefs regarding emotion recognition difficulty and mask wearing norms helped to explain cultural differences in mask wearing. When predicting mask wearing with country, we found a significant negative relationship between these two variables, suggesting that there is an effect of country on mask wearing where Americans are less likely than Japanese to report wearing a mask (B = -.23, p <.001). After including mask wearing norms, the coefficient for country is reduced, showing a partial mediation effect. After including the lay beliefs on emotion recognition when others wear masks, results suggest that cultural differences in mask wearing are mediated such

that the differences of mask wearing by country can be explained by both mask wearing norms and lay beliefs regarding emotion recognition difficulty (see Figure 3, Table 1).

Figure 3.

Explaining Cultural Differences in Mask Wearing

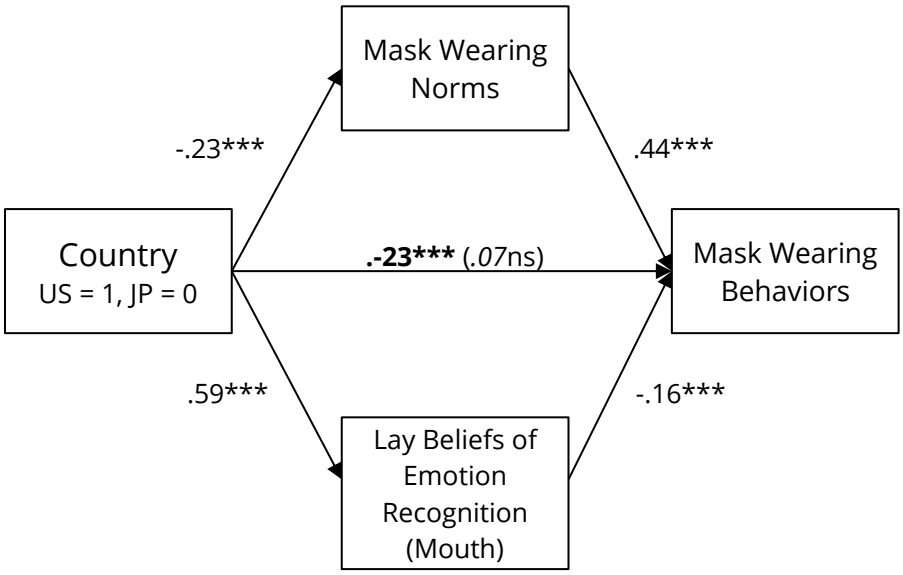


Table 1. Summary effects from mediation model examining indirect effects of country via anticipated difficulty of recognizing emotions of masked individuals and existing mask-wearing norms in Japan and the United States

				95% C.I.					
Type	**Effect**	**Estimate**	**(se)**	**Lower**		**Upper**	***β***	***z***	***p***
Component Effects	Country → Mask-wearing norms	-0.32	(.05)	-0.42	--	-0.22	-0.23	-6.36	< .001
	Mask-wearing norms → Mask Wearing Behavior	0.53	(.07)	0.40	--	0.66	0.44	7.93	< .001
	Country → Expected difficulty reading emotion (mask)	1.41	(.08)	1.27	--	1.56	0.59	18.80	< .001
	Expected difficulty reading emotion (mask) → Mask Wearing Behavior	-0.11	(.04)	-0.18	--	-0.04	-0.16	-3.20	0.001
Indirect Effects	Country → Norms → Mask Wearing Behavior	-0.17	(.04)	-0.24	--	-0.10	-0.10	-4.77	< .001
	Country → Expected difficulty (mask) → Mask Wearing Behavior	-0.16	(.05)	-0.26	--	-0.06	-0.10	-3.14	0.002
Direct	Country → Mask Wearing Behavior	-0.11	(.07)	-0.25	--	0.04	-0.07	-1.46	0.144
Total	Country → Mask Wearing Behavior	-0.43	(.07)	-0.56	--	-0.31	-0.26	-6.68	< .001

Note. Confidence intervals computed with parametric bootstrapping using 5000 samples. Betas as standardized effect sizes.

Ultimately, we found that Japanese reported lay beliefs that emotion recognition is impeded when others wear sunglasses vs. a face mask. Furthermore, this belief partially explained cultural differences in mask wearing behavior. Next, we will investigate to what extent these perceived differences in interpreting emotions translate into actual differences in emotion recognition.

Study 2

Methods

In this study, we investigated to what extent the presence of face masks or sunglasses on a target impacts participant accuracy and confidence in emotion recognition cross-culturally. Furthermore, we aimed to investigate how context variables (e.g., relational mobility) impacted this difference in emotion recognition.

Participants

Eighty (40 male, 39 female, 1 undisclosed) Japanese and 171 (51 male, 119 female, 1 undisclosed) American participants participated in the study. The ages of both Japanese (M = 20.7, SD = 5.55) and American (M = 18.8, SD = .976) participants were comparable. All participants were recruited from their home universities.

Procedure

The study was approved by the university IRB. After signing up for the study, participants accessed the consent form and a brief Qualtrics assessment and questionnaire. The assessment presented participants with sample images of people wearing either a face

mask or sunglasses and asked participants what emotion they thought was presented from the following options: (1) anger, (2) disgust, (3) fear, (4) happiness, (5) sadness, (6) surprise, and (7) other. We then calculated mean difference scores for emotion recognition accuracy to assess the degree to which one facial covering impeded emotion recognition more than another. Participant confidence in their answers was also assessed on a Likert scale from '1' (Not confident at all) to '6' (Extremely confident). The questionnaire contained measures pertaining to relational mobility (RM), individualism-collectivism (IC), regulatory focus (RF), generalized trust, and demographic information.

Measures and Materials

Emotion stimuli. The assessment was composed of 24 images to represent the measured emotions, face covering type, and gender. These images were collected from the Japanese and Caucasian Facial Expressions of Emotion (JACFEE) series. This image set shows actors portraying anger, fear, happiness, sadness, disgust, and surprise as expressed according to the Facial Action Coding System (FACS) and happiness while actors smiled candidly (Ekman, 1977; Matsumoto et. al, 1997). We then altered the images to include a face mask or sunglasses using the photo editing software GIMP. Of the 24 images, we had two images representing each emotion portrayed on a male and female actor - one with a face mask and one with sunglasses. Given time limitations for the study that prevented us from showing participants all targets from the JACFEE stimuli set, we included only Japanese targets in this study. We chose to present only Japanese targets given that American students interact with people from Asian backgrounds frequently in their everyday lives, while it is relatively uncommon for Japanese students to come into contact with individuals from non-Japanese ethnic backgrounds. After data collection, we ran a series of histograms to ensure internal consistency (see Appendix A).

Context variables. The assessment included various context variables to examine what cultural factors, if any, influence emotion recognition.

