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Abstract

The present experiment examines facial recognition memory over a short timeframe for faces with and without masks to determine if wearing face masks affects facial recognition memory. Participants first studied a group of faces (with and without masks). The participants then performed a facial recognition memory test on a larger group of faces (with and without masks) and were asked if they saw the presented face in the previously studied list. Results revealed that if the face was studied with a mask, it was more accurately recognized if it was presented with a mask at the test than without a mask. This effect was not found if the participants first studied a face without a mask. A higher false alarm rate was found for new faces with masks presented in the test phase compared to those without masks. These findings help provide initial evidence for the context memory effect of wearing face masks on facial recognition memory ability.

The COVID-19 pandemic has drastically altered our daily lives, from how we socialize, participate in activities, and dress. Previously, at least in the United States, where the author resides, it was a rare sighting to find a face mask in an individual's wardrobe or outfit, but now it has become a necessity. Typically, facial recognition is a daily task performed without much intense thought or effort. In daily life, face recognition has seemed to become an increasingly difficult task with the widespread use and necessity of wearing face masks.

One critical aspect of face recognition is face familiarity, how familiar someone is with a presented face. A familiar face would be a family member, friend, classmate, or celebrity, while an unfamiliar face would be a stranger. Overall, familiar face recognition is much more accurate than unfamiliar face recognition, where individuals are more accurate and faster in recognizing familiar faces than unfamiliar faces. When there are discrepancies in the image or partial face coverings, unfamiliar face recognition generally declines (Noyes et al., 2021). Past research examining face familiarity demonstrated these effects; for example, recognition memory of familiar faces is faster than unfamiliar faces (Kramer et al., 2018). Familiarity leads to generalizable recognition representation, leading to a more robust mechanism, whereas unfamiliar face recognition is specific to encountered images (Kramer et al., 2018). This generalization of cognitive processes leads to faster recognition of familiar faces regardless of image compared to unfamiliar faces. In line with dual-processing theories, familiarity is fast and automatic, whereas recollection is slower and controlled (Jones et al., 2018). Unfamiliar face recognition is image bound where the image quality (lighting, orientation, configuration) can significantly affect face recognition ability (Kramer et al., 2018).

Familiar face recognition is robust; when tested on face recognition ability with varying qualities of images, it was found that accuracy is maintained for identifying or matching familiar faces regardless of image quality, whereas any subtle change in image quality (such as changing from color to grayscale) results in accuracy decreasing for unfamiliar face recognition or matching (Hancock et al., 2000). More recent research has supported face familiarity improves facial recognition by examining the effect of generalizability that familiarity creates. When using celebrity faces as familiar faces, it was found their increased familiarity leads to improved facial recognition, even allowing for its recognition when the image is degraded (Kramer et al., 2018). By using a Linear Discriminate Analysis (LDA), a cognitive model was trained on different grouping images of the same person together, and a Principal Components Analysis (PCA) was used to maintain the highest 335 components of the image, which corresponded to the number of identities (Kramer et al., 2018). The requirement for more accurate recognition of familiar faces was first satisfied when the model was trained to recognize the images. Certain faces were recognized easier even at low familiarity (with little training), which corresponded to facial distinctiveness and the significant association between familiar faces and recognition rate (Kramer et al., 2018). Random photos of individuals became increasingly familiar across the experiment and more accurately recognized than photos of less familiar faces demonstrating familiarity is a significant predictor of whether a face will be quickly and accurately recognized. The following manipulation examined the effects of image degradation on facial recognition by using pixelized images that degraded the proportions of the images. With 25 percent degradation, a significant relationship was found between familiarity and recognition accuracy (Kramer et al., 2018), with more familiar faces leading to higher accuracy. With 50 percent degradation, the same trend was found; familiarity allowed for more accurate facial recognition. Finally, with 75 percent degradation, no identifying information was obtained, so recognition was impossible (Kramer et al., 2018), and a floor effect was seen for performance. Familiarity was also more closely related to recognizing internal facial features than external ones (Kramer et al., 2018). This was concluded by blurring out internal features, including the eyes, eyebrows, nose, and mouth, leaving only the surrounding area for external feature identification or leaving the internal features while blurring external features for internal feature recognition. A significant relationship was found between face recognition accuracy and familiarity with internal and external features, but recognition was associated strongly with internal features in the presence of a familiar face (Kramer et al., 2018). This cognitive model demonstrates the interaction of top-down (using LDA) and bottom-up (using PCA) processing to recognize varying images of the same person, the effects of familiarity on facial recognition, and its role in accuracy, speed, and finally, in recognizing internal and external features.

