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The role of face masks on speech intelligibility for native and nonnative speakers of English: Graduate students' experiences

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The COVID-19 pandemic caused the widespread use of face masks in teaching and other normal communication situations. To provide some insight into the communication issues the wearing of face masks causes, this qualitative study examined beliefs about the role of face masks on speech intelligibility by exploring graduate students' experiences. Data was collected by interviewing eight native speakers and eight non-native speakers of English in a large Midwestern university in the U.S.A. in December, 2020 while the COVID-19 pandemic was still ongoing. Data was analyzed by using a phenomenology approach and themes were identified. Findings indicated that both native speakers and nonnative speakers view speech with face masks as some kind of obstacle to speech intelligibility, either as speakers or as listeners, pointing towards various factors that cause the difficulty. It was also found that speakers tend to use various strategies to adapt their speech when wearing face masks to facilitate the communication. Frameworks of the factors and strategies are presented. The findings of this study can provide implications for anyone involved in academic, medical, or occupational settings, as well as for the general public during pandemic situations.

Key Words: speech accommodation, adverse conditions, COVID-19, face masks, speech intelligibility, non-native speakers, native speakers.

1. Introduction

People's everyday speech happens under a wide range of adverse conditions (Mattys et al., 2012). Listeners need to recognize speech that may be negatively influenced by one or more factors, such as background noise, competing talkers, telephone/internet mode of communication, or foreign-accented speech (Mattys et al., 2012). Adding to these conditions, the COVID-19 pandemic, (declared on March 11, 2020 by the World Health Organization [WHO], 2020), has greatly influenced the way people communicate all around the world. The quick spread of the coronavirus caused a global lockdown and continued forcing national health authorities to take measures of precaution. One of the measures to prevent the spread of this disease has been wearing a face covering (WHO, 2020). As businesses and university campuses started to reopen, communication with face masks started to become a new way of life. But what is the effect of this change on the way people communicate and perceive each other's speech?

Limited research has explored the role of face coverings on speech intelligibility in the past (Coniam, 2005; Fecher & Watt, 2011; Llamas et al., 2008), but the interest in this topic has started to expand with the public mask wearing requirement (Corey et al., 2020; Brown et al., 2021; Magee et al., 2020). The way intelligibility is defined in this paper follows Derwing and Munro's (1995)

definition: "the extent to which a speaker's message is actually understood by a listener" (p. 289). A few studies have focused on examining native speakers of English (NSs) and the effects of different types of face coverings worn for recreational, occupational, or religious reasons, such as surgical masks, cloth masks, hijab, and found differences among them. However, while some studies drew attention to the importance of a lack of visual cues when communicating with face masks, especially for hearing-impaired groups (Atcherson et al., 2017; Llamas et al., 2008), another study suggested that face masks did not have a significant effect on speech perception, neither for normal-hearing nor hearing-impaired groups (Mendel et al., 2008). Another study investigating the effects of face masks on ratings of nonnative speech during the SARS epidemic in China taking place in March 2005, also gave support to the idea that face masks do not have a significant impact on speech intelligibility (Coniam, 2005) but suggested that these results might be due to accommodation that speakers make to adapt to the adverse condition.

While the above studies can serve as a stepping stone towards exploring the way face masks interfere with intelligibility, our understanding of the effects of face masks on speech is still highly underresearched, especially in regards to NNSs of English. NNSs often have accented pronunciation which might have an impact on achieving successful communication and the way they believe speech intelligibility is impacted. Past research examined the effects of face masks in a particular context and controlled environment by exploring the speech in lab settings, but very few of the studies looked more closely at people's beliefs about speech intelligibility with a face mask during a global pandemic. Taking this wider perspective will help examine people's beliefs and perception of everyday communications with face masks under various circumstances and provide a different perspective on the topic.

Therefore, this study will help identify participants' beliefs about potential factors that influence speech intelligibility and discuss strategies to improve communication by examining the experiences of native and nonnative graduate students. The findings of this paper can be useful for anyone involved in an academic setting, such as students and instructors, but its recommendations could also be useful for NNSs of English, medical staff, immigrant workers in agricultural and industrial sectors, and the general public.

1.1. Speech intelligibility and adverse conditions

An adverse condition in speech interpretation can be defined as

> any factor leading to a decrease in speech intelligibility on a given task relative to the level of intelligibility when the same task is performed in optimal listening situations, i.e. healthy native listeners hearing carefully recorded speech in a quiet environment and under focused attention. (Mattys et al., 2012, p. 953)

It is possible that everyday speech sometimes occurs in these "perfect conditions", but speech usually occurs under various adverse conditions. Mattys et al. (2012) provided a classification of adverse conditions based on their origin (i.e. "intrinsic" variation; environmental degradation; receiver's limitation) and based on their effect (i.e. the impact they can have on the comprehension system and the compensatory mechanisms they elicit).[1]

Speech perception is a complex process and the factors listed above can play an important role in the way it develops. The intrinsic variations (source degradation), such as accented speech, conversational speech, disfluency, or speech disorders (Mattys et al., 2012), have attracted much attention from a number of researchers (e.g. Levis, 2016; Miller, 2013; Munro & Derwing, 2020) and appear to be important in speech intelligibility. In addition, past research has explored the effect of conditions investigating the receiver's limitations, such as cognitive load, incomplete

[1] For more details, see Mattys et al. (2012).

language model and hearing impairments (Lemke & Besser, 2016; Zekveld et al., 2011). Moreover, the effect of environmental degradation with energetic masking, such as noise, has long been explored, but recent research on noise and personal protective equipment in the medical field has received greater attention due to its importance for patient safety (Hampton et al., 2020). Factors with environmental degradation without energetic masking, such as telephone transmission, are considered "to occur in the absence of a separate distractor" (Mattys et al., 2012, p. 957). Face masks can be situated in this category and it will be discussed in more detail below. An important contrast between these factors is whether the speaker is aware of the degradation and if they are trying to adjust their speech; for example, people usually talk louder when there is noise in the background, but not necessarily when they communicate over the phone (Mattys et al., 2012).

