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Impact of Face Coverings During Covid-19 on Communication: A Look at Development, Disorders, and Mental Health

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Abstract

This research analysis takes a look at the impact of face coverings worn during Covid-19, had on communication. The research questions this thesis analyzes are: What impact did/do face coverings have on communication during COVID-19? Were communication development milestones impacted due to face coverings or other factors during COVID-19? If so, in what ways did they impact these milestones? How did face coverings impact individuals with receptive and/or expressive communication disorders? In what ways was the mental health of individuals who have a communication disorder (or who didn't) impacted during COVID-19? Was the overall developmental of cognitive processes in children impacted by mask usage during COVID-19? If so, in what ways? It was found that each topic in question was negatively impacted due to the required face coverings. Voice acoustics, visual cues, and facial expressions being obscured due to the face coverings led to an issue in communicating. These characteristics also led to a downfall in children acquiring language at the expected rate. The face coverings also proved to provide difficulties for individuals who had previous issues communicating and eventually led to some mental health issues for some of these individuals. With all of these factors considered, it was found overall cognition was also impacted in developing individuals. This matter needs to be discussed and addressed in a timely manner to reverse these negative impacts caused by the face coverings during the pandemic.

Keywords: Communication, Language Development, Mental Health, Communication Disorders, COVID-19

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Introduction

Background-- What is COVID-19?

The coronavirus that was discovered in 2019, and caused so much change, has been named “SARs-CoV-2” but is commonly called “COVID-19”. This disease can spread very easily, much like all other viruses, in the form of droplets that are transmitted through breathing, talking, laughing, singing, coughing, or sneezing. These droplets can stay active in indoor places and infect people even if the original host is no longer present. One of the reasons COVID-19 spread so much was because individuals can carry the disease but not show symptoms for two to fourteen days after exposure. People who have the virus can pass it along to someone else up to twenty days since showing symptoms. This virus can show up in many ways, which makes it hard to distinguish from other illnesses. Some of these symptoms are fatigue, sore throat, loss of taste and smell, nausea, congestion, diarrhea, muscle and body aches, shortness of breath, fever, and a cough. More severe symptoms include lung and heart damage, respiratory or kidney failure, nervous system issues, and death. Even at that, someone can have the virus and still not show any of these symptoms. It has taken the lives of millions of people all around the world and has left many people who made it through the virus, with various levels of lasting health problems (*What is coronavirus*). Before vaccines became available for COVID-19, the protocol the Center for Disease Control and Prevention (CDC) suggested was to remain fifteen feet apart from others and wear a face covering that covered the mouth and nose. These suggested protocols have caused much controversy on their efficiency and overall benefits.

After two and a half years of COVID-19, researchers are already beginning to see the impacts this virus has had and will continue to have on our society as a whole. Over this course of time, people have gotten use to staying in and keeping to themselves. Individuals of all ages are learning through online platforms and colleges are seeing a decline in enrollment numbers likely due to this (Chatterji & Li, 2021). Many people are seeing the advantages of working from home and this is impacting many industries across the board (George et al., 2022). It has been drilled into individuals' minds for the past two and a half years they should shy away from interacting with others and this has caused a societal shift that may or may not shift back. Many people are starting to raise concerning questions about how themselves, the people they love, and the world as a whole may be forever changed due to the virus.

Importance

One research found preschool-age children were highly susceptible to development changes due to the lack of exposure to a preschool environment. In this environment, many key skills are learned and practiced that aid in development. One of these important factors is cognitive language development (DURMUŞOĞLU SALTALI). Not being in this environment and interacting with others, has high potential to lead to improper development. Even older children are susceptible to having their communication development impacted. Before and during their elementary years, children learn a lot about communication through interaction with others. However, kids have gotten used to not having to interact, play, or share with others. In fact, they were often discouraged to do so because of germs spreading. This limits their ability to development important language and communication milestones they need in order to build other cognitive skills. Their syntax, pragmatics, and phonology will be impacted the most due to masks covering such a significant part of their and their communication partners face. Young

children watch the way in which someone moves and positions their mouth in order to mimic these movements so they can produce the sound themselves. However, due to masks, they are unable to see these types of things. They also will be unable to see important communication indicators such as facial expressions that will impact their ability to pick up on pragmatic cues.

In addition, the side effects of masks on communication raises another important question on the impact they had on individuals who already had communication difficulties. Research has already found that in individuals with hearing loss, surgical masks, and face coverings of the like, have caused difficulties in speech perception (Homans & Vroegop, 2021). This research even reported speech perception was difficult if the speaker was wearing a clear face shield.

Other individuals who might already have difficulty forming the positions their mouth needs to make in order to produce certain sounds might feel like making these sounds is impossible due to masks. Masks make it significantly harder to these individuals to function in a world that requires so much communication. It is important to understand how these difficulties impacted the mental health of these individuals so researchers can solve these problems and provide them help.

