# Face Masks, Unmasked: Identifying Changes in Gaze Focus Toward Individuals Wearing Face Masks

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## Introduction

The widespread usage of face masks during the COVID-19 pandemic prompts inquiry into long- and short-term impacts of occluding the nose and mouth, both critical mechanisms of social interaction. This study investigated how face masks alter scanning strategies and facial emotion recognition. As the lower face region is a critical area for emoting social cues, it was predicted that occlusion by a mask would result in visual scanning strategies that are impaired (e.g., difficulty recognizing an emotion) or modified (e.g., more visual attention toward the eye region).

The sudden emergence of masks in many social and academic settings produces an incentive to accurately perceive facial expressions behind a face mask, and therefore, promotes adaptive strategies for reading masked faces. Determining which strategies are most effective may provide a means to help those who struggle with reading emotions behind face masks (and other face occlusions). It is important to explore whether facial emotion reading strategies are similar in populations who routinely cover faces (for example, masking in public spaces in some Asian cultures or wearing a niqāb in some Muslim countries).

## Research Questions

1: How do face masks alter visual scanning patterns?

2: Does gaze scanning vary with emotion recognition accuracy, reaction time, or guessing confidence?

3: Does gaze scanning vary with viewer self-reported ability to read behind masks?

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## Method

### *Participants*

- 48 undergraduate students ($M_{age}$ = 19.78, age range: 18-22, gender: F= 19, M= 22, Other = 6)
- Majority from MN and IL (N = 25); international students (N = 6)

### *Materials and Measures*

Visual Face Stimuli

- 5 face models (college students, F= 3, M= 2)
- Each produced 3 emotions (happy, fearful, neutral) in 2 conditions (masked, unmasked) for 30 total face stimuli (Figure 1)

*Figure 1*

Eye Tracking

- Face areas of interest (L/R eye, nose, mouth) coded to surfaces
- Participants fitted with Pupil Core 3D printed headsets or stationary headset
- Pupil Labs calibration screen and practice faces established calibration
- Slippage and pupil ID confidence monitored throughout session (Figure 2)

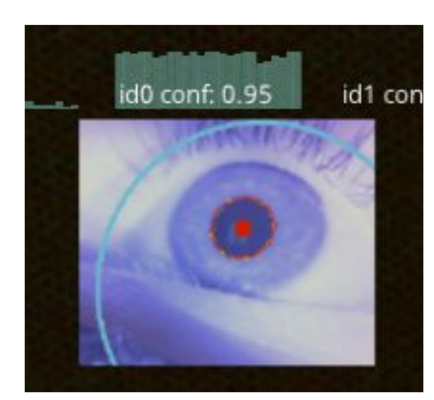


*Figure 2*

Emotion Guess and Confidence

- Modified Plutchik's Wheel of Emotions (Figure 3)
- Emotion guess confidence, 5-point Likert scale

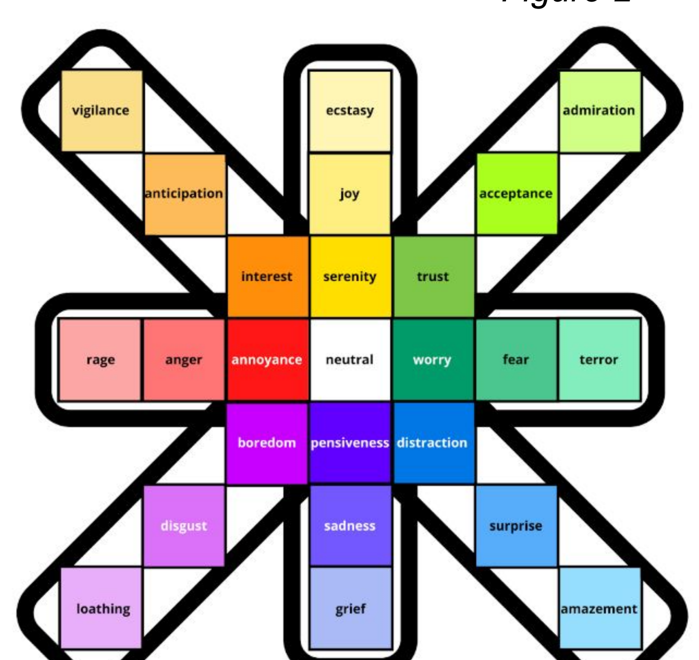


*Figure 3*

Modified Face Mask Perceptions Scale (mFMPS)