Relational mobility (RM) was measured using a 12-item questionnaire with the aim of understanding participant RM before the onset of the COVID-19 pandemic. A sample question from this measure is “Before COVID-19, they (the people around you) had many chances to get to know other people.” Responses were rated on a scale of “1” (Strongly Disagree) to “6” (Strongly Agree). The RM measure has high internal consistency in both American ($\alpha = 0.701$) and Japanese samples ($\alpha = 0.830$) (Schug, Yuki, & Maddux, 2010).

Individualism-collectivism (IC) was measured using a 16-item questionnaire with the aim of assessing IC on the horizontal-vertical scale. This measure is divided into four scales, which were four questions each: (1) horizontal-individualism (HI), (2) horizontal-collectivism (HC), (3) vertical-individualism (VI), and (4) vertical-collectivism (VC) (Singelis et al., 1995).

A sample question from the HI measure is “My personal identity, independent of others, is very important to me.” Responses were rated on a scale of “1” (Strongly Disagree) to “5” (Strongly Agree). Cronbach’s alpha varied between American samples ($\alpha = 0.755$) and Japanese samples ($\alpha = 0.580$).

A sample question from the HC measure is “The well-being of people I work with is important to me.” Responses were rated on a scale of “1” (Strongly Disagree) to “5” (Strongly Agree). Cronbach’s alpha varied between American ($\alpha = 0.549$) and Japanese samples ($\alpha = 0.746$).

A sample question from the VI measure is “It is important that I do my job better than others.” Responses were rated on a scale of “1” (Strongly Disagree) to “5” (Strongly Agree). Cronbach’s alpha varied between American ($\alpha = 0.724$) and Japanese samples ($\alpha = 0.576$).

A sample question from the VC measure is “Family members should stick together, no matter what sacrifices are required.” Responses were rated on a scale of “1” (Strongly

Disagree) to “5” (Strongly Agree). Cronbach’s alpha varied between American (α = 0.723) and Japanese samples (α = 0.616).

Regulatory focus (RF) was measured using a 4-item questionnaire. A sample question from this measure is “I focus on opportunities that will enhance my life.” Responses were rated on a scale of “1” (Strongly Disagree) to “5” (Strongly Agree). The RF measure has high internal consistency in both American (α = 0.794) and Japanese samples (α = 0.728) (Kirchler et al., 2007).

Generalized trust was measured using a 6-item questionnaire. A sample question from this measure is “Most people are basically honest.” Responses were rated on a scale of “1” (Strongly Disagree) to “5” (Strongly Agree). The trust measure has high internal consistency in both American (α = 0.794) and Japanese samples (α = 0.728) (Yamagishi & Yamagishi, 1994).

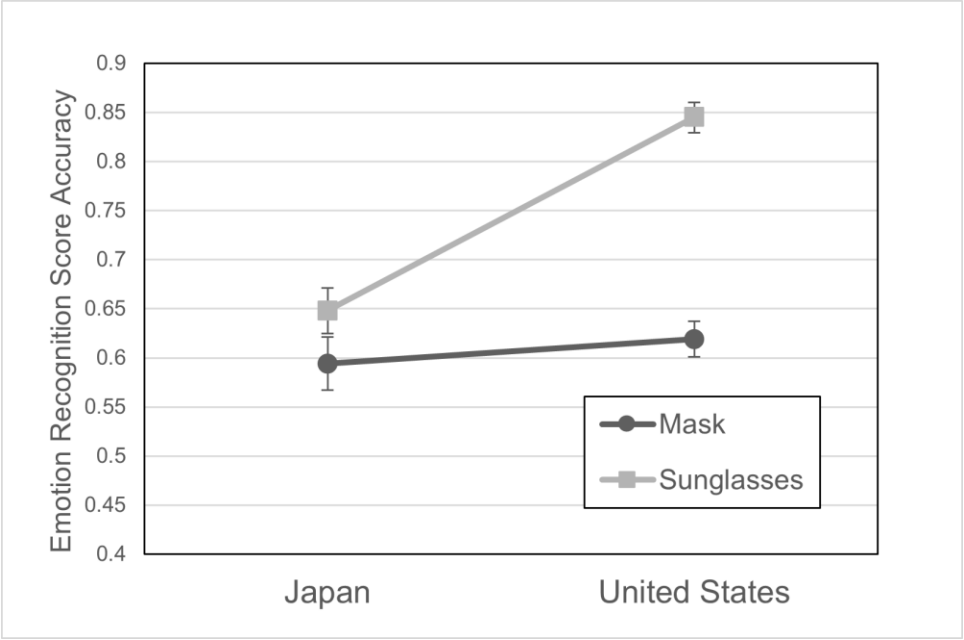
Emotion Recognition Accuracy

To analyze emotion recognition accuracy, we conducted a 2 (culture: Japanese vs. American) x 2 (type of accuracy reading emotions: accuracy with face mask vs. accuracy with sunglasses) mixed-model ANOVA. To ensure our stimuli portrayed the correct emotion to participants, we examined histograms for responses for each set of stimuli (see Appendix B). Results showed significant main effects for culture, $F(1, 249) = 80.3$, $p < .001$, $\eta^2 = .125$, and for type of accuracy reading emotion, $F(1, 249) = 227.8$, $p = .003$, $\eta^2 = .002$. There was a significant interaction between culture and type of accuracy reading emotions, $F(1, 249) = 85.6$, $p < .001$, $\eta^2 = .074$. This shows that participants in the US ($M = .619$, $SD = .122$) were more likely to correctly identify the emotion of a surgical masked stimuli than participants in Japan ($M = .594$, $SD = .122$). Participants in the US ($M = .845$, $SD = .099$) were also more likely to correctly identify the emotion of a stimuli with sunglasses than participants in Japan ($M = .648$, $SD = .119$). Both Tukey and Bonferroni post hoc tests showed that each of these groups were significantly different from each other at $p < .001$. Overall, Americans were much more accurate

in identifying facial expressions of emotion when the target was wearing sunglasses vs. wearing a mask, while differences in accuracy rates for mask or sunglasses wearing targets were not as large for Japanese, $F(1, 249) = 86.4$, $p < .001$, $\eta^2 = .076$.

Figure 4.

Score Accuracy by Country



Given the reliability for composite accuracy scores were low in both the US (α = 0.28) and Japan (α = 0.26), we repeated this analysis for each emotion (see Figure 5).

Anger. Americans were more accurate at identifying anger on a target wearing sunglasses compared to Japanese participants, meanwhile Americans were also worse at identifying anger on a target with a face mask compared to Japanese participants, $F(1, 249) = 37.5$, $p < .001$, $\eta^2 = .055$. Americans had a much higher difference score favoring sunglasses compared to Japanese participants.