With all of these possible changes in communication and language, it is likely the development of other cognitive processes in children could have been impacted due to masks or COVID-19 in general. A research conducted by Bowyer-Crane, Bonetti, Compton, Nielsen, D'Apice, and Tracey (2021) found school attendance levels were down even after the school re-opened after mandatory lockdowns. Parents were still cautious to send their children to school or choose to keep them at home instead. This could be indicative that some children were missing out on the basics of education they need to be able to build cognitive processes. This is an important topic to consider because the development of cognitive processes set the foundation

for all other education to be built on. Children who have not yet fully developed might fall behind in school at a rapid rate and may not be able to catch up with their peers. It is important to understand what impact masks could have had on the development of all cognitive processes in general so if there was a change, the appropriate parties are aware to help aid this difference.

The Unknown

There is no previous research on the use of masks and face coverings for illnesses and the impact they might have had on communication. This gives rise to the question of how face coverings used during COVID-19 could impact communication. In addition, the usage of masks and face coverings during the entirety of the COVID-19 pandemic has led to much controversy (Scheid et al., 2020). Some individuals are in full support of the masks and while they add limitations and restrictions, see the value in using them to successfully help stop the spread of the virus. On the other hand, other individuals feel the masks are not helping stop the spread at all and are only causing harmful side effects. While some research has already proven development may be delayed and the mental health of individuals with communication disorders might be worse due to masks, research has yet to provide an understanding or predictions of the lasting impact of these effects.

The goal of this paper is to further explore these negative side effects of mask usage and decipher if these changes could have a lasting impact on society. The purpose of this paper is also to highlight the barrier in communication masks can cause and recognize those who have their communication development or styles impacted negatively by masks to prevent a lasting impact. Part of the previously mentioned controversy is fueled by the debate of if the benefits of using masks during COVID-19 were worth the damages they might have caused (Scheid et al.,

2020). Many different relationship interaction styles and development milestones could have been greatly impacted as a side effect.

Thesis

Although masks may have had immediate benefits during the pandemic, many are wondering and suspecting the communication issues that could follow. These consequences, their severity, and their lasting impact are yet known. This is why it is important to analyze how communication has been impacted as a whole from mask usage during COVID-19 and more specifically how it has impacted, childhood communication development milestones, the mental health of individuals who already had a communication disorder previous to COVID-19, and the development of other cognitive processes in general.

The research questions to be investigated are as follows:

1. **What impact did/do face coverings have on communication during COVID-19?**

This particular research question will provide the basis for understanding how communication as a whole was impacted due to COVID-19. This is important to understand before examining specific areas closer because this will serve as the standard for how communication changed during the pandemic. Knowing how communication in general was impacted will help to understand if changes in communication were specific to individuals or applicable to the entire population. This will also help to further understand how and why childhood development milestones might have been impacted due to COVID-19 and determine if these are permanent changes or how they can be modified to improve development.

2. **Were communication development milestones impacted due to face coverings or other factors during COVID-19? If so, in what ways did they impact these milestones?**

For this research question, research will take a closer look at how the age-expectancy for language and communication acquisition stages could have changed since the rise of COVID-19. Using what is found about how communication has changed, the plan is to see if these changes correlate to how children typically acquire language and if they could have caused the delay. For this specific area, it will be crucial to look at the vastness of change and if development has slowed, how it can be repaired since mask are no longer required.

3. **How did face coverings impact individuals with receptive and/or expressive communication disorders?**

This particular question will look at how communication has impacted individuals who had a previous communication disorder prior to COVID-19. The difficulties they might have faced due to face coverings in receptive and expressive communication will be examined. Understanding the exact difficulties and challenges faced will provide the foundation needed to answer the next question.

4. **In what ways was the mental health of individuals who have a communication disorder impacted during COVID-19?**

These specific individuals might have struggled the most to adapt to communicating with masks during the pandemic. This question will allow a deeper look into how this hardship might have impacted mental health.

5. **Was the overall developmental of cognitive processes in children impacted by mask usage during COVID-19? If so, in what ways?**

With the suspension of language development being impacted by COVID-19 and also the mental health of individuals potentially being impacted, there is a greater chance that other cognitive processes could also be impacted due to mask usage or COVID-19 as a whole. If so,

this will be important in understanding how this impacts a child's overall development and their readiness for school. If masks can cause developmental delays, it will be important for health care providers and caregivers of children to know in order to provide them the resources and assistance they need to stay on track.

In summary, mask usage in COVID-19 might have aided significantly in slowing the spread of the virus, but they might have caused great side effects, especially for children. By taking a look at how communication as a whole changed during the pandemic due to face coverings, it will allow for a better understanding of how communication and language acquisition might have changed in children. Understanding the impact of mask usage will also allow for an understanding of how individuals who had a communication disorder might have been impacted mentally due to this change. In addition, this research will assist in understanding how cognitive processes in general could have been impacted from face coverings.