As noted above, there is a considerable amount of research on various elements that influence speech intelligibility, but the new adverse condition that has greatly affected everyday communication – face masks – has emerged as a novel factor that is typically combined with one or more other adverse conditions. By studying the combination of face masks with other suboptimal conditions, we can learn how to improve communication and make speech more intelligible.

1.2. Speech intelligibility and face masks

The literature has covered different aspects of the role of face coverings in various conditions. A few studies delved into the role of medical equipment, such as personal protective equipment, N95 masks and surgical masks in medical contexts, and their influence on speech intelligibility (Mendel et al., 2008; Round & Isherwood, 2020), while other studies have made a comparison between the various face-covering types, such as different shapes for coverings or fabric/material (Fecher & Watt, 2011; Corey et al., 2020; Atcherson et al., 2017), investigating acoustical and spectral properties of the sounds.

In particular, Fecher and Watt (2011) explored speech with various face coverings including surgical masks. They created a so-called "face cover corpus" (p. 664), investigating the spectral properties of fricatives and found that they were significantly affected by certain materials and types of face coverings. Another study investigating face masks (Corey et al., 2020) analyzed the relationship between different types of face masks (medical, cloth, and transparent) and acoustic attenuation. Similar to other findings, a substantial alteration between mask types was found, especially among cloth masks with different fabric and/or weaves.

Perhaps the most pertinent scholarship to the current study is research on the lack of visual cues caused by mask wearing (Atcherson et al., 2017; Llamas et al., 2008). These studies observed that speech intelligibility issues might be associated with the reduction of visual cues. Atcherson et al. (2017), comparing standard and transparent masks, suggested that transparent masks can be especially beneficial for hearing-impaired groups because these groups of people could benefit from seeing the visual cues. Early work on speech perception (Massaro, 1987; 1998) argued that speech perception is bimodal, meaning that people's perception of speech entails retrieving information from both visual and auditory channels. Some researchers even claim that visual images might be crucial to decoding speech for second language learners (Benson, 1993). In contrast, Mendel et al.'s (2008) research conducted in a medical context, suggested that the presence of a surgical mask did not have a detrimental effect, regardless of hearing impairment, but there is a small difference when the speech is produced with background noise.

One of the few studies in this field exploring NNS is Coniam (2005), who investigated the impact of wearing face masks in a high-stakes oral test during a SARS epidemic in China. This study examined students' test scores considering various with- and without-face-mask conditions, as well as test-takers' and raters' perspectives. Contrary to expectations, and even though the test-takers felt that wearing face masks impacted their scores, the findings of this study showed that the face masks did not have an effect on the scores. Conian (2005) suggested that one possible explanation for this outcome could be the strategies the students had previously adopted to

accommodate their speech, such as, speaking more loudly. Does that mean the speakers who wear face masks should change their normal speech patterns to achieve successful communication? This issue is yet to be explored.

1.3. Beliefs and views on the impacts of mask wearing on intelligibility

There is a general belief that face masks influence speech intelligibility, but the situation might be even more complicated for NNSs. Since we know that NNSs of English are typically heard as having accents, they are often criticized as being hard to understand and pronunciation is typically blamed for these problems. Jenkins (2009) discussed English teachers' views towards native and nonnative variations of English and found that views on NNSs were generally negative. Nonnative accents were labeled as harsh, heavy, difficult to understand, and unfriendly, while native accents were labeled as pleasant, easy to understand, and correct (Jenkins, 2009). NNSs in Jenkins' study stated that even though their accent defines their identity, they would still prefer and aim to sound native like. Other studies, such as Wang (2012) and Dykeman (2016), found similar results and preference for native accents.

This leads to the question – are NNSs truly more difficult to understand or are there negative attitudes, insecurities, expectations and prejudice intervening with the ability to understand nonnative accents? Similar questions can be raised in relation to speech with face masks. What are the views toward understanding masked speech by NSs and NNSs? Do NNSs "blame" their accent when loss of intelligibility happens during communicating under face masks? Attitudes and beliefs towards language have been found to affect individual intelligibility ratings (Derwing & Munro, 1997) and are worthy of exploration in relation to speech with face masks among NSs and NNSs.

1.4. Research problem

Even though the existing literature has explored face masks and speech intelligibility from different perspectives, our understanding of the impact of face masks on intelligibility is still fairly limited. As discussed above, studies appear to be in different communication contexts with different combinations of NSs and NNSs, with emphasis on NSs. The majority of the studies explored speech intelligibility by employing various measures on actual speech samples, but only a few of the studies asked the participants about their views, beliefs and experiences when communicating with face masks. Even though studies reported a number of obvious obstacles to speech intelligibility with masked speech (such as lack of visual cues), a few studies found that speech intelligibility is not greatly influenced by face masks (Magee et al., 2020; Mendel et al., 2008). Coniam's (2005) findings that masks do not influence the participants' speaking scores while the participants believed they did, raised the questions of what might be causing these discrepancies between beliefs and lab results, pointing towards the idea that speakers adapt their masked speech to become more intelligible. As we are aware, NNSs' pronunciation (accented speech) is also commonly blamed for the loss of intelligibility, so the NNSs' expectations might be different than NSs. There are various factors that may play a role in this process and this study will aim to examine those factors and the way people adapt their speech by asking both NSs and NNSs about their views and experiences with masked speech.

Given the large number of nonnative graduate students in English-speaking countries, such as the U.S.A., it is necessary to gain further insight into this topic. The main anticipated take-home message from this study will be identifying the main factors that interfere with speech intelligibility, the difference between NSs and NNSs, if any, as well as presenting strategies for facilitating intelligibility.

The study will be guided by the following research questions:

RQ1: How do participants view the impact of wearing face masks on their ability to understand speakers?

