

# COGNITIVE DEVELOPMENT IN YOUNG CHILDREN DURING THE ERA OF MASK WEARING: THE ROLE OF EMOTION RECOGNITION IN PEDIATRIC BRAIN DEVELOPMENTAL ABILITIES

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*ABSTRACT: Facial expressions are arguably one of the most critical social stimuli that allow infants and young children to communicate emotion and cognitively develop in areas of speech, language, and learning comprehension. Since the first reports of the 2020 novel coronavirus, mask-wearing has been a common practice to preventing the spread of the virus; however, with masks covering a great portion of an individual's face, the lack of facial cues become a great concern to how infants and young children develop and mature to adulthood during the era of mask wearing in daycares, schools, and other everyday settings. This proposal aims to explore the correlation between mask-wearing frequency and emotion recognition skills in children by utilizing a cross-sectional study design with an online survey and emotion recognition task. Statistical evidence will be collected from the emotion recognition scoring results and will be compared with the online survey that interprets the child's mask-wearing frequency. The results of the proposed study are expected to yield a more prominent understanding of pediatric cognitive development associated with the social impacts of COVID-19; we encourage the further research of the consequences of mask-wearing and to create further initiative to better support the future generations of our world.*

## Introduction & Background

Mask-wearing has been one of the most successful factors in combating the spread of COVID-19 (Mayo Clinic, 2022), yet the underlying issue of cognitive and psychological consequences in young children that come with wearing masks can present potential issues throughout their childhood. The role of emotion recognition comes into play when discussing the importance of cognitive development among young children, specifically how facial expressions are being compromised by mask-wearing; many studies have demonstrated the correlation between emotion recognition and social behavior ranging from infant to young adolescent individuals. The element of facial emotion recognition is vital during childhood, especially when friendships and social structures are prevalent, and the child must recognize and interpret the emotional context in social interactions (Garcia and Tully,

2020). The era of COVID-19 has severely compromised the social growth between individuals and has limited young children from receiving the necessary social interaction needed for their cognitive maturity. Furthermore, facial expressions become one of the main components to developing relationships with others and social skills, thus compromising the sight of facial expressions can result in future consequences in young children.

## COVID-19 Pandemic

On March 11th, 2020, the World Health Organization declared SARS-COV-2 or coronavirus outbreak a global pandemic (WHO, 2022); the uncertainty and continuous threat have contributed to great stress among communities, resulting in adverse effects ranging between complexities in mental health, societal issues, and economic stress. According to the *Journal of Anxiety Disorders*, researchers

discovered that there were multiple factors that contributed to the collective anxiety and fear among communities, including the health of an individual or loved one who is infected, economic hardship, mutation of the virus, and media bias (Mertens et al., 2020). While many adults were impacted by pandemic stressors, children's lives have been greatly impacted as they had to adjust to new changes and caregiver stress during the worldwide crisis. Accordingly, there has also been a substantial rise in mental illness that is correlated with the timeframe of the pandemic, raising more hardship and tension among individuals (Mumtaz et al., 2021). As the world enters 2022, the condition of the pandemic has barely changed due to increased infections, variants, and tiring coronavirus guidelines that have made individuals feel as if they are in a constant state of fear on top of feeling frustrated and restless. Many children have experienced a degree of stress stemming from a change in their daily way of life, financial burden, and the lack of social and physical contact. In many instances, children are often confined to their home for extended periods of time, thus are not able to learn sociable behaviors or psychologically develop which can lead to stagnation in their growth.