In addition to face familiarity, other factors can influence facial recognition ability, including image quality, lighting, orientation, and distinctiveness, specifically affecting recognition ability for unfamiliar faces. Usually, any decrease in quality or image inversion results in decreased recognition ability. Still, how a face is perceived can affect facial recognition memory, specifically its distinctiveness. Frequently unusual faces are remembered more than typical faces, where faces deemed typical are more likely to lead to false-positive recognition (Hancock et al., 2000). Furthermore, face recognition speed can also be viewed as a function of distinctiveness, where more distinct faces are likely to be recognized faster than less distinct faces (Hancock et al., 2000).

Context has a role in facial recognition in conjunction with face familiarity. When descriptive contexts are presented with faces, such as highlighting facial features like eye color, it creates higher hit rates and confidence levels for face recognition than controls, where the increased confidence was linked to context retrieval (Jones et al., 2018). These results were found by varying the conditions tied to the presented face, wherein descriptive conditions, the participant was prompted to describe the face. In viewing conditions, the participant merely observed the face. But when participants were asked to describe faces, their scores on recognition tests increased (Jones et al., 2018). Repetitive studying of these faces in their context increases recognition scores, confidence levels, and context retrieval (Jones et al., 2018). Expanding on the first result, by studying the faces through repetition, recognition increased overall, but faces presented in descriptive conditions had improved recognition (Jones et al., 2018). By explicitly controlling for when participants describe the face (varying descriptive and viewing conditions), it was demonstrated that describing features of a face to create descriptive contexts influenced facial recognition.

Furthermore, repetitive studying of faces leads to increased recognition memory (Jones et al., 2018). Overall, these past findings demonstrate context effects and repetition studying are additional factors in facial recognition memory and familiarity. Another area of research examined the effect of pupils in recognition, altering pupil diameter, where participants made attentiveness judgments and were administered a facial recognition memory test (Watier et al., 2017). In a recognition memory test, participants had a counting task between seeing the first and second group of faces. Participants had to determine if the faces were previously seen or new on the test. Although it may be thought the pupil size of eyes has a strong effect on facial recognition and memory, pupil size does not influence facial recognition memory; rather, it affects the judgment of attentiveness (Watier et al., 2017). It was found that faces showing eyes with larger pupils were perceived as more attentive. The combined results from past research demonstrate only context, familiarity, and repetition, not pupil size, are essential factors in facial recognition memory.

Super-recognizers or those with excellent facial recognition skills have been examined to understand how aspects like familiarity influence facial recognition and recognition memory. In recognition tests with delays, super-recognizers made more correct identifications and rejections over a long delay period, demonstrating long-term face memory abilities (Davis et al., 2020). This was found for unmasked, unobstructed normal faces, where super-recognizers illustrate the ability of long-term facial recognition memory compared to normal participants when presenting multiple target videos to super-recognizers and normal participants. The delay between trials varied; in the first experiment, from 1 to 56 days using 0 (as a baseline), and at day 28 for experiment two, where a recognition test was performed. It was found that the delay positively correlated with hits but not correct rejections, and super-recognizers made more correct identifications and rejections than controls at all delay timeframes (Davis et al., 2020).