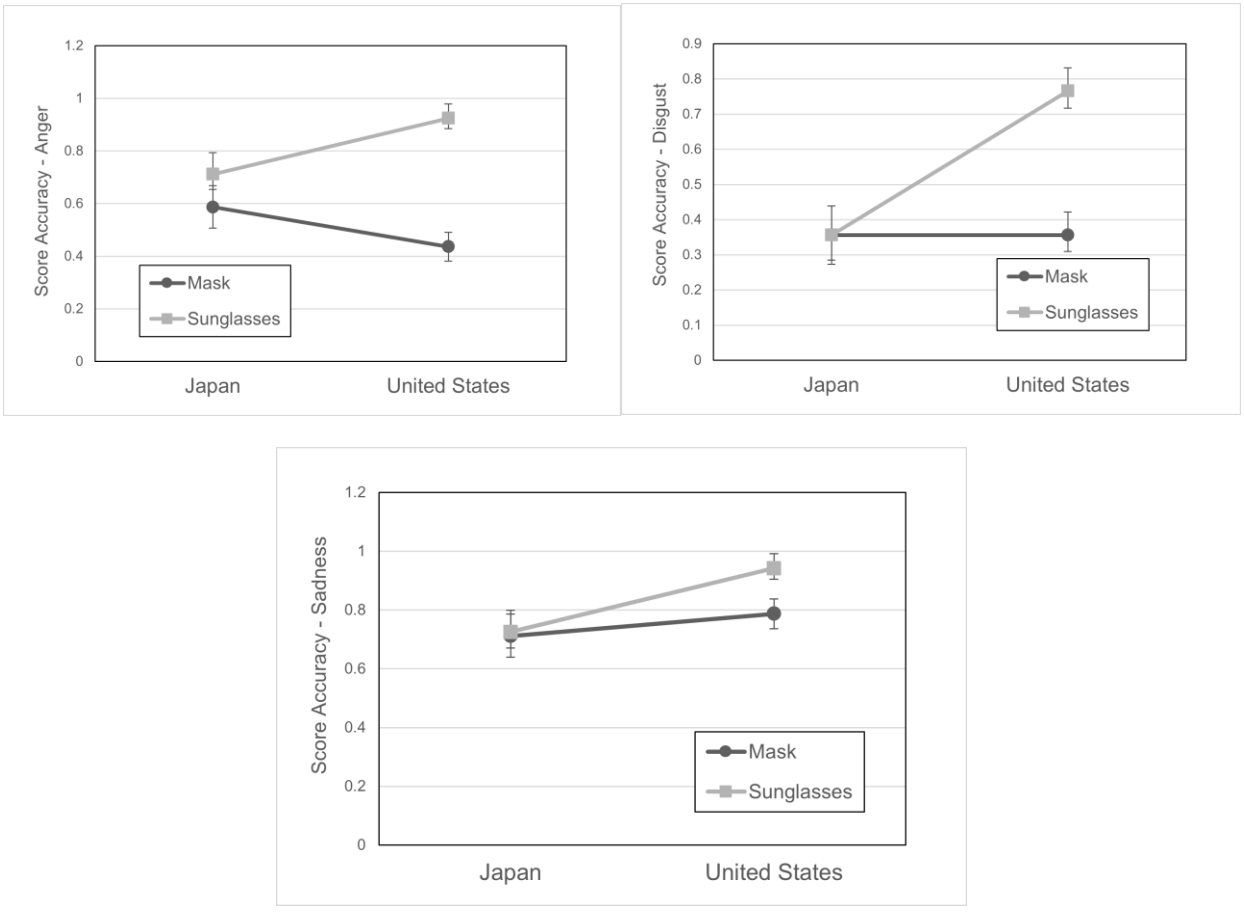
Disgust. Americans were more accurate at identifying disgust on a target wearing sunglasses compared to Japanese participants, meanwhile Americans and Japanese participants

performed similarly identifying disgust in targets wearing a face mask. Japanese participants showed no significant difference between identifying disgust in targets wearing sunglasses and targets wearing face masks, $F(1, 249) = 39.0$, $p < .001$, $\eta^2 = .058$.

Sadness. Americans were more accurate at identifying sadness on a target wearing sunglasses compared to Japanese participants, meanwhile Americans and Japanese participants performed similarly identifying disgust in targets wearing a face mask. Japanese participants showed no significant difference identifying sadness in targets wearing sunglasses or face masks, $F(1, 249) = 8.57$, $p = .004$, $\eta^2 = .012$.

Figure 5.

Anger, Disgust, and Sadness Score Accuracy by Country.



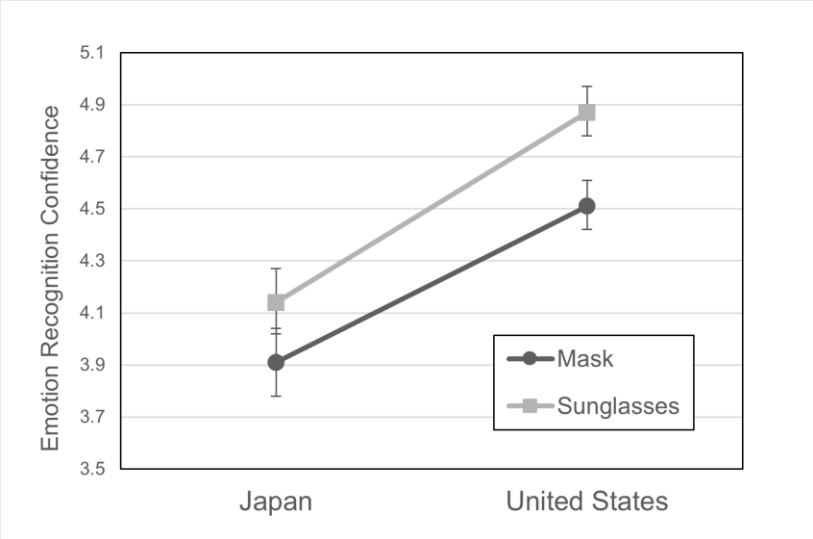
There were no significant findings identifying a difference in emotion recognition for fear, $F(1, 249) = 2.48$, $p = .116$, $\eta^2 = .004$, happiness, $F(1, 249) = .556$, $p = .456$, $\eta^2 = .001$, or surprise, $F(1, 249) = .213$, $p = .645$, $\eta^2 < .001$.

Emotion Recognition Confidence

To analyze emotion recognition confidence, we conducted a 2 (culture: Japanese vs. American) x 2 (type of confidence reading emotions: confidence with face mask vs. confidence with sunglasses) mixed-model ANOVA. Results showed significant main effects for culture, $F(1, 249) = 73.6$, $p < .001$, $\eta^2 = .195$, and for type of confidence reading emotion, $F(1, 249) = 104.90$, $p < .001$, $\eta^2 = .042$. There was a significant interaction between culture and type of confidence reading emotions, $F(1, 249) = 5.24$, $p = .023$, $\eta^2 = .002$. This shows that participants in the US ($M = 4.48$, $SD = .592$) were more likely to report higher confidence in their responses in surgical mask emotion recognition than participants in Japan ($M = 3.91$, $SD = .615$) (see Figure 5). Participants in the US ($M = 4.84$, $SD = .493$) were also more likely to report higher confidence in their responses in sunglasses emotion recognition than participants in Japan ($M = 4.14$, $SD = .710$). Both Tukey and Bonferroni post hoc tests showed that each of these groups were significantly different from each other at $p < .001$. For ratings of confidence, both Americans and Japanese participants reported that they were more confident that they recognized the emotion shown by targets wearing sunglasses vs. masks, although Americans were slightly more confident than Japanese overall, $F(1, 249) = 5.24$, $p = .023$, $\eta^2 = .002$.

