NeuroView

The face behind the mask: The future of interpersonal interaction

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https://doi.org/10.1016/j.neuron.2021.05.030

Worldwide use of face masks as personal protective equipment (PPE) during the COVID-19 pandemic has changed interpersonal interactions in myriad ways, likely permanently. Creative strategies like the PPE Portrait Project serve to mitigate social disconnection resulting from facial feature obstruction.

Due to the rapid global spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in March of 2020, the World Health Organization (WHO) declared the COVID-19 pandemic. The wearing of face masks to slow the spread of the virus was mandated or encouraged in many countries across the globe. While necessary from a public health standpoint to curtail transmission of the virus, the use of face masks interferes with our ability to view facial features critical for the recognition of faces and facial expressions of emotion. Seeing the faces of our peers is vital to successful social interactions, as the face represents the visual signature of the self, instantly communicating a dynamic synthesis of gender, race, age, emotion, and mood that signals our intentions and performs our identity and persona. The necessity of conducting in-person social exchanges with masked faces for over a year now has presented wide-ranging challenges—alongside some surprising benefits and adaptations—for communication, interpersonal interaction, and mental health.

Facial expressions are a dense nexus of both universal and culturally specific gestures that powerfully communicate and foster social bonds and affective connection. In particular, the eyes and mouth together represent crucial cues for conveying intentions and emotions of others. Recognizing the faces of others is an ability that has been selected for through evolution and conserved across species. Newborn infants are able to discriminate their mother's face from the face of a stranger in spite of poorly developed vision,

and they prefer looking at faces rather than at other salient visual stimuli (Nelson, 2001). Evidence from cognitive neuroscience supports the notion that the face represents a special class of visual stimulus processed holistically by the brain, unlike other objects that are processed in a more part-based manner. Evidence from neurological patients also supports the double dissociability of face and object recognition. The "occipital face area," the "fusiform face area," and the hippocampus are recruited in human face recognition, with an involvement of the amygdala for identifying emotional expressions (Kanwisher and Yovel, 2006). Face perception and emotion recognition are inextricably linked, as our survival depends on successful cooperative interactions that rely on our ability to infer the emotions and intentions of others.

The incursion of personal protective equipment (PPE) into daily face-to-face interactions leads to questions about how people make these important inferences about others when the most salient source of information, the face, is partially obscured. Between 2014–2016, the Ebola epidemic in West Africa required first responders and healthcare workers to wear face- and body-obscuring PPE that created an impenetrable barrier against the virus. But the PPE also created a frightening interposition between the healthcare providers and the patients they were caring for, compounding fears of the disease and deterring care-seeking behavior. One of the authors, artist Mary Beth Heffernan, surmised that using a picture of the healthcare worker's face on the PPE would have a humanizing effect that

might comfort already isolated patients. Through the PPE Portrait Project (https://ppeportrait.org/), smiling headshot photo stickers of the healthcare workers were affixed over the heart area of their protective suits, enabling patients to identify the individual caring for them. The smiling portraits sought to calm and reassure patients and foster acceptance of care. The PPE Portrait Project was implemented at two Ebola Treatment Units (ETUs) in Liberia in 2015 to an overwhelmingly positive response from patients, who affirmed that they liked seeing (a picture of) who was underneath the layers of PPE. As an additional benefit, healthcare workers found that the PPE Portraits enabled them to easily identify each other in the "red zone" of the ETU, made them appear more human and less like "zombies," and fostered camaraderie among the team.

While the face masks we use to prevent the spread of COVID-19 are not as obfuscating as the PPE used in the Ebola epidemic, their use is much more ubiquitous in the general population worldwide. Masks conceal parts of the face important to both verbal and non-verbal communication. Previously automatic subconscious deductions based on the perception of others' faces—from evaluative judgements to understanding emotions and intentions and lip-reading to support the comprehension of speech—are no longer available to individuals interacting with others. Covering the lower portion of the face including the nose and mouth disrupts holistic processing of the face, a hallmark of face perception, and significantly impairs face recognition of both

Figure 1. Santhi Kumar, MD, USC-Keck Critical Care, May 2020
The PPE Portrait Project (https://ppeportrait.org/) was adapted in the context of the COVID-19 pandemic to support patients and healthcare workers. Smiling headshot photo stickers of the healthcare workers were affixed over the heart area of their protective suits, enabling patients to identify the individual caring for them. These portraits sought to calm and reassure patients and foster acceptance of care.

spread face mask use dampens communication and diminishes the social bonds fostered through public discourse.