The research interest has shifted from facial recognition experiments to face matching experiments, where participants are tested on their matching ability with pairs of faces. This research seeks to determine if participants can accurately match a pair of faces under varying conditions. The manipulation happens by creating match and mismatch trials where faces match in the match trials and do not match in the mismatch trials. This process is also influenced by familiarity, where matching familiar faces are easier, regardless of how similar the images are (Kramer et al., 2018). In contrast, unfamiliar face matching relies greatly on image similarity. A cognitive model has been applied to identify the role of familiarity in face matching using the Glasgow Face Matching Test, where the model's results overlapped with those seen in human trials (Kramer et al., 2018). Once again, using PCA and LDA, the cognitive model demonstrated matching ability could be described as a function of familiarity (Kramer et al., 2018).

In addition to familiarity, other alterations to the photo effect matching ability, such as wearing extra accessories including masks, sunglasses, hats, and other facial coverings. The more concealed an unfamiliar face is, the more difficult it is to recognize, as illustrated in mixed matching tests where one face has glasses and the other does not (Noyes et al., 2021). Overall, super recognizes are exceptionally well at matching faces, but when matching faces with masks, they have impaired matching ability, but when matching faces with sunglasses, there was only a slight advantage compared to controls (Noyes et al., 2021). Past experiments first examined familiar face matching in super-recognizers (defined as scoring a 40/40 on the Glasgow Face Matching Task and a 93% on the Cambridge face memory task) using celebrity facial images that were unconcealed (not wearing any face coverings), with a mask, or with sunglasses (Noyes et al., 2021). The procedure encompassed a typical matching task, asking participants if the presented faces matched, specifically if they were the same or different faces. Practiced and non-practice controls, participants who either studied or did not study the presented faces, were also used to compare super-recognizers. Super-recognizers outperformed both control groups, with minor differences between the practice and non-practice controls (Noyes et al., 2021).

A slight non-statistically significant decrease in matching ability was seen in the face mask trials, especially when the faces did not match compared to the sunglasses and unconcealed trials attributed to the mask-wearing (Noyes et al., 2021). The subsequent trials used unfamiliar faces instead of familiar faces with the same matching task. It was again found that super-recognizers outperformed control groups but had decreased matching performance for concealed faces, those wearing sunglasses, and those wearing masks, compared to unconcealed faces (Noyes et al., 2021). The researchers also examined expression recognition (for anger, disgust, fear, happy, sad, surprised, and neutral) for super-recognizers in the presence of facial occlusions (those wearing masks and those wearing sunglasses), expanding the procedure in the first two trials to include the emotions. It was found that super-recognizers outperformed both practice and non-practice controls, where happy emotions were recognized the best, and neutral, surprise, anger, disgust, fear, and sad emotions followed respectfully (Noyes et al., 2021).

Furthermore, unconcealed expressions were the most easily recognized, followed by faces with sunglasses and faces with masks (Noyes et al., 2021). This demonstrates that not only do masks reduce matching ability but also reduce emotional recognition. Other research used a similar method to examine wearing face masks and emotional recognition in conjunction with autistic traits and personality traits (using the Big Five Inventory personality traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism). The six basic emotions were used: happiness, disgust, fear, sadness, anger, and surprise, where past research demonstrated that happiness and disgust emotion recognition rely on information from the mouth (McCrackin et al., 2022). Furthermore, emotional recognition of fear and sadness relies on information from the upper face, like the eyes.

Interestingly the research on anger is mixed, and surprise depends upon recognizing wide eyes and an open mouth (information from both the top and bottom of the face (McCrackin et al., 2022). Masks reduced emotional recognition for all emotions, but emotions relying on lower face features (disgust, happiness, and surprise) compared to those depending on the upper face features (fear and sadness); anger recognition also showed a decrease (McCrackin et al., 2022). Again, these results demonstrated the effect of wearing masks on facial recognition and recognizing different emotions through examining autistic traits and traits comprised in the Big Five Inventory. Those with more autistic traits did worse in identifying unmasked facial expressions, whereas those lower in extraversion and higher agreeableness were more accurate in identifying masked expressions (McCrackin et al., 2022).