## **State Compliance to Mask Mandates**

Over the past two years, many states have implemented their own policies in regard to combatting the coronavirus spread. The political leadership in each state is a large influence in deciding COVID-19 prevention guidelines, more specifically that Republican governors are more likely to delay or refuse to issue any coronavirus interventions regardless of the CDC's recommendations; consequently, these governors took about 125 days longer to implement at least a mask mandate than a democratic-led state (Adolph et al., 2022). Moreover, many believe that as a consequence of the political attitude that was established at the beginning of the pandemic, individuals might not have taken the virus seriously as a

health risk since political figures, such as past-President Trump, have mocked mask-wearers and continued to downplay the dangers of the virus (BBC, 2020). On the contrary, despite the highly politicized connotation of masks, states that have enforced mask mandates and have a mask adherence of 75% or more are associated with lower transmission rates (Fischer et al., 2021). Therefore, states that comply with the mask mandates have better control of the pandemic and can push for a more stable economic reopening compared to states that have lower levels of mask adherence. Taking preventative measures in a timely manner can significantly impact the effectiveness of controlling virus severity, thus implementing issued state policies can help protect vulnerable populations and the general public to return to normal life after the pandemic.

## **Importance of Face Masks**

Since the start of the pandemic, one preventative measure that was introduced to reduce infections was face masks. Masks have been used to protect vulnerable populations such as immuno-compromised individuals and children that are too young to be wearing masks. Subsequently, the use of face masks has made a large difference in infection rates during the pandemic. Mask mandates issued by local governments can vary by location, with few being strict and others being more lenient. Studies concluded that the reported use of face masks and implemented social distancing decreases transmission rates, thus being one of the most effective interventions for coronavirus (Rader et al., 2021). This suggests that implementing public health interventions such as mask mandates is needed to maximize transmission control. While face masks are essential and the most accessible to prevent the spread of the virus, there are rising concerns on whether this could pose a threat to young children. Masks that are often mandated in primary schools are essential to reducing transmission rates, yet it

takes away facial expression recognition which is critical for child development.

## **COVID-19 Impact on Schools and Education**

Due to the alarming rate and extremity of the virus, many schools were left unprepared to continue educational learning in a remote environment. On one hand, most schools opted to hold classes completely online, while others attempted to conduct hybrid learning for the sake of having some sort of normal environment but would end up with a higher infection rate. Children that had no choice but to adapt to these new learning conditions have taken a social and psychological toll on their health by developing anxiety, depression, and behavioral issues (Malboeuf-Hurtubise et al., 2021). The closure of schools, separation of friends, and underdeveloped coping strategies have also resulted in detrimental effects such as increased screen time of excessive media coverage about the virus, household stress, and social isolation, thus becoming an urgent issue on the child's overall health (Nazish et al., 2020). Over the past two years, schools have attempted to adjust to the new environmental conditions such as allowing in-person options with multiple preventative measures implemented such as social distancing, mask mandates, vaccination requirements, and limited interaction between teachers and students to decrease community transmission (AAP, 2022). Regardless of the educational system's efforts, it is crucial to provide interventions that focus on supporting resilience in children by opening conversations about their fears and taking measures to alleviate loneliness in order to nurture children and adolescents through this difficult time.

## **Cognitive Development in Young Children**

Cognitive development in early childhood refers to their mental comprehension of problem-solving, language acquisition, important relationships, and perception of social behaviors (The White House, n.d.). There are specific ways to develop cognitive skills

simply by practicing speech skills, language development, and social interaction. When a young child is in an environment rich in language and literacy interactions where they can hear and see language constantly, they can easily develop strong speech skills and cognition. If a child is not able to access this environment, this can delay their development and present a significant risk of being constantly behind. In a study researching the correlation between emotion recognition and cognitive development, it was found that a child's poor emotion knowledge is associated with problematic outcomes such as poor academic performance and social functioning (Kujawa et al., 2014). This shows the importance of developing emotion recognition skills; thus, it is crucial to a child's growth particularly during the first years of life to develop sufficient social and mental skills such as cognitive comprehension and emotional capacity. By the age of five, children should be able to comprehend relationships with friends and family, ask questions to expand their curiosity, decision-making, social rules of interactions with other kids, and take steps to control their emotions (APA, 2017). Due to the coronavirus impact, preventative measures such as social distancing and face masks have limited the critical time of not only the social interaction between children but also staggered a child's developmental process of interpreting facial expressions.