Findings/Results

Introduction to Findings/Results

The following progressive research questions serve as steppingstones for each other. First, one must understand the potential impact face coverings had on overall communication during COVID-19. From here, it is important to look at how development could have been impacted by these changes in communication. These developmental differences could lead to expressive and/or language disorders. So next, the research will look at how communication for individuals with expressive and/or language disorders could have changed due to COVID-19. If communication did change, it is likely to have had a mental impact on these individuals. The research will look at how mental health for individuals with communication disorders, and individuals without communication disorders, might have been impacted due to COVID-19. If

all of these factors were impacted, it is likely overall cognitive development could also be impacted due to COVID-19 and face coverings. To understand each new concept, research first has to be conducted and analyzed. Below each research question, readers will find research to answer the given question and then an interpretation that provides an answer to the question, relates the information, and provides relevancy.

Results/Findings by Question

1. **What impact did/do face coverings have on communication during COVID-19?**

Communication during COVID-19 was impacted in a variety of ways due to face coverings. The two biggest ways this impact could be seen was by changes in acoustic properties and visual cues. To begin, it is important to review how speech communication works. On the basic level, speech production comes from oral movements that produce auditory and visual cues for a listener. These cues are strung together to form words. Then, the listener must process these speech sounds to comprehend what the speaker is saying (Grieco-Calub, 2021). Adding a face covering to this cycle has the potential to cause many disturbances along the way. 60% of participants in a study reported they communicated different due to a face covering (Saunders et al., 2020).

Research conducted by Saunders, Jackson, and Visram (2020) found that individuals reported masks had a negative impact on understanding and hearing, but also engaging in a way that made them feel connected to their communication partner. A reason for this could be the muffling of the speech acoustic sounds that are being transferred to the listener. Some acoustic properties of speech that could be impacted by face coverings are amplitude, frequency, and duration.

Vowels are among the most important speech sounds when it comes to intelligibility. Without clear understanding of vowels, it is hard for a listener to comprehend what the speaker is trying to convey. When a speaker is wearing a mask, vowels are produced with a longer duration than they are when the speaker is unmasked. The vowels /e/, /a/, and /u/ are specially altered the most during masked speech production. (Georgiou, 2022). The Source-Filter Theory of Speech Production and the Quantal Theory of Speech both support that even a small change in the acoustics of a sound can cause production of sounds that are not typically produced. Without this clarity, listeners can have a hard time processing speech sounds for comprehension. When speaking through a mask, speakers may feel like their articulators can not move as freely as they can without a mask, causing them to make adjustments to their speech they feel could be helping. However, these small changes will have a great impact on the acoustic production and can potentially lead to new sounds (Georgiou, 2022).

For fricative sounds in particular, amplitude was recorded as being significantly lower when the sound was being transmitted through a surgical and KN95 mask versus no mask at all (Nguyen et al., 2022). This is an important measurement to note because voiceless fricatives often rely on amplitude for identification purposes. Decibels (dB) is used to refer to how loud a sound is heard at. For the voiceless fricative /f/, there is a decrease of 5.66 dB on average when an individual is wearing a mask versus when they are not wearing a mask. Another example of this can be seen with the voiceless fricatives /s/, /ʃ/, and /z/. When adding a KN95 mask to these sounds, dB decreased by 6.57, 4.95, and 4.98, respectively, from what the sound was heard at without a mask. The dB decreased by 4.11, 1.92, and 3.43 respectively when passed through a surgical mask versus no mask (Nguyen et al., 2022). Speech clarity scores also saw a significant decrease when heard through surgical masks and KN95 masks. The negative change from no

mask to a surgical mask was 2.81 dB and from a surgical mask to a KN95 mask was 2.46 dB (Nguyen et al., 2022).

It is also important to note the differences that varying masks can have on acoustic properties. The three main types of masks that are most commonly used are cotton masks, KN95 masks, and transparent face shields. In terms of acoustic properties, transparent face shields cause more problems than both cotton masks and KN95 masks. When testing how many decibels each mask type blocks for a human speaker, the KN95 masks were found to block 4 dB at their height, whereas the face shields were found to block 8 dB at their height (Corey et al., 2020). This means the transparent face shields are the worst option of face coverings in terms of acoustic property breakthrough. One research study used a Voice Handicap Index (VHI) to determine the impact mask usage had on an individual's voice quality (Shekaraiah & Suresh, 2021). This research found 26.24% participants reported an abnormal VHI score due to mask usage. VHI score also was reported as being worse in participants who wore their mask for durations of 4-8 hours and 8-12 hours, than those who were theirs for 1-4 hours. Participants who had higher mask usage were found to show more vocal discomfort, fatigue, and effort than the participants who had less mask usage (Shekaraiah & Suresh, 2021)