RQ2: What strategies do speakers report using to ensure that they are understood when they wear a mask?

2. Research design

2.1. Conceptual framework

This qualitative study followed the guidelines for phenomenology, that is, exploring the "common meaning for several individuals of their lived experience of a phenomenon" (Creswell & Poth, 2018, p. 75). The study was designed to explore the phenomenon of communication with face masks during the COVID-19 pandemic for graduate students. This phenomenon presents an interesting area for exploration to discover the different perceptions of NSs and NNSs and the influence of face masks on their communication. Phenomenology was selected as the most appropriate methodological approach for this issue because it is closely related to the aims of the study, that is, to understand the common experience of several individuals to provide a deeper understanding of the characteristics of the phenomenon.

The formation of themes for RQ1 was framed around the four main categories of adverse conditions proposed by Mattys et al. (2012). The themes in RQ2 were primarily framed around the *explicitness strategies* (i.e. self-initiated communication strategies where the speakers themselves use strategies to enhance the explicitness of a statement they feel may be potentially risky) identified by Björkman (2014), and the *pronunciation-specific strategies* identified by Saito and Poeteren (2012). Adapting these frameworks facilitated the organization of data and allowed a clear presentation of the themes.

2.2. Context and participants

Data collection took place in a large Midwestern university in the U.S.A. Data were collected in December 2020 when the COVID-10 pandemic was still ongoing. At the time of the study, face masks were required almost everywhere, starting from the grocery stores, restaurants, schools, university campuses, and basically throughout most public enclosed spaces. The academic year started in August and all the students were required to wear face masks both inside and outside on campus spaces.

The participants in this study were 16 graduate students, eight NSs and eight NNSs, aged 23-40 (6 male, 10 female). The NNSs came from different L1 backgrounds: Turkish (3), Arabic (2), French (1), Macedonian (1) and Thai (1). They were all proficient English speakers living more than two years in the U.S.A. The NSs were all American English speakers from the Midwestern part of the U.S.A. None of the participants reported having any hearing or speaking problems. This study aimed to include both NSs and NNSs to explore the experiences of both types of speakers. Graduate students were selected as an interesting group of participants as many of them serve as both students and instructors, have frequent interaction with NSs and NNSs, and they are more likely to have a common perceptual baseline of accent familiarly.

2.3. Data collection

Data were collected through semi-structured interviews using the web meeting platform WebEx. The use of this app, instead of an in-person data collection. was chosen to avoid in-person interaction due to COVID-19. The online data collection allowed for more flexibility and facilitated the data collection process, allowing for easier accessibility and time management for both the researcher and the participants. Semi-structured interviews, lasting between 15–30 minutes, were selected to elicit information about the participants' experiences of the phenomenon. Namely, the questions elicited answers about the amount of interaction they had had with face masks, the

issues in communication caused by the face masks, the factors or conditions that influenced speech intelligibility, and some recommendations for communication improvement. The questions helped build rapport and gather data relevant for the study following the guidelines for developing interview questions (Spradley, 1979; Berg, 2004).

2.4. Data analysis

Interviews were manually transcribed (137 double-spaced pages of transcripts) and analyzed following the guiding RQs and the guidelines for phenomenological data analysis (Creswell & Poth, 2016). The researcher analyzed the interview transcripts and highlighted "significant statements," sentences or quotes that "provide an understanding of how the participants experienced the phenomenon" (Creswell & Poth, 2016, p. 79).

After careful consideration and observation of the interview transcripts, the sentences and phrases were coded and organized into themes and subthemes. As elaborated above, the selection of themes for RQ1 was primarily guided by Mattys et al. (2012), while RQ2 was guided by *the explicitness strategies* (Björkman, 2014), and *pronunciation-specific strategies* (Saito & Poeteren, 2012), and a new category labelled *nonverbal communication strategies* was added. As communication with face masks for NSs and NNSs is novel and still underresearched, adapting these theoretical frameworks based on the needs of this study provided guidelines for using commonly known terminology and situating the study in the existing literature.

2.5. Validity

To ensure the validity of this study, several strategies for dealing with validity threads were incorporated. The interview questions were piloted with two participants, one NS and one NNS, to see if any changes needed to be made to the questions. The questions appeared appropriate to elicit the data needed, so no changes were made. Moreover, as suggested by Berg (2004), the interview questions were reviewed by another researcher to ensure the questions were clear, concise and well-designed to elicit responses. Another strategy employed was "Respondent Validation" (Maxwell, 2013). During the interviews, the interviewees were asked for feedback, clarification or confirmation by paraphrasing their statements.

3. Findings

The findings of this study are presented in two parts to refer to the two RQs. First, the factors related to the impacts masked speech have on intelligibility are outlined, referring to quotes from the participants. Then, a summary of the strategies used by the participant for intelligibility improvement follows.

3.1. RQ1: How do participants view the impact of wearing face masks on their ability to understand speakers?

The findings suggest that participants in this study view face masks as some kind of obstacle of speech indicating that there are several factors that influence speech intelligibility in masked speech. The ten subthemes that emerged from the data were organized under the four main categories of adverse conditions proposed by Mattys et al. (2012). Based on the findings of both NSs and NNSs, a framework for describing factors related to speech intelligibility with face masks is proposed (Figure 1).

Figure 1 shows that the participants' experiences with the subthemes *Difficulty understanding unfamiliar accent or lower-level speaker*, *Speakers' expectations of not being understood* and *Enunciation as part of conversational speech* fall under the *Source degradation* category. This category includes any intrinsic variation of the speech as produced. Participants shared their experiences when communicating with masked NNSs and almost everyone agreed that they typically do not have a lot of issues with understanding highly intelligible NNSs. However, problems

with masked speech arose when the speakers are highly accented or their level of English is very low. One participant commented:

> *I always have more difficulty understanding accented non-native speakers. It's because of my lack of, you know, like practice because of my lack of familiarity with those accents. I always have trouble and now with the masks on, it's even it doubled.* (NNS7)

In support of this claim, another speaker commented that they have not had issues with understanding NNSs but acknowledged it is very likely due to familiarity with their accents. For example, the participant NS3 illustrates that their exposure to certain accents, given that the students are proficient NNSs, facilitated the speech intelligibility.