## **Gaps in Knowledge**

Additional research into how emotion recognition plays a factor in cognitive development during the COVID-19 pandemic is imperative for a child's growth and development; lack of emotion recognition in a child's first five years of life can significantly impact their future social skills and interpersonal behavior, while less is known about the pandemic's contribution to cognitive difficulty. Although these studies pave the way to examine the connection between cognitive development and facial expressions, there are limitations in knowledge that may have

held the studies back. For instance, most studies consist of a sample population of children ages three to adolescence (14-17). While this is an important age group to study in terms of brain development, this could be too large of a range to represent the critical social skills developed in young children. Another gap in knowledge is that some studies that address emotion cognition have a limited selection of emotions that are included in the child's assessment, such as only being happy, sad, and angry. We will address gaps of knowledge with this research study by adding more variety in how many emotions are assessed as well as degrees in the intensity of each facial expression. In addition, we will limit the age range to be three to six years old to get a better understanding of essential cognitive development skills. Proceeding with this research study can help bridge the knowledge gap between the effects of the pandemic and how it has impacted communities, thus providing results that can provide opportunities and strategies to help reduce social and psychological consequences in young children.

## **Research Question & Hypothesis**

The COVID-19 pandemic has completely altered the way we live and how we function as a society in the past two years. Specifically, this has impacted those that are currently growing up during these environmental conditions. While the use of face masks has significantly contributed to minimizing the spread, it has also hindered a child's ability to recognize specific emotions.

Therefore, the lack of emotion recognition due to the implementation of mask-wearing can severely affect a child's way of social interaction and interpersonal behavior that could carry with them to the future. Proceeding with our cross-sectional study, it is important to address the various difficulties that may be present in a child's future and prioritize their overall wellbeing for the betterment of any future in society. Our research essentially explores this

topic by asking the question: How has a child's emotion recognition ability been impacted by mask-wearing during the COVID-19 pandemic? With the use of masks, our research assumes that a child's cognitive development will stagger or fall behind compared to without face masks. We believe that if children are not able to correctly interpret basic facial expressions, then this could cause potential difficulties in future social interactions, mental health, and relationships.

## **Research Approach**

### **Study Design**

We will conduct a quantitative cross-sectional study, which is the most appropriate method because we can assess the prevalence of the individual's current state of knowledge, attitude, and cognitive ability at one time. Since daycares primarily focus on consistent socialization, school readiness before primary education, communication skills, and cultivating confidence (Cadence Education, 2021), the cross-sectional study will allow researchers to assess the child's current state based on their developmental progress and mask use more accurately at a daycare than at a primary school. It is also crucial to collect data quantitatively as statistical analysis provides more simplicity since subjects might not be able to answer to the extent of what is needed to determine the subject's current state of cognitive function.

### **Sampling**

The study will consist of 400 children that are ages three to six currently enrolled in daycare. We will be utilizing cluster sampling in 10 different daycares from Seattle, Washington, and Orlando, Florida. This specific age range is appropriate because a child's cognitive advances continue to expand more logically as they interpret concepts such as social relationships, behavior, and emotional dynamics (Hagan et al., n.d.). Additionally, this chosen age group is expected to have social and cognitive skills ranging from developing independence, social

interaction with other kids, and being able to comprehend basic emotional cues (AAP, 2021). Washington and Florida State were chosen as study sites because both states have opposing mask mandates and COVID-19 guidelines. Washington state's guidelines over the course of two years had required individuals ages five and older to wear a mask in public indoor settings with strong encouragement on vaccinations. In contrast, Florida state recommends but does not require face coverings. In addition, Gov. Ron DeSantis issued an order of legislation that includes prohibiting schools from implementing face mask policies and mandatory vaccinations (Governor Ron DeSantis Signs Legislation to Protect Florida Jobs, 2021) while Washington state issued a state-wide mandate for schools, therefore not even allowing districts to make their own decisions (Velez & O'Sullivan, 2021) making them paralleling study sites in terms of pandemic preventative measures. We will specifically pick Seattle and Orlando since they are considered the most populated areas and can provide enough data for the study to lessen bias.