In the healthcare setting, both providers and patients wearing masks cannot see one another's facial gestures and run the risk of being misunderstood, undermining the bidirectional communication central to the improved health outcomes associated with patient-provider trust. For patients hospitalized during the pandemic, faceless caregivers compound their confusion, lack of agency, isolation, fear, and anxiety. Beginning in March 2020, the PPE Portrait Project was adapted to support patients and healthcare workers in the coronavirus pandemic to ameliorate patient anxiety during COVID-19 testing, enable isolated patients to identify their providers, and humanize healthcare workers who could no longer see their co-workers' full faces (Figure 1). PPE Portraits bolstered social bonds and camaraderie in medical facilities that relied on visiting nurses and physicians to handle surging patient loads where their co-workers had never seen their faces. PPE Portraits were particularly beneficial in palliative medicine and hospice contexts. Provider teams used PPE Portraits as an affordance to initiate communication and establish social bonds with patients and their families.

The impacts of mask-wearing on social interactions are vast and extend far beyond healthcare settings. PPE Portraits are also being used by teachers at schools and childcare centers across the US and abroad, with the hope of fostering trust and social bonds between teacher and student. Although the influence of this context needs further long-term study, we can think of opportunities to adapt PPE Portraits to the needs of different populations who are disproportionately impacted by masked interactions. For instance, children with autism can experience difficulties with face recognition if information is only available from the eye region. A social context involving people wearing face masks that leave the eye region as the only source of information further complicates an already difficult interaction for autistic people. The use of headshots with positive emotional facial expressions may be one way in which the PPE Portraits could help in educational or therapeutic

familiar and unfamiliar faces (Carragher and Hancock, 2020).

Facial emotion perception is also affected by face masks, especially for emotions on the negative side of the spectrum, with disgust being misinterpreted for anger, for example. Some emotional expressions including happy, sad, and angry are sometimes not perceived at all under a mask, with the face being interpreted instead as neutral (Carbon, 2020). However, consistently engaging in social interaction with masked individuals is already leading to behavioral adaptation in Americans, with those who have more frequent masked interactions increasingly using cues for visual emotion information from the eyes (Barrick et al., 2020).

Human brains are hard-wired for social interaction. The human mirror neuron system (MNS) acts like a neural wi-fi, auto-

matically and subconsciously monitoring the intentions, actions, and emotions of others, leading to the activation of regions that subserve the encoding of those same intentions, actions, and emotions in the viewer's own brain. This embodied simulation mechanism instantiated by the MNS allows us to attune our own mental and emotional state to that of those around us. Attunement provides a self-to-other mapping, allowing us to represent ourselves in and through each other, co-creating the scaffolding for social interaction and meaning, and forming the bases of culture (Molnar-Szakacs and Uddin, 2013). However, if part of the information about the intentions and emotions of others that are expressed through facial expressions is obscured, this may lead to instances of misunderstanding and miscommunication. The "epidemic of facelessness" engendered by wide-

contexts for autistic and other neurodiverse individuals. Our masked world has also presented additional challenges to those who experience hearing loss and rely heavily on visual cues from the mouth to communicate. This increased difficulty in communicating and having meaningful social interactions can lead to social isolation and loneliness (McKee et al., 2020). Considering aspects of accessibility in mask design, such as masks with see-through panels that allow for lip-reading, is one way we can help alleviate this barrier.

Even as face masks complicate social interactions for many, others have found unexpected benefits from wearing them. For those with social anxiety, wearing a mask helps them feel less judged and less self-conscious when they go into public. Mask wearing "might reinforce [their] sense of personal control and… mitigate helplessness and moderate anxiety" (Szczesniak et al., 2020), providing a sense of emotional comfort. People with compromised immune systems feel safer in public when everyone is wearing a face mask. Before mask-wearing became ubiquitous due to the COVID-19 pandemic, immunosuppressed individuals had to be very cautious in any crowded space, as a bystander's sneeze could send them to the hospital with an infection.