- 16 Likert scales assessing beliefs toward and habits of wearing face masks ("Face masks make people seem untrustworthy") rated "disagree strongly" to "agree strongly"
- mFMPS Adapted from Howard (2020)

### *Procedure*

- Eye tracking apparatus fit and tested on participant
- Participant observed face stimuli for 2 seconds each, and for each face guessed the emotion and reported guess confidence
- Immediately following the experiment, participant completed mFMPS and demographic questionnaire

## Results

### *Q1: Face masks alter gaze scanning strategies*

- Across all mask and emotion conditions at large, gaze duration concentrated in the eye region (M = 1.274 seconds) compared to the nose and mouth region (M = 0.135) (Figure 4)
- Independent-Samples Mann-Whitney U Test revealed masked faces produced significantly shorter looking times in the nose and mouth region (M = .068, U = 20.264, z = 4.143, $p < .001$) and longer looking times in the eye region (M = 1.388, U = 13.388, z = -3.535, $p < .001$)
- Independent-Samples Kruskal-Wallis Test revealed no significant differences in gaze patterns between face emotion condition and looking times in the eye region, $H(2) = 3.527$, $p = .171$, or the nose and mouth region, $H(2) = 1.845$, $p = .398$

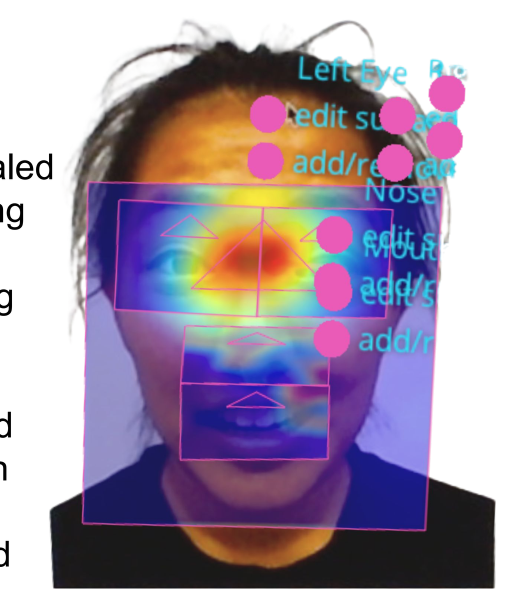


*Figure 4*

### *Q2: Gaze scanning varies with emotion recognition*

- K-Means Cluster classification organized participants into high, middle, and low emotion recognition groups per total mask emotion accuracy (Figure 5)
- Independent-Samples Mann-Whitney U Test revealed significant gaze differences between the three mask accuracy groups and mean gaze at the nose and mouth ($p = .003$) (Figure 1), emotion recognition reaction time ($p = .000$), confidence ($p < .001$), and confidence reaction time ($p = .000$)