Figure 6.

Confidence Reading Emotions by Country



Overall, these results generally support the findings from Study 1, in that Americans were much better at recognizing facial expressions of targets wearing sunglasses than were Japanese participants. However, while the results from Study 1 suggested that Americans felt they would be less able to recognize facial expressions of emotion displayed by people wearing a mask, the US-Japan difference was not as apparent. This suggests that US-Japan differences in expectations of whether they would be able to infer the emotions of people wearing a mask or sunglasses were correct for sunglasses, but incorrect for masks.

Correlations

Next, we examined correlations among recognition rates and accuracy scores in Japan and the US. There was a significant relationship between country and accuracy amongst stimuli wearing both masks (anger and fear) and sunglasses (anger, disgust, fear, sadness, and surprise). Additionally, mean difference scores were significant between both mask (anger,

disgust, fear, and sadness) and sunglasses (all emotions) accuracy. Mean difference scores for accuracy were calculated to assess the degree to which one facial covering impeded emotion recognition more than the other. There is a significant relationship between country and mean difference scores, where participants in the US were more likely to report significantly different mask and sunglasses scores compared to Japanese participants. Additionally, among American participants there were significant correlations between surprise-mask and disgust-mask accuracy, happiness-mask and anger-sunglasses accuracy, and surprise-sunglasses and happiness-mask accuracy. In Japanese participants, there were significant correlations between both surprise-mask and surprise-sunglasses and happiness-mask accuracy, surprise-mask and surprise-sunglasses accuracy, and anger-sunglasses and disgust-sunglasses accuracy.

Table 2. *Correlations of Accuracy rates between conditions.*

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1. Anger (Mask)	--	.14	-.09	.13	-.08	-.18	.05	-.04	.03	.06	-.05	-.06
2. Anger (Sunglasses)	.01	--	-.09	-.32**	.01	.09	.11	.03	.12	.02	.19	.15
3. Disgust (Mask)	.00	.04	--	.14	.07	.11	.01	-.16	-.06	-.04	.09	.19
4. Disgust (Sunglasses)	-.03	.02	.07	--	.11	-.25*	-.25*	-.08	-.16	.01	-.10	-.04
5. Fear (Mask)	.09	.12	-.06	-.01	--	.05	.10	-.23*	.01	.21†	.12	.06
6. Fear (Sunglasses)	.05	.01	.09	.08	.02	--	.15	-.19†	.21	.01	.08	.15
7. Happiness (Mask)	-.09	.32***	.03	-.14†	.02	.18	--	-.04	.13	.21†	.39***	.37***
8. Happiness (Sunglasses)	-.09	-.05	-.05	-.03	.11	.18	-.02	--	.13	.21†	.01	.07
9. Sadness (Mask)	.03	.04	-.11	.06	.21**	.05	.18*	.05	--	.21†	.10	.09
10. Sadness (Sunglasses)	-.11	.00	-.08	-.07	.16*	-.01	.14†	.09	.37***	--	.08	-.03
11. Surprise (Mask)	-.06	-.04	-.24**	.05	-.16*	.08	.00	.03	-.13	-.11	--	.53***
12. Surprise (Sunglasses)	.10	.06	-.04	-.00	-.09	.08	.20**	-.04	.02	-.10	.04	--

Note. Japanese data are presented above the diagonal, while US data are presented below the diagonal.
†p<.10 *p<.05, **p<.01, ***p<.001

Finally, we examined correlates of accuracy, confidence, and context variables. In American and Japanese participants, there was a significant relationship between mask and sunglasses accuracy and mask and sunglasses score confidence. There was not a significant relationship between accuracy and confidence in either sample.

Among the American participants, there was a significant relationship between generalized trust and all our individualism-collectivism variables (HI, HC, VI, & VC) and regulatory focus. The majority of our individualism-collectivism variables were also correlated with regulatory focus. For Japanese participants, we did not see this same pattern. In this sample, there was not a significant relationship between individualism-collectivism and any other variables. However, there was a significant relationship between regulatory focus and mask confidence, sunglasses confidence, and vertical individualism. There was also a significant relationship between vertical individualism and mask confidence scores.

Table 3. *Correlations between Accuracy rates and context variables.*

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1. Accuracy (Mask)	--	.35***	.56***	-.09	.03	.06	-.03	.01	-.17	-.05	-.19†	-.04
2. Accuracy (Sunglasses)	.22**	--	.58***	.05	.22*	-.14	.14	.03	-.14	-.13	.10	.04
3. Accuracy difference	.72***	-.52***	--	-.12	-.17	.18	-.15	-.02	-.02	.07	-.26**	-.07
4. Confidence (Mask)	-.02	-.05	.02	--	.84***	.00	.12	.11	.25*	.19†	.39***	.20†
5. Confidence (Sunglasses)	.08	.07	.02	.70***	--	.08	.09	.08	.15	.17	.29**	.09
6. Relational mobility	.24	.04	.18**	.11	.18*	--	.06	-.01	.04	.10	.07	-.09
7. Horizontal Individualism	.14†	.04	.09	.04	.03	-.10	--	.05	.06	-.08	.04	-.07
8. Horizontal Collectivism	-.13†	-.03	-.09	.09	.05	.17*	-.12	--	-.06	.13	.18†	.34**
9. Vertical Individualism	.07	-.07	.11	-.00	-.02	.01	.29***	-.15†	--	.20†	.36***	.16
10. Vertical Collectivism	-.08	-.12	.02	.12	.11	.11	.01	.19*	.20**	--	.12	.03
11. Regulatory Focus	.09	-.08	.13†	-.03	.01	.16*	.13†	.20**	.34***	.29***	--	.17
12. Trust	-.01	-.05	.03	.07	.00	.18*	-.24***	.44***	-.17**	.12	.20**	--

Note. Japanese data are presented above the diagonal, while US data are presented below the diagonal. "Accuracy difference" represents the difference between emotion recognition accuracy of mask and sunglass conditions.