However, another important aspect of communication that is lost through face coverings is the ability to read facial expressions. Eye-tracking studies can be used to prove individuals process speech slower when there is a visual alteration versus when there is not (Grieco-Calub, 2021). When the acoustics of speech are altered, individuals tend to lean on the visual cues they can obtain from the speaker. Participants of a study noticed how often they relied on the lips and face for clarity in communication when these two aspects were taken away and processing of speech became harder (Saunders et al., 2020). Visual cues can come from all over the face, but

the middle and lower face tend to play a bigger role in emotional expression (Mheidly et al., 2020). Studies have shown that when given only a visual cue, individuals had higher accuracy levels when asked to identify emotions such as anger, happiness, surprised, and dislike, than when they were only given an auditory cue (Grieco-Calub, 2021). Unlike acoustic property reports, other studies have found transparent face shields yield 58.9% higher speech recognition scores than face coverings that completely obstruct the face (Thibodeau et al., 2021). This study also further proves the transparent face shield is degrading to acoustic properties because when participants relied only on auditory cues, the transparent face shield yielded 40.7% lower scores than regular face masks did. However, when given the auditory and acoustic cues, scores jumped 70.8% (Grieco-Calub, 2021).

Interpretation of Findings

When taking into account both the acoustic properties and visual cues that are impacted by face coverings, it is fair to determine face coverings had a vast negative impact on communication during COVID-19. Individuals are consistently reporting a more difficult time understanding individuals due to consequences of the masks. The research on acoustic properties shows not only individuals with impaired hearing could have a difficulty in hearing masked speakers, but the levels at which these signals are coming through are lower for everyone. This provides an explanation as to why speech does not sound as clear through a mask. Due to social distancing, this could prove to be even harder. During COVID-19, individuals had to maintain an adequate distance apart from each other while communicating with masks on. This could have caused additional problems with acoustic properties being properly passed by communication partners.

In addition, facial expressions are a key aspect of communication that were often taken away due to face coverings. Listeners use the social cues displayed on the speaker's face to pick up on many cues such as sarcasm and emotion. Without clear visual cues, it makes it harder for individuals to participate in the pragmatics element of communication. In addition, with acoustic properties being harder to comprehend, individuals would tend to rely more heavily on visual cues. However, with face coverings, both vital aspects of communication are hindered. In the reverse scenario, when a speaker is unable to rely on their visual cues, they often turn to prosody, intonation, and pitch to communicate pragmatic elements of their speech to the listener. However, due to these being impacted by the face covering, it is much harder for emotion to be passed and conveyed between communication partners. With all of these factors considered, it can be concluded that face coverings did have a drastic negative impact on communication. This will not only impact the speech pathology profession but all types of interactions that have potential to take place. If changes and habits of communication were formed, individuals will have to relearn how to communicate efficiently once face coverings are no longer required.

2. **Were communication development milestones impacted due to face coverings or other factors during COVID-19? If so, in what ways did they impact these milestones?**

Without sufficient time passing to fully understand how COVID-19 and face coverings might have impacted communication development milestones, it is possible to predict these changes when looking at school reports. A concern for schools in the fall of 2020 was the impact COVID-19 and virtual school would have on the development of children. (Charney et al., 2020). Even though most children were participating in online school, only 26% of students in a survey included learning in the activities they did during a typical day during the lockdown (Ares

et al., 2021). In one research study, 76% of the schools participating reported they felt the children who began school in August of 2020 needed more support and language skills were lower than in past years. These schools also reported their highest areas of concern for the children were communication and language development (100% of schools), personal, social, and emotional development (100% of schools), and literacy (97% of schools). Even with these levels of concern, only 83% of schools reported they were placing more emphasis on communication and language development and personal, social, and emotional development, while only 57% of schools were emphasizing literacy development (Bowyer et al., 2021). When parents were asked, only 6% reported a concern with their child's communication and language development.

Two of the most important ways in which children acquire language is through having language and speech modelled and by interacting with others using language, both of which many children get exposure to through school. "Peer talk" is when children interact with others and learn the pragmatics of language. This skill is practiced and used a lot in school where children learn social skills (Charney et al., 2020). Even when schools did reopen, some parents chose not to send their children back to school so attendance levels were down (Bowyer et al., 2021). Children not being in school causes them to miss out on the appropriate preparatory steps they need to take in order to be able to move onto the next stage.

While schools provide a good understanding of current language levels, masks can impact language and communication even as early as infancy. As early as a few days old, infants can distinguish face expression and rely on these to build the foundations of social interactions. From here, they use gestures, body language, pitch, and tone to begin decoding the language they are absorbing (Green et al., 2021). Infants rely on the familiar faces and objects early in life to allow

them to feel safe and communicate. When their caregivers are wearing face coverings, this may make it more difficult for the infant to develop these attachments to familiar faces. This can impact the attachment process of the infant and mother, causing the infant to be in a stressful state and can hinder brain growth (Green et al., 2021).