## **Proposed Sample & Sampling Techniques**

When selecting participants, researchers will utilize cluster sampling by randomly selecting 10 different daycares in both the Seattle and Orlando locations and forming groups of 20 children per daycare. Cluster sampling would be the best fit to sample this specific population because we are analyzing populations from different states, Washington and Florida. In addition, cluster sampling can randomly select the daycares within the specified area on top of randomly selecting the students within the daycare. This study will primarily target children who are ages three to six years old who spend at least five hours a day or 25 hours a week at the daycare center to ensure they are in the daycare environment following the mask mandates based on the location. This study will exclude children with pre-existing conditions that may impact emotion recognition independent of masks such as those with attentive,

neurological, developmental disorders; this can be conducted in a separate study through long-term observational research on seeing the lasting impact of mask-wearing in individuals with neurodivergent conditions. Recruitment will be done by providing informational sessions about the research and educational materials such as pamphlets about a child's cognitive development to parents who are interested in their child's learning behavior. After sampling, we will proceed to investigate each daycare's mask policy to ensure that they fit within testing conditions, specifically dividing the daycares based on if they require masks or not.

## **Operationalization & Measurements**

The independent variable will be the use of face masks and the dependent variable will be the child's cognitive development based on emotion recognition. Mask-wearing behavior will be assessed through a short survey given to the parents to answer for their child. Cognition development will be interpreted by using the Emotion Recognition Task (Gibb et al., 2009). In the Emotion Recognition assessment, the subject will be given 25 questions where they will be asked to identify the model's facial expression ranging from varying intensities of seven emotions: happy, sad, angry, tired, disgusted, embarrassed, and fearful. We will then record the number of times a child can correctly identify the emotion as well as the emotion they answered if the question was answered incorrectly. We will also consider how long the child is wearing their mask and if they are wearing a mask in their respected location from the survey the parent previously answered. An instance of potential results provided from Gibb et al.'s study (2009) show that outcomes are directly consistent with the relationship that facial expression recognition skills are correlated with reports of child abuse. It is expected to predict this correlation as those that have experienced child maltreatment find it much more difficult to interpret positive facial expressions due to the lack of being exposed

to positive emotions from their parents. This explanation can further clarify the correlation between face mask behavior/frequency with childhood cognitive development due to the limited exposure to facial expressions and children scoring low results on the Emotion Recognition Task.

## Data Collection

### Phase I: Mask-wearing frequency

We will send out two surveys to the parent/guardian using an online accessible link; one survey will ask about the household's demographics such as the child's age, sex, ethnicity, location, and household income. The second survey will focus on questions in regard to the child's mask-wearing frequency during their time in their respective daycare. In the second survey, questions will include asking about the household's demographics: the child's age, sex, then three nominal and two ordinal variables to shape the following questions:

1. Do you enforce mask-wearing on your child outside of daycare? For instance, at stores, public places, and/or family outside of the household, etc.  
Yes  
No
2. Does the daycare your child attends require masks?  
Yes  
No
3. Does your child wear a mask?  
Yes  
No
4. If yes, how often do they wear a mask?  
Always  
Mostly  
Sometimes  
Never
5. How long is your child at daycare?  
Less than or equal to 5 hours  
More than 5 hours

It is important to consider these questions because they can supplement statistical analysis and help categorize/separate the data. A survey would be the best fit to analyze the data we need because we can utilize basic questions and simple formatting to reduce complications for the subjects.

### Phase II: Emotion Recognition Task

We will be utilizing an online quantitative survey to assess the child's emotion recognition called the Emotion Recognition Task (Gibb et al., 2009) which can be taken at home using a pre-downloaded program, and finished assessments can be sent back to the researchers. In the process of the emotion recognition task, parents will administer and help their child throughout the assessment while they will be asked to choose between those seven emotions listed using multiple-choice structure by using the question format: "What is this person feeling?" and having the model perform the specific emotion. To reiterate, since the subjects are underaged, parents must be able to facilitate the assessment by reading questions and options, otherwise, they cannot help their child answer the questions. Scoring of this test will be based on how many questions they answered correctly based on the correct interpretation of the emotion, results will be directly sent to researchers. We believe that those who score 60% or above would be considered age appropriate and those who scored less will be marked for consideration during analysis.