Mask wearing has other surprising positive impacts. Some have found that the acceptability of wearing masks has freed them from the pressures of appearance or grooming standards. Being able to jettison makeup and shaving routines is not only saving people time and money but is also relieving the stress associated with these perceived societal pressures. Interestingly, in aesthetic judgements, masked faces are perceived to be more attractive overall, and this effect is most significant for faces judged to be least attractive when unmasked. Covering the lower half of the face may be hiding asymmetries of the face that decrease perceived attractiveness (Patel et al., 2020). Facial attractiveness has important social consequences and implications for interpersonal interactions, as individuals judged as more attractive are perceived as having higher social status, better health, and more positive personality traits and are even more likely to be hired

for jobs. Those in service industries, such as retail or restaurants, who are expected to always present a friendly face may no longer feel obliged to fake-smile at customers, potentially lifting the burden of emotional labor. Mask wearing may also relieve the burden felt by women and people of color to perform gendered and racial personas that are non-threatening to the dominant culture.

While our current "facelessness" is thought to impede social bonds, widespread mask wearing is shown to foster elements of interpersonal interaction in some contexts. A study found that masked faces were perceived as more trustworthy, leading people to reduce interpersonal distance between one another. While that may seem like a win for social interaction, reducing interpersonal distance during a pandemic could contribute to increased risk of infection. These findings reveal that the recommendation to wear face masks in the current pandemic context needs to be accompanied by an emphasis on social distancing to prevent detrimental health consequences (Cartaud et al., 2020).

Face mask mandates are gradually being lifted in parts of the world, but they are still crucial to curbing the pandemic in many countries. As the social acceptability of mask wearing increases and individuals find benefits including avoiding the seasonal flu, protection from airborne pollutants, and relief from social anxiety, it is likely that many will continue to wear masks even when we have emerged from the current pandemic. Considering this shift, whereby the primary purpose of masks will change from reducing the spread of COVID-19 infection to more general health and social use, it is vital to understand the short- and long-term effects of mask wearing on communication and social interaction at the neural, behavioral, and societal levels as well as the long-term impacts on human relationships and mental health.

The disruption of social norms framing interpersonal interactions that was necessitated by the COVID-19 pandemic presents us with challenges and opportunities. Given that face masks put a disproportionate burden on those who are isolated, hospitalized, and the providers who care for them, we need to

continue to innovate in our psychosocial adaptations to alleviate the potential harms of using PPE, especially for vulnerable persons, and move toward greater access and equity. We also have the opportunity to embrace the health and social benefits that face masks provide. Despite stigmatization in the U.S., many have embraced face masks as the new cultural norm for infection control and other secondary benefits, akin to some East Asian countries where mask wearing has been commonplace for years. This marks a fundamental shift in the culture to embrace new hygiene practices, a beneficial change that conjoins care for the self with concern for the common good.

REFERENCES

Barrick, E., Thornton, M.A., and Tamir, D. (2020). Mask exposure during COVID-19 changes emotional face processing. PsyArXiv. Published online December 11, 2020. https://doi.org/10.31234/osf.io/yjfg3.

Carbon, C.-C. (2020). Wearing Face Masks Strongly Confuses Counterparts in Reading Emotions. Front. Psychol. 11, 566886.

Carragher, D.J., and Hancock, P.J.B. (2020). Surgical face masks impair human face matching performance for familiar and unfamiliar faces. Cogn. Res. Princ. Implic. 5, 59.

Cartaud, A., Quesque, F., and Coello, Y. (2020). Wearing a face mask against Covid-19 results in a reduction of social distancing. PLoS ONE 15, e0243023.

Kanwisher, N., and Yovel, G. (2006). The fusiform face area: a cortical region specialized for the perception of faces. Philos. Trans. R. Soc. Lond. B Biol. Sci. 361, 2109–2128.

McKee, M., Moran, C., and Zazove, P. (2020). Overcoming Additional Barriers to Care for Deaf and Hard of Hearing Patients During COVID-19. JAMA Otolaryngol. Head Neck Surg. 146, 781–782.

Molnar-Szakacs, I., and Uddin, L.Q. (2013). Self-processing and the default mode network: interactions with the mirror neuron system. Front. Hum. Neurosci. 7, 571.

Nelson, C.A. (2001). The development and neural bases of face recognition. Infant Child Dev. 10, 3–18.

Patel, V., Mazzaferro, D.M., Sarwer, D.B., and Bartlett, S.P. (2020). Beauty and the Mask. Plast. Reconstr. Surg. Glob. Open 8, e3048.

Szczesniak, D., Ciulkowicz, M., Maciaszek, J., Misiak, B., Luc, D., Wieczorek, T., Witecka, K.-F., and Rymaszewska, J. (2020). Psychopathological responses and face mask restrictions during the COVID-19 outbreak: Results from a nationwide survey. Brain Behav. Immun. 87, 161–162.