> *The speakers in my class, are quite proficient and they don't really have much of an accent. But then, I'm thinking, like, when I'm in class, like, taking class, is everyone who I'm used to hearing. So, maybe there's familiarity at play. I'm used to their accent.* (NS3)

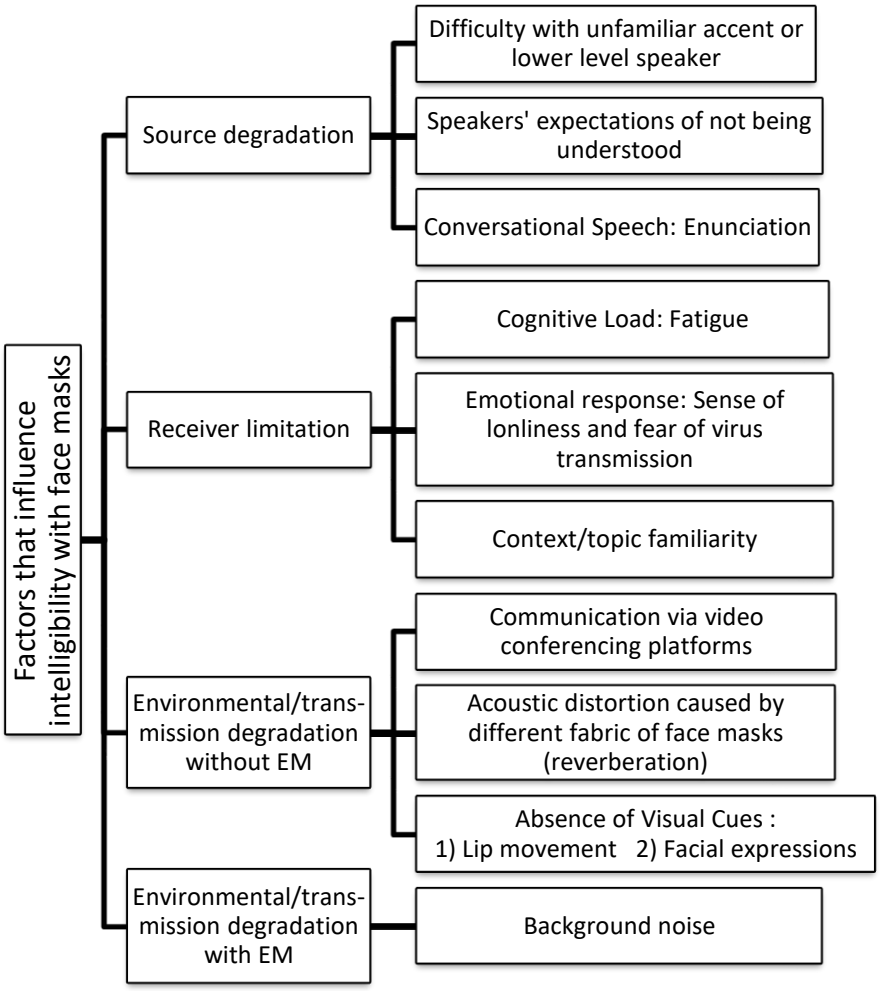

Figure 1. A proposed framework of the factors that influence speech intelligibility with face masks (based on ideas in Mattys et al., 2012).

Both NSs and NNSs had similar experiences regarding their communication with NNSs, however, regarding their own speech, NNSs comments emphasized their expectations of not being

understood. The NNSs discussed the ways they felt when they communicated with NSs, pointing out the NSs' reactions to their speech with a face mask. The quotes below reflect this discussion.

> *I think it's because of my foreign accent, and also the fact that I'm kind of shy. I always notice when people look at me, like, oh no, she has an accent and with the mask on.* (NNS1)

> *I think I realized with the first time, when I asked for water, and she did not understand what I was asking for water water water, because of my pronunciation always, I cannot pronounce W, she did not understand what I was asking for. I haven't had issues before, but with mask it was so bad. I felt terrible that they couldn't understand. And I've been living here for five years, but they did not know that I was asking for a water.* (NNS5)

Both NNS1 and NNS5 reflect their insecurities as well as their awareness of their mispronunciations. Based on the lived experience of the participants, due to various reasons, the existing issues in their speech were not as problematic without wearing the face masks. Moreover, the participants indicated that enunciation plays a crucial role in understanding speech with face masks. The results suggest that fast, connected speech sometimes causes problems due to lack of enunciation and mumbling. While this subtheme appeared in some of the NSs' transcripts, the majority of comments on this topic came from NNSs. Examples from NNS4 and NNS6 are:

> *Enunciation affects intelligibility the most if you ask me. You know, like, without wearing a mask, my answer was definitely different maybe, but with the mask on, enunciation really like affects intelligibility badly.* (NNS4)

> *I teach undergrads, so, if there are mumbling or just, like, barely moving their lips, and they're on top of that, you have the mask, it does make it harder.* (NNS6)

The second set of subthemes belong to the theme *Receiver limitation*. This theme refers to "adverse conditions arising from limitations in the perceptual or cognitive abilities of the listener" (Mattys et al., 2012, p. 957). Four main subthemes emerged from the data: *cognitive load: fatigue; emotional response; sense of loneliness and fear of virus transmission*; and *context/topic familiarity.*

A large subtheme that appeared throughout the data was the influence of communication with face masks on cognitive load. Most of the participants, both in the role of a speaker and/or a listener, noticed that during and after masked speech, they feel exhausted. Data suggest that it was mostly due to the amount of effort they need to exert to provide clear and comprehensible output as well as the concentration required to decode and perceive someone else's speech. For example, NS1 commented that they feel relieved after a conversation with face masks, suggesting that the masked conversation required additional energy and cognitive load from them. NNS1 also suggested the effort needed to communicate successfully, both as a speaker and as a listener.