A previous experiment demonstrated a similar effect of face masks which decreased the matching ability of familiar and unfamiliar faces; when masks were present, more false-positive matches were made for familiar faces and false rejection matches for unfamiliar faces (Carragher & Hancock, 2020). By using three different masked pairs conditions (all masked, half masked, and non-masked), masks impaired matching ability regardless of familiarity and which faces in the pair had a mask either in all masked or half masked conditions (Carragher & Hancock, 2020). This experiment highlights the importance of understanding how masks affect recognition and matching abilities for faces. As unfamiliar face matching or recognition is already error-prone, the angle of which the face is shown and the occlusion of internal features can affect matching accuracy (Carragher & Hancock, 2020). Other research on face recognition has demonstrated the upper half of the face is more helpful in recognizing and matching faces, specifically the eyes (Carragher & Hancock, 2020). Similar to the present investigation, this research assessed masks' effect on face-matching ability because past research has not examined the impact of specifically face masks. Past research has demonstrated faces with ski or nylon stocking masks were remembered less accurately than undisguised faces on a recognition test (Carragher & Hancock, 2020). Since the researchers only found one other experiment that examined the effect of face masks inhibiting face matching with severe limitations, their experiment used the short version of the Glasgow Face Matching Test (GFMT) and the Stirling Famous Face Matching Task (SFFMT) to examine the effect of face masks on matching ability. Participants were randomly assigned to complete both tasks by viewing two faces with no masks, both with masks, or where only one face in the pair had a mask (the mixed trial in the study). The masks on faces were superimposed via photo editing software to prevent stimuli variation. Digitally superimposed masks are a severe limitation because the faces were not covered in actual masks, possibly preventing the participant from perceiving the entire face shape. In the short version of the GFMT, 20 match and 20 mismatch trials were completed; again, the masks were superimposed on the images for all masked faces. In creating the SFFMT for this matching experiment, pictures of celebrities (for familiar faces) and pictures of unfamiliar faces were gathered, showing neutral or positive expressions where participants partook in 40 trials of familiar famous faces and 40 trials of unfamiliar faces for a total of 80 trials (Carragher & Hancock, 2020). The trials were controlled where no face appeared in a match and mismatch trial, and the less familiar (less famous) celebrity would always wear the mask in the mixed condition.

To check the familiarity of the faces used in the SFFMT, a recognition test was given to participants to gauge their familiarity with the presented faces; it was found that none of the unfamiliar faces were recognized, so this analysis was performed on all 40 trials (Carragher & Hancock, 2020). The GFMT was always administered before the SFFMT to allow for analysis of performance correlation between the two tasks, where they answered yes/no based questions as to if they knew the presented person; when participants answered yes, they were asked to name the person (Carragher & Hancock, 2020). When examining the results from the GFMT, there was a significant effect of face masks on sensitivity and response bias rate. Sensitivity was higher for controls than those in the mixed condition, and the controls showed a lower response bias rate than in the mixed condition (Carragher & Hancock, 2020). When further examining the sensitivity of recognizing and matching faces, familiarity is a strong influence. Face masks had a more substantial sensitivity effect for familiar than unfamiliar faces and were higher in control conditions compared to the mixed and masked conditions used in the trials (Carragher & Hancock, 2020). Furthermore, the response bias, the bias to say two faces match, was only affected by face masks for familiar faces, with it being more extensive in the mixed condition than in the non-masked and all masked states (Carragher & Hancock, 2020). The correlation between the GFMT and SFFMT was only significant in the sensitivity for familiar faces (Carragher & Hancock, 2020). In general, this matching experiment highlights that mask-wearing (specifically wearing surgical masks) can negatively affect face-matching ability regardless of if one or two masks are present in the face pair, with a more significant detrimental effect on familiar face matching compared to unfamiliar face matching (Carragher & Hancock, 2020). The experiment provided valuable information regarding the impact of face masks on face matching ability along with the influence of familiarity. Familiarity increases the response bias (stating faces match), whereas this is less of a problem for unfamiliar face matching instead of masks influencing the declaration of mismatches. The only significant limitation of the study was no authentic face masks were used, possibly resulting in poorer perceptions of the face shape. Moving forward in examining similar domains of facial recognition, such as pure facial recognition or facial recognition memory, as in the current investigation, familiarity should be considered when presenting participants with facial images to recognize.