Interpretation of Findings

Interestingly enough, even though 100% of schools were concerned about the communication and language development of their students, only 83% of them were planning on placing emphasis on this subject during the school year. In addition, 97% of the schools were concerned with literacy development, but only 57% were placing an emphasis on this during the school year. With many children being reported as under the levels of their same age peers the year before, it is concerning that more emphasis is not being placed to catch these children back up to the development milestones they need to be at. If children are not provided the help they need to get back on track, they will only fall farther and farther behind in development. Only 6% of parents being concerned with their child's language and communication levels shows that the parents potentially do not know their children are behind the levels of the kids their age the previous year. If they are not made aware of this and schools do not place an emphasis on language development, it is likely developmental milestones will begin to be pushed back among kids.

With what is known about the loss of visual and acoustic cues in communication due to face coverings, development can be impacted in a few ways. First, children who are learning sounds might have difficulty in hearing these sounds if they are muffled through masks. Like previously discussed, sounds may be altered because of the need to alter articulators in production of sound. This will cause children who are trying to acquire language to hear multiple

versions of similar sounds and potentially lead to confusion on proper articulation. Like adults, children may also have to modify the movements of their articulators to produce sounds while they are learning how to produce them. This could have a detrimental impact for typical development. In addition to this, children often rely on the visual cues of the movement of articulators to learn how to produce sounds. One of the earliest acquired sounds in typically developing children are /p/, /b/, /w/, and /m/. All of these sounds are called bilabial sounds because they are produced with the lips. Thinking about how these sounds are produced, the mouth moves and positions in a way that is very visible. In comparison, think about how a /g/ is produced. This sound is a lot harder to see being produced. So, when children are learning how to produce sounds, they tend to look at the speaker's mouth and try to figure out how to position their mouth and mimic these sounds. When the speaker is wearing a face covering that obscures their mouth from the child's view, they are unable to have this demonstration and can not mimic the sounds as easily. With masks, children are blindly trying to figure out how to move their mouths in a way that will produce the same sounds.

Losing visual facial cues behind face coverings will also have a drastic impact on a child's social communication skills. Without facial expressions, it will be harder for children to be able to learn how facial expressions are tied to emotion. In relevance to COVID-19 beyond face coverings, children spent less time in school learning social skills with other kids such as turn taking, problem solving, eye contact, and body language. Many of these skills are not specifically taught to children but instead they pick up on them during their early years in school. Due to the lockdown, many children had to spend time away from school. Even once they were able to return, social distancing rules made normal interaction with other children more difficult.

It is still hard to determine for sure whether communication developmental milestones in children were permanently impacted due to COVID-19, but research does show it was at least temporarily delayed due to children not being at the expected level at the beginning of school. If teachers, parents, and professionals are not made aware of these differences and do not take proactive steps in catching children back up, these development stages might cause milestones to be pushed back and cause a permanent change on what is expected of kids at what age level. Even with the spikes in kids being developmentally behind, referrals for speech therapy were less than they were during the same time period in 2019 and speech language pathologists felt 83.5% of their patients that were missing out on therapy, needed it (Chadd et al., 2021). This shows that children are not getting the help they need. This is important for more than just language and communication development because other areas of development could be impacted by this too. Research has shown the majority of kids who require speech services are a greater risk of facing many other challenges in life. Some of these include reduced academic performance, less job opportunities, social difficulties, and overall reduced quality of life if the problem persists (Tohidast et al., 2020). All individuals involved in a child's development need to understand the social, emotional, cognitive, and academic risks delayed language and communication development might cause for the child.

3. **How did face coverings impact individuals with receptive and/or expressive communication disorders?**

Face coverings can impact individuals with receptive and/or expressive communication disorders in a variety of ways, depending on the severity and type of communication disorder they have. Individuals who attended speech therapy prior to COVID-19 either had to move their therapy to teletherapy sessions or take a break from therapy altogether. This is not ideal at all for

developing children because typically when they are attending therapy, they are in their prime age for correcting their communication impairments. If they miss out on this important time period, it will be much harder for them to adapt their skills later. In addition to this, many children need constant reminders and practice to master what they learn at therapy. Without the consistency of working with a speech pathologist, the child might lose all of their progress.

If they are lucky enough to continue therapy through an online platform such as Zoom or Skype, therapy will not be as effective. Often times therapists are very hands-on with their patients. The therapist might need to do an oral examination, might have used suckers to help remind the client where to hold their tongue, or might have used tools to help move the client's oral cavity how it needed to during speech. While teletherapy is better than no therapy, a lot of the essential work of a speech pathologist can not be done through a computer screen so the client risks losing essential progress.