> *Getting home and talking to my partner without a mask I, I notice the difference. It's almost like a big relief to just be able to relax and speak without a mask. So there is a cognitive load.* (NS1)

> *Cognitive load, both on the side of speaking, because I have to make a conscious effort to speak louder and articulate more and well, and for listening also.* (NNS1)

Adding to one of the categories above, one of the NNSs argued that when a person communicates with a NSs they have certain expectations that need to be met, and therefore, the effort exerted to meet those standards additionally increases with the face masks. The quote below illustrates the finding:

> *You're talking to native speakers you have certain expectations that you think you need to meet so that would probably change everything like the way you construct your speech and the cognitive load you put on yourself.* (NNS2)

Regarding the theme *Emotional response*, mostly NNSs expressed a *sense of loneliness and fear of virus transmission*. The results indicate that NNSs are especially emotional, stressed out, and worried about virus transmission. One participant (NNS8) reported they felt sad not being able to see people smile nor socialize. On the other hand, NNS6 stated that conversation with face masks reminds them of the current situation and makes them worry and think of various virus-related issues making them less focused on the actual conversation. This may also add to the difficulty in being focused on decoding the produced speech.

> *(...) whenever I'm wearing masks and talking with other people wearing masks, this means I'm in a situation where my high alert of "be careful what you're touching, how are you gonna wash your hands afterwards?, do you have a sanitizer?"* (NNS6)

Moreover, the c*ontext and topic familiarity w*ere brought up by several participants. Many participants reported that the use of face masks especially impacts their speech intelligibility if it occurs in an unknown context or with an unknown person. A statement by NS4, presented below, demonstrates the difficulty the speaker is facing when communicating with an unknown person:

> *Yeah, so talking with that unknown person, it definitely, definitely, definitely added to the cognitive load. Like, after that conversation, I felt really exhausted like wow but normally, when I talk to people, I don't feel exhausted. Normally, it makes me, like, more energized and more happy.* (NS4)

The next theme consisted of adverse conditions that "originate in imperfections in the communication channel between the speaker and the listener" caused by the physical environment or channel (Mattys et al., 2012, p. 956). The subthemes that belong to the larger theme of *Environmental/transmission degradation without EM* are *Communication via video conferencing platforms, Acoustic distortion caused by different fabric of face masks (reverberation)*, and *Visual cues (Lip movement and facial expressions).* Regarding online communication with face masks, some of the participants did not have experience with it, but those who did agreed that it adds to difficulty in understanding. Depending on the amount of exposure, participants shared different experiences, and one of them commented that,

> *having the mask through whatever tool that is Webex or something else is terrible. I think I might have got like 60-70% of what the person was saying, plus if the person also have an accent you know it is really hard for me* (NNS6).

In addition, the results show that most of the participants believe that different types of masks, both their shape and fabric, influence the person's speech. The majority of people commented that the thicker, cloth mask muffles the sound more compared to the paper surgical masks. Participants discussed that the cloth masks do not allow the sounds to "go through the masks" and found them more challenging to use, both as a speaker and as a listener. Other people believed that the fabric is not as relevant as the shape of the mask and those which are closer to the mouth muffle the sounds more, as follows:

> *I think it is maybe less about the cloth and more about the shape.(....) Because sometimes you can tell that the fabric is like right up against their mouths, so then it really muffles the sound.* (NS7)

On the other hand, two people argued that the fabric or shape does not influence speech intelligibility, but the only difference between the masks is the style.

> *I use both I prefer cloth just for stylistic purposes, I mean, looking better. I don't really like, the other one is really like, the surgical mask so it, it makes*

> *it feel bad. It's like, you know, yes, it doesn't feel the way it is a part of your, your dress your clothes at that time, but when you're wearing a cloth mask, it's a part of you.* (NNS3)

One of the topics that emerged as an important factor that reduced the intelligibility is the *absence of visual cues.* The quotations below reflect the participants' discussion of the way the lack of visual cues prevents them to understand the speech or how they rely on lip movement if they need additional cues to decode the speech.

> *Yeah, I'm a very visual and audial person, so whenever I speak to someone, I always, always look at their mouth. So for me it really affected my understanding on my intelligibility a lot, not being able to see the mouth and enunciation.* (NNS7)

> *If the mask would cause some concerns, because I think I do rely a lot more on visual cues when I'm sort of using effort to understand somebody's pronunciation, if they have an accent.* (NS1)

While NNS7 explained that they rely on lip movement in general regardless of the speaker status, NS1 commented that the only time they rely on lip movements is when they need to understand accented nonnative speech. Additionally, the results show that many participants rely on facial expressions to understand the "audience feedback" as well as to convey the tone of their own message (sarcastic, serious, humorous, etc.). One student compared the communication with face masks to texting without emojis, as follows:

> *I think I think communicating with the mask is a lot like, communicating through text. I use emojis and text to convey my feelings about what I'm saying, and being sarcastic or something, so it's like, like,* ***texting without emojis****. I think a lot of that has to do with the lower half of my face. I can't convey all of that information with my eyes.* (NS5)

The final group of factors which are part of the group *environmental/transmission degradation with EM* consists of one subtheme: *background noise.* This group of factors has an interfering signal from the environment and requires selective listening. The results suggest that the majority of participants struggle to have a successful conversation around background noise. Their answers indicate that conversations that happen in a quiet environment, such as the classroom, do not appear as problematic as a conversation in louder settings such as grocery stores, restaurants, or the bus. One participant shared their experience, stating the following:

> *Communicating on a bus is nearly impossible so we just don't talk. We just don't talk, because I can't I can't communicate an idea. I can say something and I'll go say something again and I'll go HA?* (NS5).

Overall, the findings of this study revealed that there are various factors that seem to influence speech with face masks. All these factors influence the speech intelligibility in some way, both for speech production and perception.