The present experiment aims to determine how wearing face masks affect facial recognition memory. There is a gap in the literature examining the impact of facial recognition memory, which explores an individual's ability to recognize a presented face on a memory test, specifically for faces with and without masks. Prior research has examined the matching or facial recognition under different scenarios rather than if the individual retains the face they saw and can later recognize that same face. To control for familiarity effects, as seen and thoroughly examined in the literature, unfamiliar faces will be used to gauge the effect face masks have on facial recognition memory. With the status of the COVID-19 pandemic and the necessity of wearing masks, it seems imperative to determine if faces with a mask impair facial recognition memory. This experiment aims to determine if wearing a mask reduces facial recognition memory on a memory test and if facial recognition is more accurate for individuals not wearing a mask than those wearing a mask. First, it is hypothesized that facial recognition memory for faces with a face mask will be worse than faces without masks when administered a recognition memory test. The second hypothesis is there will be more false alarms for masked faces than unmasked faces not studied on a recognition memory test.

1. Methods

1.1. Participants

The study consisted of 166 undergraduate students at Seton Hall University.

1.2. Design

A 3×2 ANOVA was used to compare the study type (study mask, study no mask, and unstudied) and the test face type (mask or no mask) on a facial recognition test for faces with masks and faces without masks. The experiment measured the proportion of participants answering "yes" to a presented face. Study face type and test face type were measured within groups.

1.3. Materials

A total of 30 faces were used from the Sejong face Database (Cheema & Moon, 2021). These were dispersed evenly among the six groups (3 study x 2 test conditions) and inserted randomly in a Qualtrics survey. Twenty faces were used in the study phase, either with a mask (10 faces) or without a mask (10 faces). Questions on the test phase included faces from this database, either with or without the mask from the study phase (20 faces) or was a completely new face (10 faces). Some faces from the study phase were included in the opposite condition within the new faces set for counterbalance. These opposite conditions would

	Test Mask	Test No Mask
Study Mask	.637 (.255)	.375 (.251)
Study No Mask	.635 (.241)	.684 (.263)
Unstudied	.352 (.246)	.208 (.209)

Note: SD reported in parentheses

Figure 1. Descriptive Statistics: Proportion "yes" responses, Mean, and Standard Deviations

consist first of the face having a mask in the study phase and not having a mask in the test phase, and second the face not having a mask in the study phase and having a mask in the test phase. In the 5-minute distraction phase, random online images (with common creative license) were used. The survey was administered via SONA and Qualtrics, and the results were analyzed with SPSS.

1.4. Procedure

Participants were administered a survey link via SONA, which led them to the consent form on Qualtrics. After they agreed to the consent form, the participants read the instructions and were taken to the study phase of the survey (on Qualtrics). In the first part of the survey (study phase), participants made yes/no judgments on 20 faces shown in sequence, determining if the person was wearing a face mask or not. Each image was shown for a minimum of 7 seconds to ensure the participants studied the face rather than focusing solely on answering the questions. After the study phase, participants took a 5-minute break during which they completed an image matching/identification task. Finally, in the test phase, participants answered yes or no questions about whether they saw the presented face in the study phase. The order of faces in the study and test phase was randomized for each participant, presented one at a time, and varied in masking status. Furthermore, Qualtrics randomly assigned participants to one of the six counterbalancing conditions. The total experiment time was 30 minutes, with approximately 12 minutes for the study phase, 5 minutes for the break between the study and test phase was about 12 minutes. Participants could have finished sooner depending on the time taken for the study and test phases, but the break time was controlled at 5 minutes.