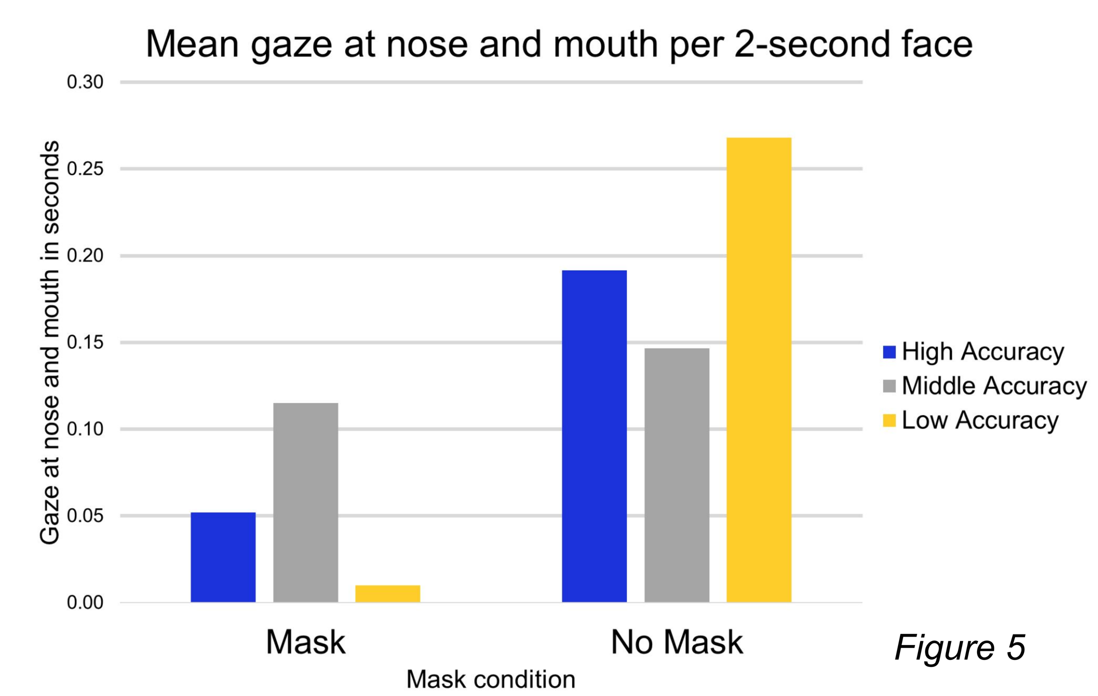


*Figure 5*

### *Q3: Gaze scanning varies with self-reported ability*

- Independent-Samples Kruskal-Wallis Test revealed significant gaze differences in the eye region, $H(2) = 18.959$, $p < .001$, and the nose and mouth region, $H(2) = 14.550$, $p < .001$, between viewers whose reported ability to read faces behind masks (improved, stayed the same, or declined since the start of the pandemic) ($p < .001$) (Figure 6)
- Independent-Samples Kruskal-Wallis Test revealed a trend to significance between the three mask change groups and emotion response reaction time, $H(2) = 5.078$, $p = .079$, and no significant trends to emotion guessing confidence, $H(2) = 1.541$, $p = .463$, or confidence reaction time, $H(2) = 2.483$, $p = .289$

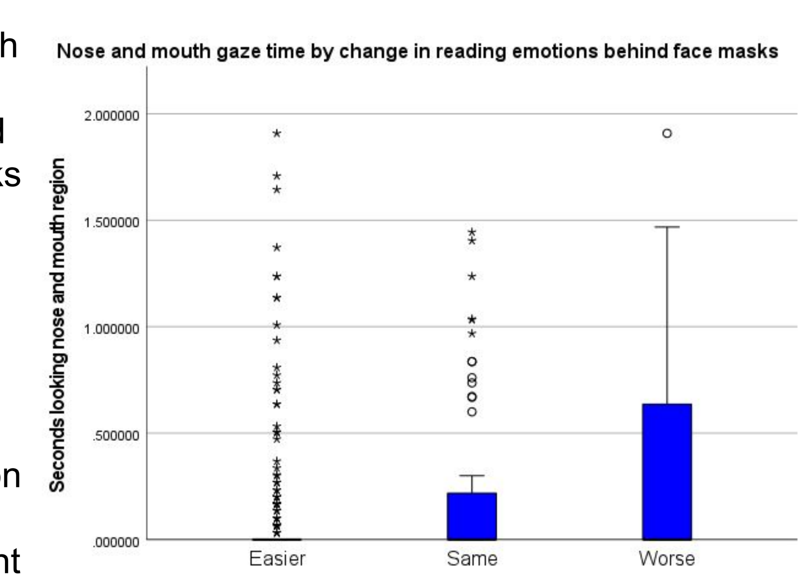


*Figure 6*

## Discussion

### *Conclusions*

Even though many individuals have adapted to the COVID-19 lifestyle changes, face masks are still a topic inspiring debate and strong emotions. In this study, the difference between the participants who guessed the most (13) and least (1) masked face emotions (out of 30) underscores how more research is needed to offer solutions to this social challenge. Is this wide variability in emotional recognition accuracy a cause or product of the individual scanning patterns? What distinct strategies lead to higher emotion recognition accuracy? Are effective scanning patterns learned, and if so, how can they be taught?

Future research should investigate how certain sequences of scanning the face (such as eyes first, then lower face) or speeds of scanning face regions can be tied to higher emotion recognition accuracy. With the portability of Pupil Labs, future gaze tracking research can incorporate naturalistic field studies with live actors and realistic social scenarios.

## Resources

*Poster PDF*

*Pupil Labs Website*

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