3.2. RQ2: What strategies do speakers report using to ensure that they are understood when they wear a mask?

Regarding RQ2, findings suggest that participants employed various strategies to improve speech intelligibility. Ten subthemes belonging to three broad themes emerged from the data: explicitness strategies, pronunciation-specific strategies, and nonverbal communicative strategies. The themes and subthemes are summarized in Figure 2.

The explicitness strategies, adapted from Björkman (2014), consisted of: *avoidance, simplification,* and *clarification requests.* The first strategy that participants discussed as one of their ways of improving intelligibility was *avoidance*. More specifically, a large number of NSs suggested that they often avoid small talk because they cannot understand the interlocutor or they are simply

tired of conversations and do not want to put the effort into small talk. On the other hand, most of the NNSs and some NSs seem to completely avoid any kind of conversation because it causes more cognitive load and they expect to experience difficulty being understood. The quotes below show examples of NS discussing the avoidance strategies.

> *I usually try to make an effort, but as this pandemic has gone on, I've become grouchier and grouchier. So I have reduced the amount of small talk.* (NS4)
>
> *We just don't talk, because I can't I can't communicate an idea. I can say something and I'll go say something again and I'll go HA?* (NS5)
>
> *I think I wouldn't do any unnecessary talk I wouldn't talk on unnecessary topics, I would just ask my questions get answers and then just leave.* (NNS6)

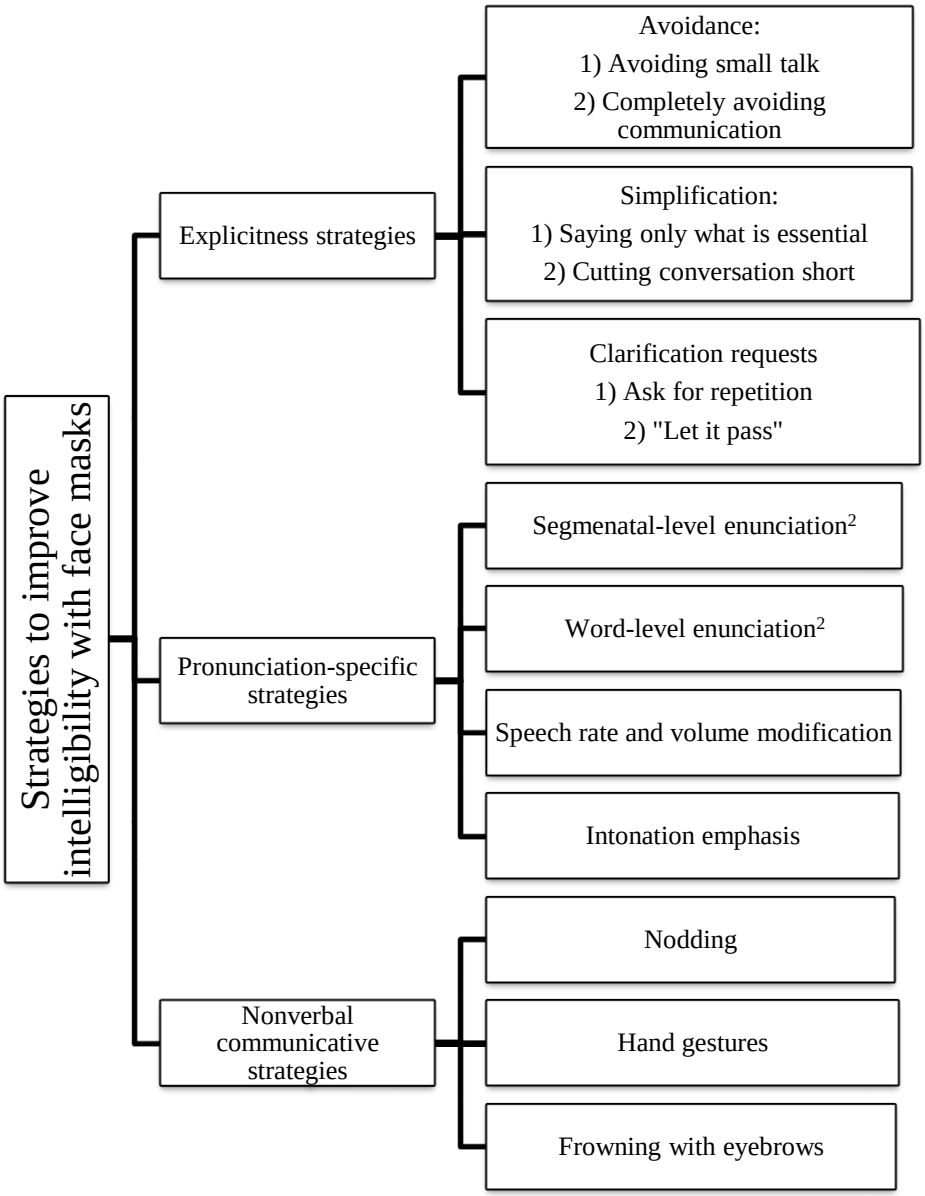

Figure 2. Strategies used by NSs and NNSs to improve speech intelligibility (based on ideas in Björkman (2014) and Saito and Poeteren (2012)).[2]

[2] In the language teaching context, language teachers often compensate for potential speech intelligibility issues by using segmental and word level enunciation strategies. As defined by Saito and Poeteren (2012), segmental-level enunciation refers to "teachers' exaggerated enunciation of certain consonants and vowels, such as /æ/, /r/, and /th/, in order

The next set of findings refers to *simplification* of the conversation. The results show that besides avoidance, the participants also simplify their language by saying only what is essential and they try to cut the conversation short. The language used with masks on appears to be simple, short, concise, and to the point. NS5, as shown below, explained that they typically adapt their language when they speak to NNSs of English or when they are on the phone. However, now, due to the face masks, they seem to change the language when they talk to everyone, as if they were NNSs or as if they were communicating over the phone.