2. Results

Table 1 contains the means and standard deviations. Figure 1 contains the means and standard deviations for the average yes response rate. A 3 (study type: study mask, study no mask, and unstudied) x 2 (test face type: mask or no mask) ANOVA was used, where the yes response rate or the proportion of "yes" responses on a facial recognition test for each of the six combinations of study and test type was measured. Study type and test type were manipulated within groups. A main effect of studying faces with masks was found $F(2,330) = 196.743$, $p < .001$, $\eta_p^2 = 0.544$. A second main effect was found for testing faces with masks in the test phase, $F(1,165) = 86.898$, $p < .001$, $\eta_p^2 = 0.345$. An interaction was found between the study and test pairs $F(2,330) = 40.606$, $p < .001$, $\eta_p^2 = 0.197$. Paired sample t-tests and a correlation test were performed to interpret this interaction further. Recognition rates (yes response rates) were found to be higher in the study mask, test mask condition compared to

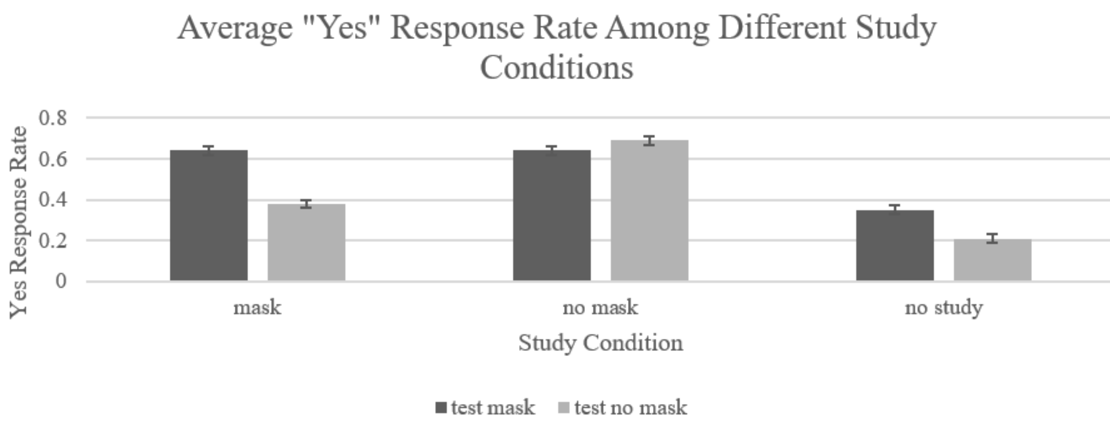

Figure 2. Group Means and Standard Errors

the study mask test no mask condition $t(165) = 10.559$, $p =< 0.001$, $\eta_p^2 = 0.820$. The recognition rate was not significantly different between study mask, test no mask condition and study no mask, test no mask condition $t(165) = -1.956$, $p = 0.052$, $\eta_p^2 = -0.152$. Lastly, the recognition rate was found to be significantly different between the unstudied, test mask and unstudied, test no mask conditions, where it was higher for the unstudied, test mask condition compared to the unstudied, test no mask condition $t(165) = 6.742$, $p =< 0.001$, $\eta_p^2 = 0.523$.