## Analysis

Researchers will interpret the data using quantitative analysis to support the survey approach because it will primarily focus on cross-referencing the child's responses by the correct emotion they identified, the emotion they incorrectly identified, and the use of mask-wearing. It can provide a simplistic method to understand the data collection and best to compare statistically between the individual to the overall population. In addition, it

allows researchers to easily quantify emotion recognition and interpret cognitive development among young children and how it relates to the child's use of face masks. In the process of analyzing the data collection, researchers will utilize a bivariate analytical approach to compare those results if the child wears a mask versus no mask and emotion recognition. Secondly, we will also perform a multivariate analysis to see if there are any associations based on demographics such as the subject's location, household income, number of people in the household, and parent's education level to see if there is a correlation between demographics and the child's frequency of mask use.

## **Ethical Considerations**

In the process of the cross-sectional study, researchers will follow a group of young children ages three to six, thus parental and informed consent will be considered for this study to proceed. In addition, an Institutional Review Board approval must be obtained before beginning the experiment, making sure that all subjects are protected and that parents/guardians are given the necessary information before participating in the research study. Furthermore, since the study will involve 20 daycares from two different states, we will confirm informed consent to the directors of each daycare. The child's identity who participates in the study is only between the parent, child, and the researchers, therefore ensuring confidentiality. Researchers will also ensure the protection of data through confidentiality agreements, secure databases, and limited access to the data. The survey and assessment can also be stopped at any time and the participant can drop out at any time if they choose to.

## **Discussion**

### **Significance**

There is a necessary obligation to understand the psychological impact that mask-wearing has on young children. As we have experienced two years' worth of the pandemic, there is

great stress of not knowing how long the crisis period of the pandemic will last. Research on COVID-19 itself, let alone the impacts it has on young children during the era of mask-wearing, is extremely sparse and has not been well studied. In addition, the long-term effects of face masks have yet to be studied; it is important to conduct research that relates to mask-wearing and how it impacts young children to reduce possible consequences. Further, collective trauma becomes a pressing issue across the globe, especially impacting children who are coming into and currently living in a world that limits social interaction and crucial factors to cognitive development. This can potentially create social and emotional consequences from the pandemic that can severely impact future generations. Proceeding with this research study can help bridge the knowledge gap between the effects of the pandemic and how it has impacted communities, thus providing results that can provide opportunities and strategies to help reduce social and psychological consequences in young children.

## **Limitations**

As an observational method, a cross-sectional study will only look at one specific moment in time, therefore it cannot support evidence for an association between long-term mask-wearing and the cognitive effects of young children since there are multiple factors that stem from the pandemic such as social distancing, changes in the environment, and other psychological stresses. In addition, the study contains a self-reporting survey on mask use answered by the parent, which could impact the accuracy of the study as parents might have a belief that their child wears a mask more or less than if they are in a daycare setting that requires masks. Moreover, the majority of the data collection heavily relies on parents' participation, therefore there could be potential parental bias introduced. A child's perception of mask use could be a result of their parents' behavior towards masks, which could also affect the child's behavior as well.

Regarding the location of the study sites, since the study only sampled two states across the United States, on top of both study sites being politically skewed, statistical analysis might indicate that individuals from pre-defined groups will correlate with each other. The two cities, Seattle and Orlando, might not be representative of the entire United States due to being on a completely different side of the political spectrum.

### Future Directions

The proposed study can proceed with further research by laying the foundations for a longitudinal study to examine the long-term effects of mask-wearing on children as they grow into adulthood. Future research can develop upon our findings by following young children that are experiencing long-lasting pandemic conditions and documenting significant developmental changes in diverse aspects of emotion recognition. Our research also calls for a better understanding of a correlational relationship between the use of face masks and emotion recognition to see the impact on older adolescents. Since the study was conducted at two sites that may be politically skewed from each other, it would also be beneficial for the study to conduct at a site where the region was more moderate. By conducting our research, we can hope to come up with future interventions and strengthen support between communities and the pediatric field.

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