> *Sometimes you, you want to talk to people, but since you have mask on, it's, you feel like it should be kind of temporary. I mean, you should just stop this conversation as soon as possible, because it's difficult to speak in mask.* (NNS3)
>
> *I think adapting the speech like when u are talking to a language learner or like you are on the phone.* (NS5)

In regards to *clarification requests,* the participants discussed that when there are speech intelligibility issues, they would sometimes ask for clarification. However, in many cases, participants explained that they would just "let it pass" because they felt uncomfortable asking for clarification. In those situations, the interlocuters might have assumed there were no issues in understanding their speech (NS3, NNS7).

> *So, sometimes, I just have to nod my head pretend and hope it wasn't a question.* (NS3)
>
> *When I was not understanding people, but they were older than me so to be polite I didn't ask too many times "excuse me?" so I let it pass and then if it was really really really important that I understand that particular sentence or you know like something they said, then I would be like "oh I'm just so sorry. Because of the airplane I just had like something in my ears. I couldn't hear you".* (NNS7)

The next set of strategies used by this group of participants is labeled as *pronunciation-specific strategies.* These strategies were adapted from Saito and Poeteren (2012) who identified them as a part of a NNS's teacher talk analysis. Saito and Poeteren (2012) discussed the ways teachers adapt their speech when they talk to second language learners and distinguished L2 pronunciation-related adjustment strategies. The results of the current study suggest that speakers with face masks also tend to adapt their pronunciation to achieve intelligibility when communicating with both NSs and NNSs. Specifically, some speakers pointed out that they enunciate more carefully on segmental (sound) level and word level to make their speech more understandable. One example of a NS comment (NS1) illustrates the discussion for the need of clear articulations of the vowels and consonants because the interlocutor cannot see the mouth movement. The comment is presented as follows:

> *The thing to focus on is articulating the vowels and consonants more because people can't see your mouth moving. And they can, it's harder to guess at what you're trying to articulate.* (NS1)

Participants also reported speaking at a slower pace, louder volume, and higher range of intonation. One NS emphasized that they are using this strategy when they communicate with language learners (NNSs), but other participants shared that they use this strategy with everyone. Interestingly, one of the NSs commented that they change their speech when they are wearing face masks, the same as if they were talking to a NNSs.

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to elicit students' noticing and awareness of these problematic sounds at a phonemic level." (p.376), while word-level enunciation involves "teachers' word-level enunciation in order to facilitate students' comprehension of L2 classroom discourse instead of exaggerating individual sounds" (p.376).

> *Yeah, I'm consciously making changes to my speech. I think when I speak to an English learner in my work I will slow down and enunciate very clearly. I will have sort of a higher range of intonation when I'm speaking to a learner and I feel like I'm doing that when I have my mask on*. (NS1)
>
> *So, I gauge my voice and make it louder so that the other person the listener doesn't have any trouble hearing me*. (NNS2)

Finally, the results also revealed use of *nonverbal communication*. The participants argued that when they wear face coverings their use of nonverbal communication has immensely increased in an attempt to clarify their ideas and send their message. The use of *nodding* to confirm listening as well as an increased use of *hand gestures* emerged from the data. One participant commented: *I think I exaggerate my body movements, like my head nodding and using my hands to sort of try to indicate enthusiasm* (NS2). Other participants emphasized the way they *frown with eyebrows* to indicate confusion and to send the signal that clarification is needed.

Overall, it is important to note that the results demonstrated that participants use various strategies to achieve successful communication. They adapt their language, the manner of speech, and use a number of different ways to indicate unintelligible speech and the need for clarification.

4. Discussion

This study set out to describe the participants' lived experiences with speech intelligibility with face masks during the COVID-19 pandemic. The two main findings are:

> **RQ1:** Most participants view speech with face masks as some kind of obstacle that interferes with speech intelligibility and causes occasional issues for them either as a listener or as a speaker due to many factors; and
>
> **RQ2:** Both NSs and NNSs tend to adapt their speech when communicating with face masks which may facilitate speech intelligibility.

RQ1 in the study explored how participants view the impact of wearing face masks on their ability to understand speakers. Following the organization of adverse conditions by Mattys et al. (2012), this study proposes a framework for analyzing factors that influence masked speech. Considering that this topic of face masks, previously mostly relevant in limited contexts, is still novel to a wider audience, this framework of factors allows for a structured approach to investigating masked speech. Examining one or more factors from the framework may provide a better understanding of this topic.

While previous studies measured actual intelligibility of masked speech by having listeners transcribe the speech or by performing acoustical or other types of analysis of recorded speech, this study dives deeper into people's beliefs and perceptions of intelligibility. People's beliefs and expectations of not being able to understand masked speech or not being understood may play a key role in this type of communication. This appeared especially relevant for native-nonnative speaker communication, where the NNSs expected to be misunderstood because of their accent and felt intimidated by it leading to adapting their speech and in some cases, avoiding communication. They also anticipated having problems with understanding masked speech because they believed that due to their nonnative status they rely more heavily on visual cues than they would in their L1. Even though listening in adverse conditions is typically more difficult for NNSs, as they have to cope with both imperfect knowledge and an imperfect signal (Lecumberry et al., 2010), masked speech appears to cause issues for some NSs, too. The reason why other studies have shown little to no issues with the actual intelligibility (Coniam, 2005; Mendel et al., 2008) while people reported problems in their everyday communication, might be related to people's expectations that face masks will cause intelligibility problems and therefore, subconsciously blocking the ability to understand speech.