†p<.10 *p<.05, **p<.01, ***p<.001

Discussion

General Discussion

Results from this investigation supported predictions. Compared to Japanese participants, American participants reported higher levels of lay beliefs regarding emotion recognition when compared to Japanese participants, especially beliefs regarding difficulty interpreting emotions when others are wearing face masks. By contrast, Japanese participants reported lower levels of lay beliefs on emotion recognition difficulty, but did report high levels of lay beliefs when conceptualizing others wearing sunglasses compared to their American counterparts. When looking at emotion recognition performance, overall American and Japanese participants scored similarly to each other when interpreting the emotions of a target with a face mask. By contrast, Japanese participants reported a more difficult time reading individuals wearing sunglasses compared to their American counterparts. Analyzing results by emotion, the emotions where culture was related to emotion recognition accuracy (anger, disgust, sadness) showed Americans had a significantly easier time interpreting emotions of targets wearing sunglasses than face masks. Meanwhile, both Japanese and American participants performed equally recognizing the emotions of targets wearing a face mask. The finding that Americans and Japanese participants performed similarly at the face mask emotion recognition task is interesting considering that Japanese participants were overall less confident in responses in both face mask and sunglasses emotion stimuli compared to Americans.

The findings from this study align with previous research on cultural differences in using the eyes and mouth as display cues to recognize emotions. Previous research found that when asked to rate emotions of a target, American participants were more likely to use the mouth as the primary cue and Japanese participants were more likely to use the eyes as the primary cue (Yuki et al., 2006; Jack et al., 2009). This investigation provides more evidence to support these findings and builds upon the theory that this difference is supported by display rules in American

vs. East Asian societies. In Study 1, we found that American participants reported higher difficulty when perceiving others with a face mask and lower difficulty when perceiving others with sunglasses, and the inverse for Japanese participants. When participants completed the emotion recognition task, results supported the theory that Americans are more likely to use the mouth as the primary emotion recognition cue, as American participants performed significantly better than Japanese participants better at recognizing emotions of targets wearing sunglasses, whose mouth was clearly visible.

A novel finding was that neither emotion recognition accuracy nor confidence had strong correlations with our context variables cross-culturally. Despite this, in the American sample both mask accuracy and sunglasses confidence were positively correlated with relational mobility ($p < 0.05$). In the Japanese sample, both mask and sunglasses confidence were positively correlated with regulatory focus ($p < 0.01$). Additionally, in the Japanese sample, mask confidence was positively correlated with vertical individualism ($p < 0.05$).

Implications

Implications from this study are useful in understanding limitations in emotion recognition and understanding factors that influence mask wearing behaviors. If there is an issue with emotion recognition in the presence of a face covering, then there may be an issue with communication during routine tasks that involve wearing a face mask. The results of this study help to identify problems in communication during the pandemic, leading the way for future research to find model-based solutions.

The results of this study also help us better understand factors that increase or decrease mask wearing appeals. Increased mask wearing limits the spread of disease, and understanding what factors increase peoples' likelihood to wear a mask in public in turn sheds light on deterring factors in mask wearing behavior. When addressing deterring factors in mask

wearing behaviors, we can learn how to increase mask wearing appeals in our fight against COVID-19 and future pandemics to come.

The reasons Japanese participants and American participants reported different difficulties due to different facial obstructions may not be due to inherent biological differences, but due to norms within their different social contexts. If it is expected in Japan to express oneself primarily from the eyes, it makes sense that covering the eyes with sunglasses would lead to increased difficulty in understanding emotions. Likewise, if it is expected in the United States to express oneself with a more holistic approach to the face, including mouth based facial expressions, then it would make sense that covering the mouth with a face mask would yield the results we found.

Limitations

It is important to recognize at what point during the COVID-19 pandemic each society was in during data collection. The world is changing very quickly, and there is a chance that as mask wearing becomes more of a norm following the COVID-19 pandemic, Americans will get better at interpreting emotions of those wearing a face mask, supporting the proposed mediation model. It may be worthwhile to collect additional data at different time points, throughout and after the pandemic, to assess how prolonged use of masks in America could affect difficulty of reading emotions. With prolonged use of face masks, Americans may find it less difficult over time to understand emotions of a masked face.

One limitation of Study 1 is that we relied on self-report when assessing difficulty in reading emotions. This type of measure has benefits, such as the understanding that in the natural settings individuals would draw from individual experiences, likely within the same setting they were in pre-pandemic. Individuals are more likely to accurately interpret emotions from their own cultural ingroup (Elfenbein & Ambady, 2003), thus allowing participants to define that for themselves yields the most accurate results. However, this type of measure ultimately

measures perceived difficulty, or it relies on participants having personal insight and accurately assessing their own abilities. There is a chance that participants over or under rated their own difficulty in reading emotions. To address this, future research can look into an experimental manipulation, providing stimuli of masked and sunglasses wearing faces expressing various emotions. This can assess participants' actual ability to differentiate emotions in addition to perceived ability.

Like Study 1, one limitation Study 2 had was we recruited participants using a university sample as opposed to a community sample like Study 1. This means we had less of a range of age, thus we could not accurately measure age related effects of emotion recognition accuracy. However, one discrepancy in the previous research we found was regarding effects of our demographic variables. In the literature there is a pre-established understanding that older participants are more likely to be negatively impacted by increased difficulty of tasks, leading to older participants reporting higher difficulty in emotion recognition (Ruffman et al., 2008; Ortega, 2010). Despite this, in Study 1 we found no significant effect of age on perceived difficulty of emotion recognition. In addition, there is a pre-established understanding that females are better at emotion recognition than males (Abbruzzese et al., 2019; Hoffmann et al., 2010). We found a significant difference between males and females in both face mask and sunglasses emotion recognition where in Japan females were more accurate than males, but in the US males were more accurate than females.

Also, in this study we only utilized Japanese faces from the JACFEE, as we needed to keep the survey concise enough to maintain participant attention. We ultimately decided to use the Japanese faces because both sets of participants would be accustomed to seeing East Asian faces in their university environments. However, the inclusion of targets from a diverse set of ethnic groups could help verify the generalizability of the results. Additionally, there was a lack of control conditions showing faces without coverings in this study, which would allow for comparison for baseline emotion recognition on an individual level. Lastly, when considering the

context variables, the measures for individualism and collectivism had high internal consistency in our American sample, but low internal consistency in our Japanese sample. The reason we used this measure was because it is historically used when investigating individualism-collectivism, however in future research measures with higher internal consistency cross-culturally need to be developed.

Future Directions

In future studies, this study should be replicated with dynamic emotional stimuli instead of static stimuli. The facial expression stimuli used in the present study depicted high intensity, prototypical facial expressions. However, facial expressions such as these are only shown on the face momentarily. Dynamic emotion stimuli activate similar brain areas as perceiving actual emotion, making these stimuli more indicative of emotion recognition in real life situations (Kilts et al., 2003; Trautmann et al., 2009).

Additionally, it would be interesting to see if the results of this study could be replicated using eye-tracking software, similar to the approach Jack and colleagues utilized when investigating emotion recognition using uncovered faces (Jack et al., 2012). This way, if we can see where participants first looked at the stimuli, we can better understand if the theory of display rules in emotion recognition is the reason for these differences.