A few specific groups of people who are impacted by face coverings and have communication disorders are individuals with hearing impairments or autism. Individuals who are hearing impaired are arguably one of the groups that struggle the most with face coverings. Studies have proven speech perception decreases even for normal hearing individuals when they are listening to a masked speaker (Homans & Vroegop, 2021). If a hearing-impaired individual is still developing language and required to wear a mask, the lack of visual sensory input caused by face coverings will cause many problems in the future (Tohidast et al., 2020). Even if the individual is not in the developing stage, facial coverings can cause serious problems for the hearing impaired. 80% of the participants in a cochlear implant study reported face masks caused great issues in their daily communication (Homans & Vroegop, 2021). This problem is caused greatly by the covering of faces and no visual cues during communication. While these

individuals do have cochlear implants, they still heavily rely on lip reading for most of their receptive communication. In addition to this issue, cochlear implant users also reported the disturbance in acoustics caused them great problems (Homans & Vroegop, 2021). Results from a research study very similar showed the same results. Hearing impaired participants in this study reported much higher levels of speech perception with transparent face coverings than normal masks because they were able to lip read (Homans & Vroegop, 2021). Again, these results can be seen in another study where hearing impaired participants noted that even if a vast difference in scores is not seen from a transparent face covering to a normal one, they felt much more confident in their answers when they could see the speaker's mouth (Atcherson et al., 2017). Face coverings impact more than just receptive communication abilities for cochlear implant users. It is also hard for these individuals to even wear a face covering because the risk of damage taking a mask on and off can have to their cochlear implant is too high (Homans & Vroegop, 2021).

Individuals with autism are likely to also struggle with the use of facial coverings because of the abnormality. Autistic individuals operate best under specific, repetitive routines. With a drastic shift in many people's lives, many routines had to be changed and individuals lost this consistency causing difficulties. Autistic participants reported the mask itself made them feel uncomfortable and added negative sensations (Tamon et al., 2022). Researchers found a direct correlation with lower-order repetitive behavior individuals having greater negative sensations due to masks. They also reported they had a harder time in identifying other's emotions when they are masked. Individuals with autism also are likely to struggle with reading social cues. Adding a face covering to this already hard scenario leaves autistic individuals at an even more disadvantage (Tamon et al., 2022).

Interpretation of Findings

As a whole, face coverings could have a detrimental impact on the progress and development of individuals with a receptive and/or expressive communication disorder. First, individuals who may just be attending therapy for common issues might have to stop therapy altogether. This will cause a regression in progress because the child will be out of practice or may even cause the child to exit their critical time period and make it substantially harder for them to make the changes they need to make. Individuals who can do teletherapy will also face hardships due to the lack of physical contact with their therapist.

It is also clear that individuals, such as those who have hearing impairments or autism, have their daily communication abilities greatly impacted due to face coverings. Individuals with hearing impairments face great challenges when interacting with others because of the lack of visual cues. Like previously discussed, all individuals rely in some manner (knowingly or not) on visual cues when they are interacting with a communication partner. Even for normal hearing individuals, research proved it was harder for them to comprehend speech based only on auditory input. Hearing impaired individuals rely very heavily only on visuals, like lip-reading. During COVID-19, most individuals wore masks that completely obscured their mouths making it impossible to lip-read and therefore nearly impossible for the hearing impaired to efficiently communicate. Expressive communication was even made harder for individuals with cochlear implants due to the difficulty of wearing a mask. Individuals with autism also struggled with the lack of visual assistance in communication. While already struggling in social interactions, autistic individuals now had an added challenge of not being able to read facial expressions. They also felt less comfortable due to routines off balanced and unfamiliarity of the masks.

It is important to identify the added struggles individuals with communication disorders might have faced due to masks during COVID-19 because such great difficulties could lead to serious mental health problems. With lockdowns and social distancing, many people already felt lonelier but adding the difficulties of communication could make these individuals feel even more outcasted. This information is important for mask manufacturing companies to pay attention to so they can make masks more inclusive of everyone's needs. Many masks take away the ability to see someone's mouth which research has shown time and time again causes many problems for all kinds of individuals. New methods of facial coverings need to be designed to make sure everyone's needs are accounted for.

4. **In what ways was the mental health of individuals who have a communication disorder impacted during COVID-19?**

While face masks do not cause any physical changes, such as oxygen level decreasing, the repeated and consistent use of a face covering could have psychological consequences (Scheid et al., 2020). Uncertainty, excessive social media exposure, stress, anger, sleep problems, closure of school and workplaces, social isolation, fear, boredom, and financial hardship can all play a big role in mental health (Behrmann et al., 2021). The lack of autonomy and relatedness many people felt due to wearing face coverings also could have played a role in the decline of mental health in individuals. Autonomy refers to the ability of having control and free will over actions. When people were told they had to wear a face covering, even though they might have understood the reasoning behind it, the idea of someone else having control over them could lead to them feeling uncomfortable. In a time that was already very stressful and uncertain, adding more uncertainty and taking away control left many people feeling worse (Scheid et al., 2020). Much like this, if people do not feel a sense of relatedness to those around them, they are at a

higher risk of developing worse mental health. When people were told they had to wear masks, many people took sides on the argument. Having an uncertainty of the effectiveness of the face coverings and therefore the individual's health, also adds to stress, which is not good for mental health (Campagne, 2021). This led to a great divide, causing a more polarized feel. Again, this feeling of not being connected to others could have a negative impact on someone's mental health (Scheid et al., 2020). Research also shows that trust, empathy, and recognition are at lower levels when a person's mouth is covered (Campagne, 2021).