Besides their expectations to be misunderstood, another interesting finding is that NNSs appear to suffer from more cognitive load during masked speech. Mannell (2008) argues that cognitive load may increase when exposed to non-optimal speech because the brain needs to exert more effort to identify the phonological content of the spoken message. In addition, NNSs discussed that the pressure to meet certain self-imposed standards when talking to NSs influences their communication success. The way NNSs are unfamiliar with certain aspects of the culture (such as topics for discussion, small talk), as well as reduced vocabulary knowledge, might explain the imposed cognitive load. Past literature shows that the familiarity with topic greatly facilitates the interpretation of the entire message (Gass & Varonis, 1984). What is more, the NNSs comments indicated that their constant awareness of the situation around them, their continuous thinking about surfaces they have touched or the proximity of their interlocuters, as well as their emotional state, have added to the difficulty to process information and to focus on the conversation. NSs in this study did not seem to be greatly affected by this factor, as this topic did not emerge throughout the interviews. The reason why NSs and NNSs might have been differently affected might be the increased fear in NNSs of being alone and fearing the ways they would cope with the virus in a foreign country, therefore imposing even greater load distracting them from understanding the speech.

Participants' beliefs about noisy environments are in line with findings from previous literature that noise influences the ability to understand masked speech (Brown et al., 2021; Cory et al., 2020; Mendel et al., 2008). This may also be an explanation of why the investigation of recorded speech may not show a large difference between masked and unmasked speech recorded in a quiet, ideal recording environment. In everyday life, communication rarely occurs in ideal noise-free surroundings and hence, being influenced by many factors, people have the impression that masked speech is difficult to understand. A combination of a few adverse conditions may not only influence speech intelligibility, but it can also make the conversation very difficult to conduct (Mattys et al., 2010).

Another important finding was the negative impact of the lack of visual cues for both NSs and NNSs. NSs seemed to more heavily rely on visual cues, especially facial expressions, to set the tone of the conversation and to "read" the audience or to decode the pronunciation of sounds of NNSs. Most NNSs discussed the relevance of visual cues, especially lip movement, but mostly **if** they need additional cues to decode the speech. One explanation for NSs' need to rely on visual cues more than NNSs, is because the NNSs' speech is more challenging to decode. The finding aligns with past studies who also observed that speech intelligibility issues might be associated with the reduction of visual cues (Atcherson et al., 2017; Llamas et al., 2008).

Lastly, there was a divided opinion regarding the influence of the fabric of face masks. Some participants' experiences showed that the fabric does not influence the speech at all, while others believed that cloth masks muffled the sound more. Results are contradictory in the existing literature, too. A few researchers found significant differences among various types of masks (Corey et al., 2020; Fecher & Watt, 2011), while another study suggested that there was insignificant difference between transmission of the signal among different fabric types (Llamas et al., 2008). Llamas et al. (2008) argue that the relationship between the thickness, weight, and cover is complex given the wide range of fabrics available, which might explain the divided opinion among participants.

The second part of the study discussed the participants' strategies to improve the communication. It appears that both NSs and NNSs argue that they adapt their speech in various ways to make the speech more intelligible. Speakers tend to adapt their pace and loudness of voice, carefully enunciate, simplify their language, and use a lot of nonverbal cues to facilitate the communication which may result in more intelligible speech given the obvious obstacles. As Conian (2005) suggested, this might be one of the possible explanations for his findings and findings by other researchers (Mendel et al., 2008) that point to no differences in speech with and without face masks.

Both NSs and NNSs appeared to adapt their speech and a few of them compared it to other types of adapted speech, such as teacher talk (Saito & Poeteren, 2012) or foreigner talk (Scarborough et al., 2007). Accommodated speech is used by speakers to facilitate intelligibility and improve communication. For example, foreigner talk is characterized by specific features such as slower and louder speech, less vowel reduction, simplified grammar, use of high frequency words (Rodriguez-Cuadrado et al., 2017). The current paper proposes the term *mask talk* as a label for speech with face masks, which should be treated as a separate type of adapted speech. As discussed above, based on the participants' comments, the *mask talk* has several main characteristics: slower pace; louder voice, intentional enunciation and emphasis of sounds and words, use of short and simple sentences, enhanced use of body language (nodding, hand gesturing and frowning with eyebrows to signal confusion), avoiding small talk, stating only the essential words, repeatedly asking for clarification or "pretending to understand" the conversation by letting pass segments of speech not understood. This new category seems worthy of further exploration because it provides an insight into the language used in everyday communication under masks.

5. Conclusion

This study explored graduate students' views on speech with face masks by conducting interviews with NSs and NNSs. The face masks appear to add to the wide range of adverse conditions under which people communicate daily. The findings regarding the first research question revealed that participants reported there are several factors that influence speech intelligibility. Moreover, findings regarding the second research question showed that speakers tend to adapt their speech when they wear face masks to increase intelligibility by employing various strategies, such as explicitness, pronunciation-specific or nonverbal strategies.

However, it is important to acknowledge that there are certain limitations to this study. Findings are limited to graduate students only and hence covering only a certain age range. It would be interesting to explore participants among various ages to see whether they have different views on this topic. Also, all the NNSs participants, as well as the communication among NSs and NNSs in this study, mostly occurred among high-proficiency NNS. It is possible that other contexts and lower- proficiency NNS may show different findings.

The suggested framework for factors that influence speech intelligibility with face masks can be used as guidance for further research and exploration of mask talk. By further exploring the suggested groups of factors, it may help us better understand what influences the speech to the highest degree and what would be the best approach to improve communication under face masks. In particular, more research is needed in relation to nonnative speakers. The qualitative approach to speech intelligibility allowed us to observe this phenomenon more closely and identify what people's experience with face masks is. The second proposed framework (Figure 2) can be used for future exploration of the suggested phenomenon labeled with the term *mask talk.* Studies of spontaneous conversations among participants and analysis of the ways the speakers adapt their speech could provide more support for this claim.

Finally, this study has implications for both research and pedagogy. Besides contributing to the emerging field of masked talk research, this study can also be helpful for anyone who communicates with face masks in various settings, such as medical staff, construction workers and the general public during epidemic or pandemic situations. The organization of factors and speech accommodation techniques in this study can facilitate a better understanding of this phenomenon and can help us towards successful communication.

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