3. Discussion

The results demonstrate a significant interaction between the study type (if the participant studied a face with a mask or without a mask) and the level of face masking at the test (mask or no mask). The proportion of yes responses was recorded during the test phase, corresponding to a higher recognition rate. An errorless response on the test would be participants responding yes to all the faces that were in the study phase and no to the new phases that were presented in the test phase regardless of how they were studied (with or without a mask) or how they were presented on the test (with or without a mask). The interaction found in the results is between how the face was presented at study, with or without a mask, and then how that face was presented at test again with or without a mask. If the face was initially studied with a mask in the study phase, it was recognized better (had a higher yes response rate) on the test phase if the face was presented with a mask compared to if the face on the test phase was not wearing a mask. In the test phase, the faces presented with a mask had a higher yes response rate or recognition rate if they were initially shown with a mask in the study phase (the study mask, test mask condition). The yes response rate was lower if the face was studied with a mask and tested without a mask, the study mask, test no mask condition. So, the yes response rate or recognition rate was higher for the study mask, test mask condition than the study mask test no mask condition. This demonstrates the context effects of wearing masks in the study and test phase. If the participant studied a face with a mask, it is harder to recognize that same individual (in the photo) without a mask during the test phase; there is a more accurate recognition rate (higher yes response rate) if the face is studied and tested with a mask). There is a practical application of this result; for example, if you meet a student on the first day of class who is wearing a mask (which can be equivalent to studying that person's face with a mask), and then the next day in class, that same student is not wearing a mask, you are less likely to recognize them. A similar scenario that practically depicts this result is initially seeing a student for the first time in class with a mask and then seeing them again with a mask leads to improved recognition memory for that person; seeing the same individual consistently with a mask is helpful for facial recognition memory. This result expands on past research describing context effects. This research has found famous (familiar) faces were more accurately recognized if they were presented in the same background context, whereas the environmental context effect was not found with unfamiliar faces (Roediger et al., 2017). The current experiment held the background constant, and unfamiliar faces were used to avoid any background or familiarity effects. These results demonstrated a context effect of mask-wearing, where recognition memory rate was influenced by whether the individual in the image was studied with or without a mask.

The opposite effect of initially studying faces with masks was not seen; if the face was studied initially without a mask, it does not matter if it has a mask on the test phase as the recognition rates are the same. There was a slightly higher recognition rate for faces studied without masks and then presented at test without masks, but the difference was statistically insignificant. These first two results partially support hypothesis one: masks only decrease facial recognition memory when the face was initially studied with a mask and tested without a mask. These results demonstrate context effects for masks because recognition memory was the best when the context of mask-wearing matches. Support was found for the second hypothesis because higher false alarm rates were found for unstudied faces wearing masks during the test phase. The unstudied test mask condition had a higher yes response rate than the unstudied test no mask condition, meaning participants were more likely to recognize seeing the presented person from the study phase if they wore a mask even though the person was not present in the study phase. These results demonstrated another variation of concealed face recognition research; recognition ability and matching ability are decreased for concealed faces (Noyes et al., 2021), where face masks reduce recognition memory ability for unstudied faces.

This experiment provides preliminary evidence of wearing face masks and their effect on facial recognition memory. Specifically, wearing masks has two effects: recognizing individuals not present in the study phase and making it more difficult to recognize an individual with no mask for the first time after initially seeing or studying them wearing a mask. The first limitation of this experiment is the lack of demographic data. Research has demonstrated cultural effects on the individual viewing the photo and the individual in the image. For example, in looking at eye movements, Western cultures focus on discrete locations (like eyes and mouth) in facial recognition, and Eastern cultures tend to have global fixations (Caldara, 2017). These cultures differ in facial recognition of emotion; Western cultures focus on the mouth in distinguishing emotion expression, and Eastern cultures focus on the eyes (Caldara, 2017). A second limitation is an uncontrolled context during participation. Since this study was administered virtually, there was no way to control the settings during participation. Due to this uncontrolled context during participation, it is unclear if the context of the environment influences facial recognition memory. Since this experiment demonstrated context effects for masks, it is essential to consider if the environment also has context effects. Future research can further examine the effect of context on facial recognition memory by manipulating the image's background, location, sounds, and color. Repeated study effects can also be examined for facial recognition memory. The faces in the present study were only presented once in the study phase and once in the test phase. Future research should examine repeated study effects to determine if repeated presentation improves or has no effect on facial recognition memory. Since the trials used only 30 facial images, future research can expand the number of face images used to determine how the quantity of faces needed to be remembered alters facial recognition memory. Finally, research should aim to apply eye-tracking techniques to facial recognition memory tasks to determine where the eyes focus and correlate this with facial recognition memory performance. Does focusing on the top portion of the face (eyes and surrounding area) lead to improved recognition memory than focusing on the bottom part of the face, and what is the effect of masks? There are many ways research can expand on the effect of masks on facial recognition memory. The present experiment provides a starting point for studying masking phenomena for facial recognition memory.

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