Another factor that can influence emotion recognition accuracy is age. Older adults may have a more difficult time accurately interpreting the emotions of others, as there are differences in neurotransmitter balance and neuron density in older adults when compared to young adults. Previous research suggests differences in performance on cognitively taxing tasks increase as the difficulty of the task increases (Ruffman et al., 2008). Furthermore, there is also evidence from previous research suggesting that increases in task difficulty further impair emotion perception in older adults as compared to younger adults (Orgeta, 2010). Due to these

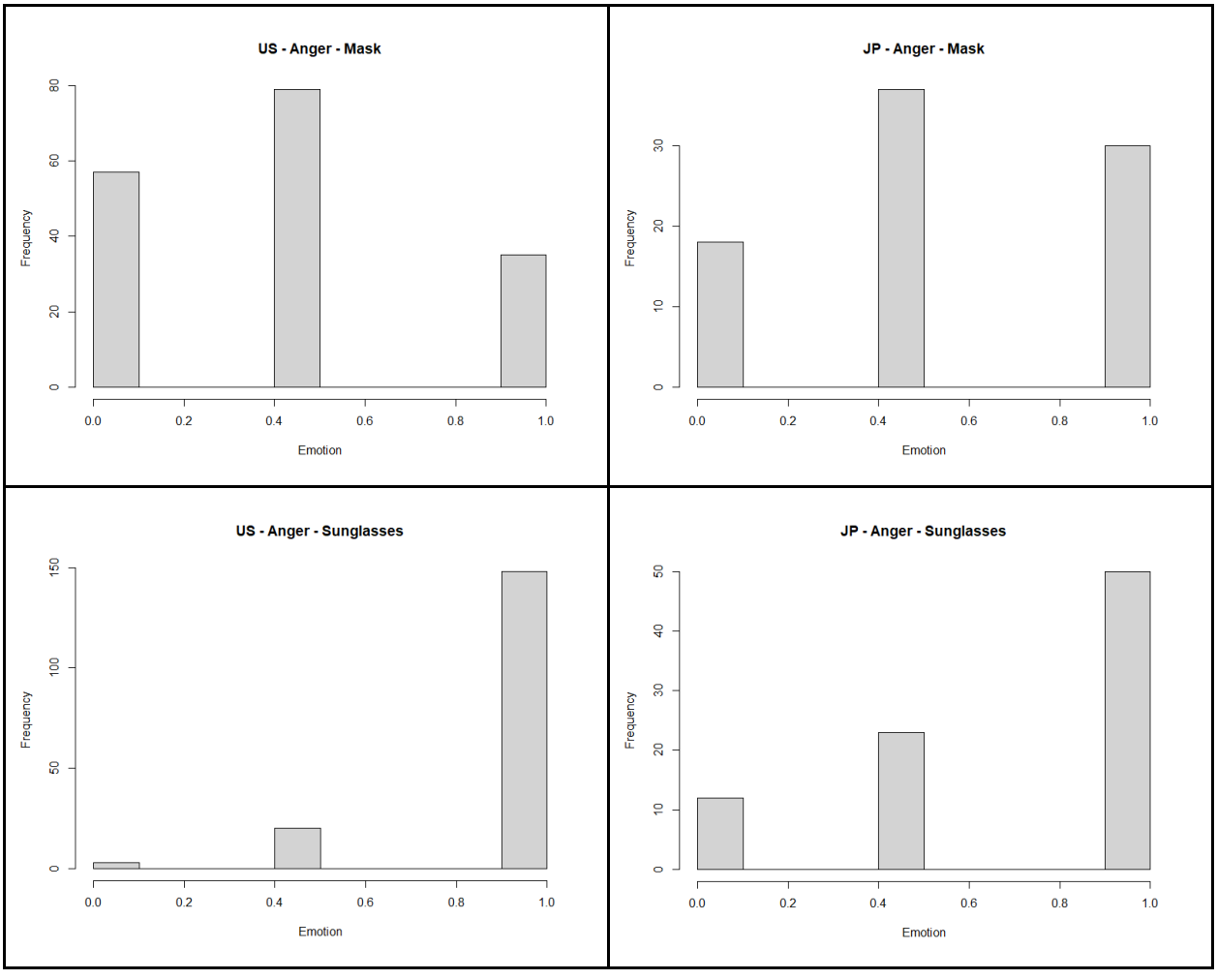
differences in older adults, previous research suggests that older adults may be less willing to wear a face mask compared to their younger counterparts. In future studies, it would be interesting to investigate how age influences emotion recognition when a target is wearing a face covering, and if this influences willingness to wear a face mask.

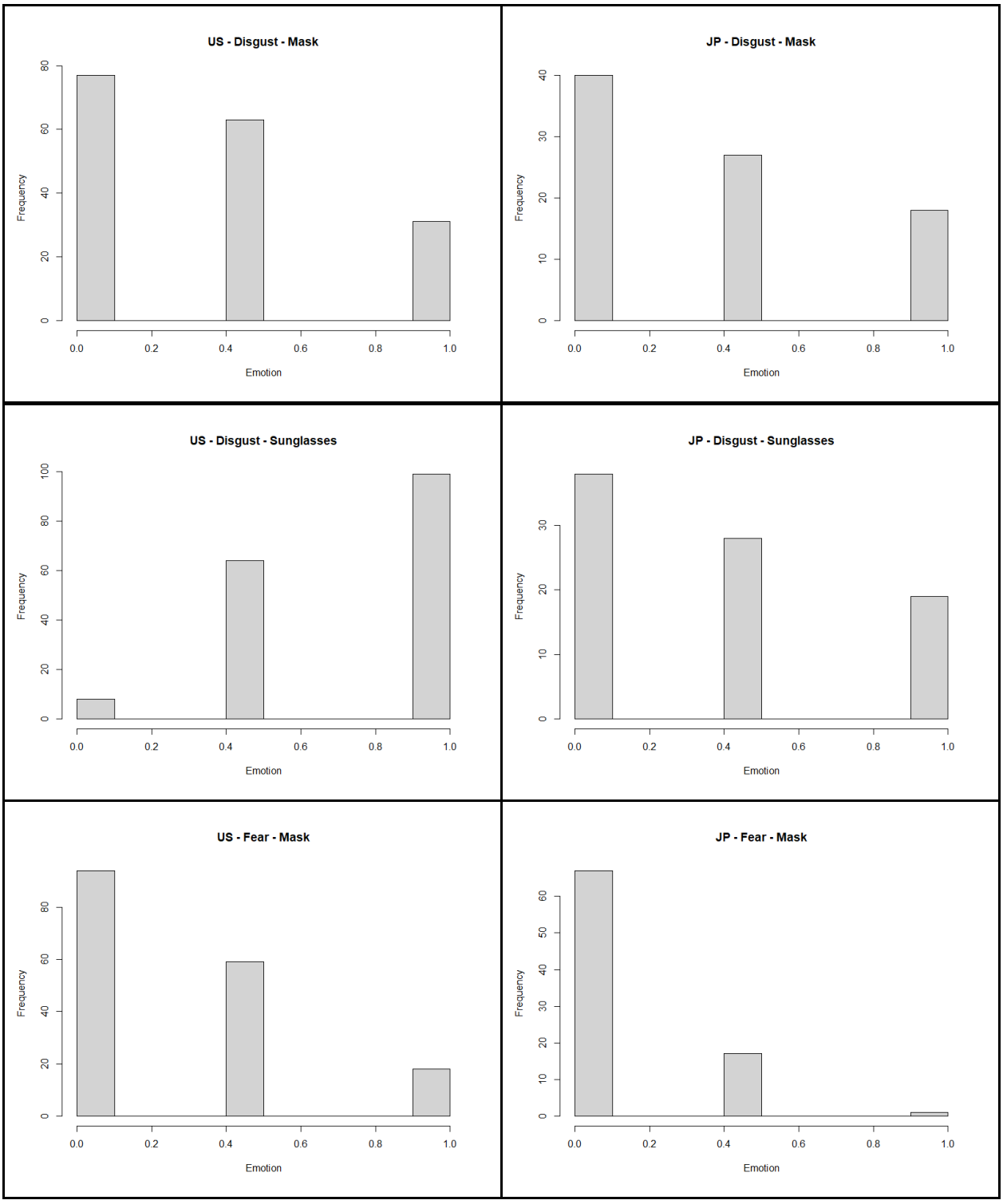
Finally, future studies can collect feedback from participants on whether or not they believe the results would influence their mask wearing behaviors. If participants knew that face masks do not impede emotion recognition accuracy, to what extent would this affect their willingness to wear a face mask? Understanding whether emotion recognition accuracy influences willingness to wear a mask cross-culturally can help us better understand the mechanism behind mask wearing behavior, and aid in efforts to reduce transmission of disease.