While many (likely most) individuals struggled with mental health during COVID-19, individuals who had a communication disorder could have struggled more. They had the added level of the stress of difficult communication on top of all the other challenges everyone else was facing. Research shows how again hearing impaired individuals struggled greatly with mental health during the pandemic. In addition, individuals with Attention-Deficit/Hyperactivity Disorder (ADHD) struggled also.

As previously discussed, individuals with cochlear implants faced many difficulties in communication due to face coverings. All of these difficulties could lead to these individuals feeling more lonely because of the lack of communication. They likely experienced social withdrawal and had a high possibility of depression. 59% of participants in the cochlear implant study reported they felt more insecure about their communication abilities because of masks (Homans & Vroegop, 2021). Individuals with ADHD tend to hyper fixate on activities or objects, have shorter attention spans, restlessness, disruptive behavior, and require more attention to keep them entertained. During COVID-19 when people were being socially isolated and told to remain home, these individuals were at a greater risk for mental health issues (Behrmann et al., 2021). In a research study conducted, individuals with ADHD tended to show severe

psychological, behavioral, and social issues due to the pandemic (Behrmann et al., 2021). Some of the most common symptoms found were sadness, boredom, loneliness, and anxiety. Requiring these individuals who already struggle with restlessness, disruptive behavior, and problematic relationships to social distance and complete school online, only worsened their mental health (Behrmann et al., 2021).

Interpretation of Findings

So far, most research has looked at the observable physical changes and challenges individuals faced due to COVID-19 and face coverings. All of these challenges and changes accumulate overtime and led to great unknowns, stress, anger, and fear for a lot of people. With the pandemic lasting nearly two years, individuals can only operate under these kind of feelings for so long until it begins to have a detrimental impact on their mental state. For many individuals, it is likely they faced mental health issues at some point during COVID-19. As predicted by the last research question, individuals who also struggled with a communication disorder during COVID-19 are even more likely to have faced issues with mental health. Not being able to communication efficiently with others often lead to social isolation and feelings of loneliness. On top of this, individuals were told to stay at home, only increasing social isolation.

This is a very important topic that is relevant to many people because often times mental health issues go unseen. In all environments, it is likely a friend, coworker, or family member is struggling from some kind of mental health issue. During the pandemic, this had a great chance of being heightened. All individuals need to be more understanding of each other's circumstances and provide accommodations. This also goes back to mask manufacturing companies making more efficient face coverings for everyone, so communication is not a challenge for individuals with communication disorders.

5. **Was the overall developmental of cognitive processes in children impacted by mask usage during COVID-19? If so, in what ways?**

Many researchers often link language and communication with all cognitive processes. Language and communication are arguably one of the most important cognitive processes to develop and can be a good predictor of the development of others. Due to this, if masks and COVID-19 could cause a delay for language and communication development, it is likely it could cause a delay in the development of other cognitive processes. One way to access this is to look at school reporting and their assessment on the student's cognitive abilities.

Pre-school age children are in the most sensitive stages of development. Therefore, their development was likely impacted the most during COVID-19. One important aspect of development is sleep. The pandemic greatly impacted the sleeping habits of children due to changes in the parent's work schedule and children were at risk for not getting adequate amounts of sleep. In addition to this, many children were kept from attending preschool because of school closings or their parents keeping them home due to the health risk. However, preschool is an essential time for social development for a child. This can lead to children having trouble forming relationships with peers in the future. In addition, children were likely exposed to many conversations in relation to the pandemic that could have caused fear and anxiety. If these emotions go unaddressed, it can lead to great psychological problems that will impact emotional development of the child in the future. Another risk factor for children during the pandemic was an increase in technology use. If this habit continues, there will likely be consequences for cognitive and linguistic development (DURMUŞOĞLU SALTALI, 2021).

Research also shows communication between individuals has gotten shorter during the pandemic and informal chat has declined. Speech interactions flow less well, are less personal,

and emotions are harder to read. Conversations are more about passing along information. Participants of the study reports they felt more fatigued after communicating with someone who was masked because they had to concentrate more on communicating (Saunders et al., 2020). This degrading form of speech not only will leave individuals feeling tired, but it will also have a negative impact on working memory, word recognition, linguistic processing, emotional recognition and processing, and acquisition of new words in kids. In addition, if an individual has to provide more of the brain's resources to process language, this is less resources the brain has to perform other cognitive tasks (Grieco-Calub, 2021). Language, social, and cognitive development are all tied very closely together and require social interaction to be able to develop.