Appendix

Appendix A

We generated histograms to ensure that overall, participants rated emotions accurately as they were intended in the pre-validated measure. These figures were calculated by averaging male and female targets wearing a mask and male and female targets wearing sunglasses. Results were reported by country. Scale of 0.0 to 1.0 refers to, in order, anger, disgust, fear, happiness, sadness, & surprise




US - Disgust - Mask
Frequency
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Disgust - Mask
Frequency
0
10
20
30
40
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
US - Disgust - Sunglasses
Frequency
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Disgust - Sunglasses
Frequency
0
10
20
30
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
US - Fear - Mask
Frequency
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Fear - Mask
Frequency
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10
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0.0
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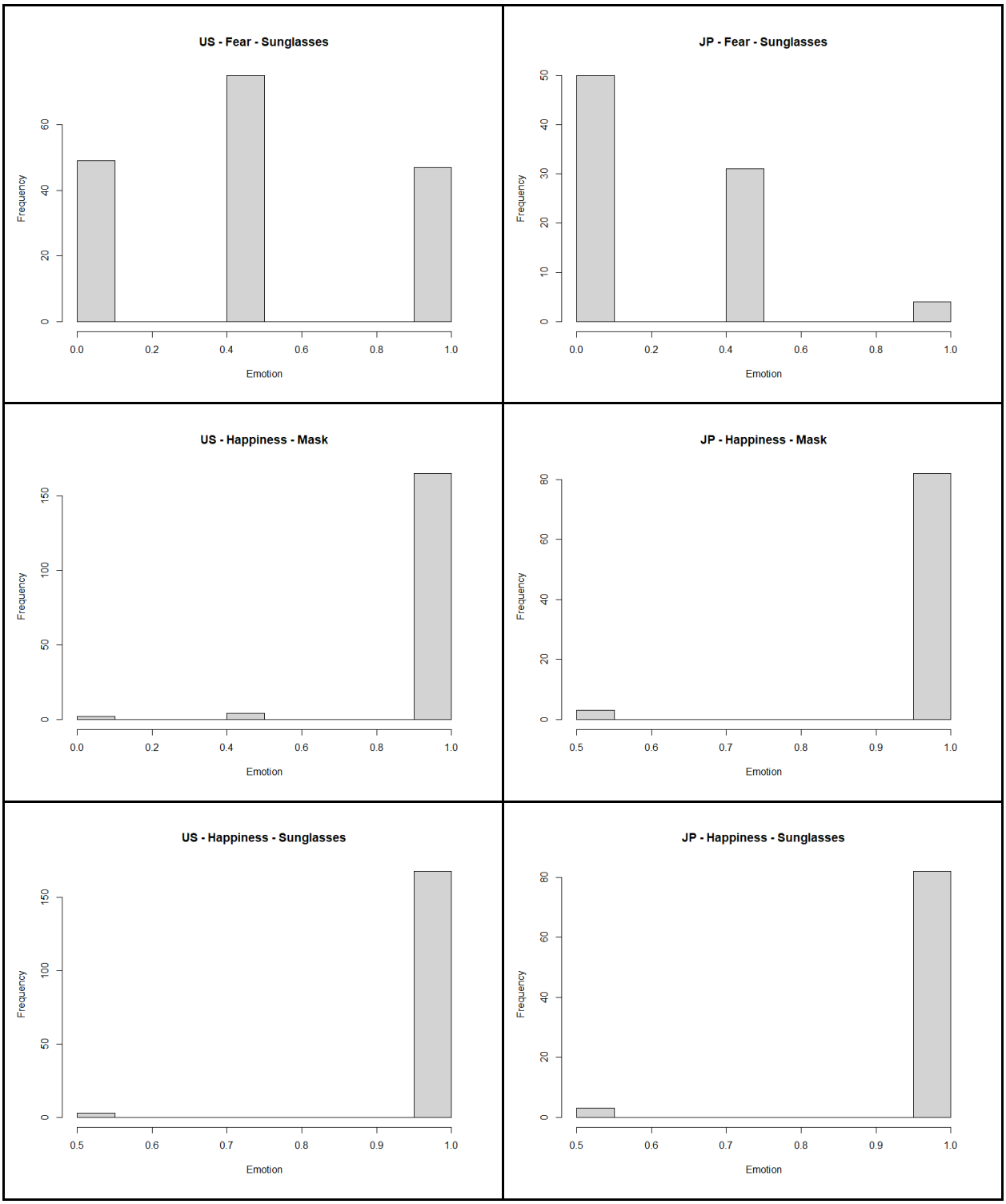
0.8
1.0
Emotion


US - Fear - Sunglasses
Frequency
0
20
40
60
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Fear - Sunglasses
Frequency
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20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
US - Happiness - Mask
Frequency
0
50
100
150
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Happiness - Mask
Frequency
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20
40
60
80
0.5
0.6
0.7
0.8
0.9
1.0
Emotion
US - Happiness - Sunglasses
Frequency
0
50
100
150
0.5
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0.7
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Emotion
JP - Happiness - Sunglasses
Frequency
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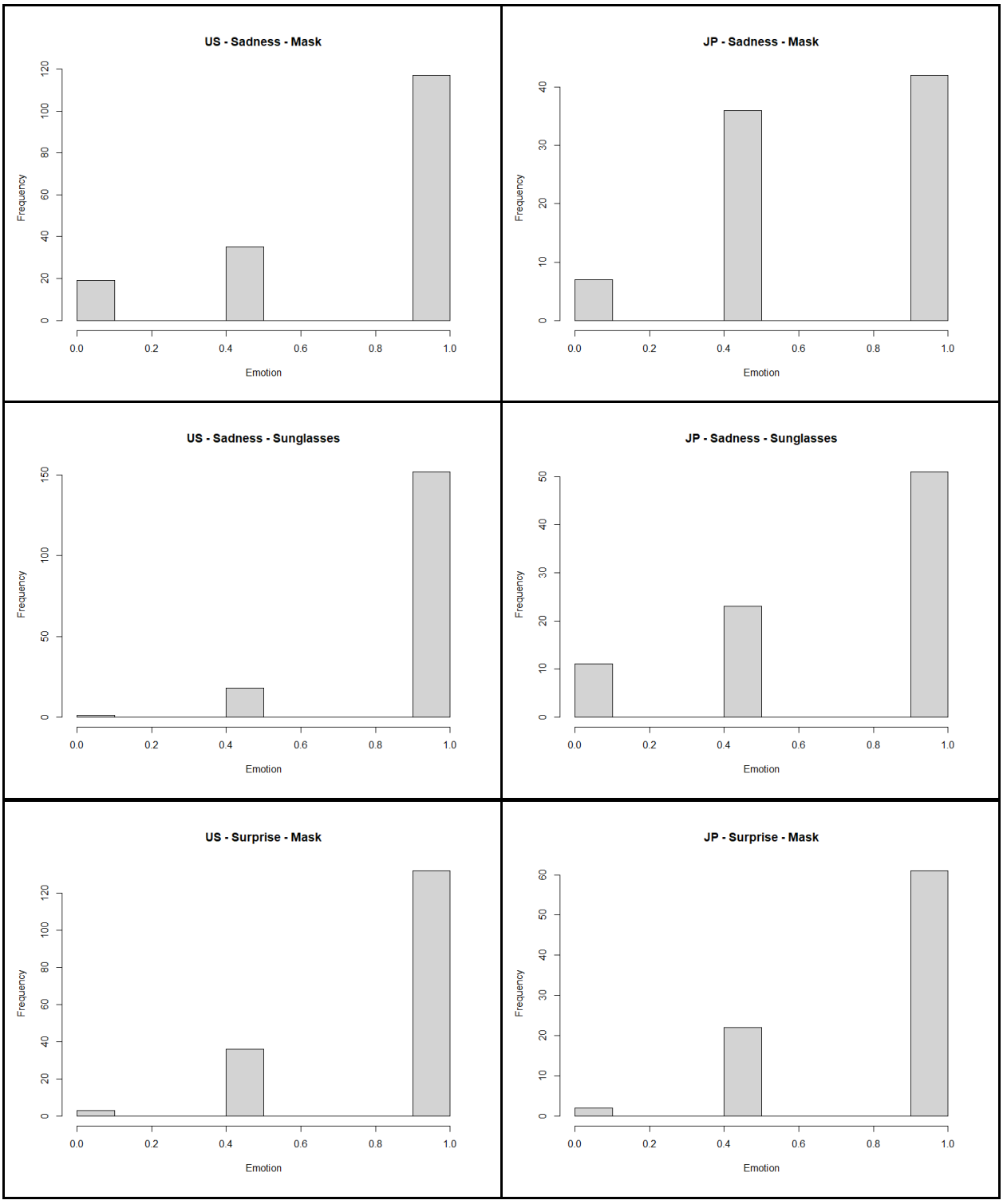
Emotion


US - Sadness - Mask
Frequency
0
20
40
60
80
100
120
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Sadness - Mask
Frequency
0
10
20
30
40
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
US - Sadness - Sunglasses
Frequency
0
50
100
150
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Sadness - Sunglasses
Frequency
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10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
US - Surprise - Mask
Frequency
0
20
40
60
80
100
120
0.0
0.2
0.4
0.6
0.8
1.0
Emotion
JP - Surprise - Mask
Frequency
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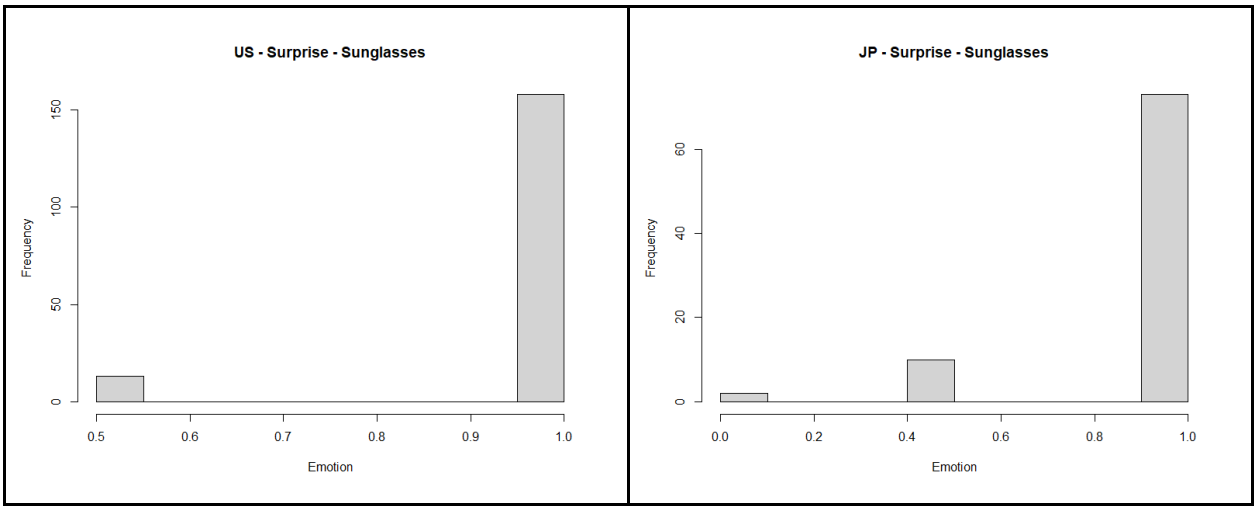
0.8
1.0
Emotion


US - Surprise - Sunglasses
Frequency
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100
150
0.5
0.6
0.7
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0.9
1.0
Emotion
JP - Surprise - Sunglasses
Frequency
0
20
40
60
0.0
0.2
0.4
0.6
0.8
1.0
Emotion

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