Interpretation of Findings

Social interaction is vital for development in various ways. Specifically, social interaction is important for language acquisition to flourish. Since language, social, and cognitive development are all so closely related, it is not far off to say that because language development was impacted by mask usage during COVID-19, overall cognitive development would likely be impacted by face coverings as well. It is known that face coverings and social distancing discouraged many people from social interaction. Even if individuals did participate in social interaction, it was not the most efficient, especially for language development. Research has shown the visual and acoustic properties of communication that were impacted by face coverings made speech perception much more difficult. Due to this, it is highly likely development of language and communication will be greatly impacted, thus impacted overall cognitive development.

Face coverings might not seem to have as many negative consequences and still provided many people great protection against COVID-19, but researchers, professionals, and caregivers

need to be aware of the great impact they could have on a child's development. Researchers should look into alternatives to protect future generations if face masks are ever needed again. Professionals, such as doctors and speech language pathologists, need to be aware of the various developmental delays that could have been caused and provide resources to help children remain on track developmentally. Caregivers also must know about the risk their child could be in and be sure to find them the help they might need. They also should be sure to keep their child engaged in social interactions as often as possible to prevent developmental delays.

Conclusion

The purpose of this research data analysis was to assess the impact COVID-19, specifically face coverings, would have on a variety of aspects of communication. The data answered whether or not face coverings had an impact on communication, what impact this had on children's language development, the impact of face coverings on communication with individuals who already had a communication disorder, their mental health challenges through the pandemic, and lastly the impact face coverings could have on all cognitive development for children. Many researchers and experts had guessed at what these impacts would be, but none have compared and compiled all of this information together to see the impact of the face masks on communication and development as a whole.

This research found face coverings did have a negative impact on communication as a whole during the pandemic. More specifically, the acoustic properties and visual cues of communication took the most drastic change. Many acoustic properties were altered by the face coverings creating a barrier for the sound to travel through. Many visual cues that listeners rely on during communication were also lost due to the mouths being covered. Facial expressions were obscured and made pragmatics hard for communication partners.

Communication development milestones were also negatively impacted. This was found through research done with elementary schools. Schools reported they were concerned with incoming students' language and communication abilities, but some were not taking the appropriate steps to accommodate for this difference. Many children entering school after the pandemic even scored lower than their same age peers who entered school before the pandemic.

Individuals who already had communication disorders also experienced difficulties in communicating. Many were unable to continue with speech therapy that needed to be in therapy. With little routine and little visual cues, many of these individuals struggled to communicate with others. Individuals with autism and hearing impairments struggled significantly.

Along with this, many individuals who have a communication disorder experienced mental health issues during the pandemic. This is due to the added hardship of difficulty in communicating with others. They also reported experiencing more anger, stress, and fear. This sense of isolation due to lack of communication left many individuals feeling very lonely.

Lastly, with social, language, and cognition development being all so closely tied together, it is a given that overall cognitive development would face a decline when language and social development did. Social and language development slowed due to social distancing and the use of face coverings during the pandemic. Researchers found this also led to a decline in overall cognitive development for children that could be a permanent change if gone unnoticed.

These findings are important beyond this study because many of these changes are not being highlighted coming out of the pandemic. Many people realized the importance of the face coverings during the pandemic, but not many people are assessing and talking about the negative impact they might have had and taking the steps needed to overcome these changes. Children are experiencing declines in development of language, social, and cognition skills. These changes

will become the new normal if caregivers and teachers do not help bridge these gaps for children. This will impact the education field because if overall cognition abilities are changing, children will not be at the academic level they are expected to be in elementary school. Children who have not properly developed language, will not properly develop literacy skills. Without this foundation, learning will be very hard for these students. If these difficulties go unchecked, children can go too long not receiving the help they need and will fall behind drastically in school.

In addition, individuals who have a communication disorder could still be experiencing mental health issues even after the pandemic is over. If these individuals were unable to attend speech therapy during the pandemic, they could have missed out on a very sensitive time period where their language could have improved the most. These individuals might not return to therapy or might face great declines in progress. This can lead to them continuing to have communication problems and therefore a continue in mental health issues. Again, this extends farther than just an issue in the communication fields because mental health issues will have a negative impact in all areas of the individual's life.

The enforcement of all individuals to wear face coverings might have been the best decision for everyone's general health during the pandemic, but now, researchers need to be assessing how this could have a lasting impact in a variety of fields. This research analysis is the first step in bringing these issues to light and creating conversation that will lead to steps of action being put into motion to help all individuals impacted receive the help they need to keep their communication development and abilities on track.

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