



## Letter to the Editor

**How face masks can affect school performance**

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Speech is the verbal production of language, while language is the basis of communication. Language includes receptive language (understanding) and expressive language (the ability to convey information, feelings, thoughts and ideas). The language is commonly thought of in its spoken form, but it can also include a visual form, such as the Brazilian Sign Language (LIBRAS) [1].

For verbal communication to be effective, auditory information must be understood by the listener. However, everyday communication often occurs in contexts of acoustic challenges that degrade acoustic information. External sources of acoustic challenge include background noise, competitor speech and even accent speakers [2].

Listening to distorted speech is a challenging task that requires the listener to use additional cognitive resources for a successful understanding. The cognitive processes involved in hearing acoustically distorted speech are likely to include verbal work memory and attention-based performance monitoring. Therefore, the acoustic challenge is not only an auditory problem, but significantly affects a variety of cognitive operations needed for linguistic and non-linguistic tasks [3].

School-aged children communicate, socialize, and learn in environments with background noise and reverberation [4]. Classrooms are often noisy which can hinder the child's ability to listen and learn. Excessive background noise and classroom reverberation may affect the educational performance of children with normal hearing that present other learning difficulties [5].

In addition, approximately 11–15% of children between 6 and 16 years of age in the United States have auditory loss  $\geq 16$  dB HL in one or both ears and children with minimal/slight hearing loss represent more than 33% of this population [6].

Children with minimal or mild hearing loss may have difficulties in the perception of speech in adverse hearing conditions, as well as delays in speech, language, and socio-emotional development. The academic performance of many of these children is also poorer than for children with hearing at normal levels [6].

**The COVID-19 pandemic and the use of face masks**

The Centers for Disease Control and Prevention (CDC) recommends wearing face masks in public environments, when in close contact with people who do not live in your home, especially when other measures of social distance are difficult to maintain [7].

**Facial masks**

The masks have two serious problems for children: 1) the typical masks (cloth or medical) present a visual barrier to those who rely on non-verbal communication signals on the face (e.g. mouth, lips, teeth, tongue and cheeks); the child is unable to obtain visual cues, hiding the speaker's face and not allowing the lip reading and 2) the voice of the teacher is attenuated and distorted.

Both linguistic and non-verbal information are important for understanding social communication and interaction. In a timely publication about medical masks, Goldin, Weinstein, Shiman [8], 2020, reported acoustic degradations where medical masks act as lowpass filters and high frequencies (between 2000 and 7000 Hz) are attenuated by about 3–4 dB (dB) for simple surgical masks and up to 9–12 dB for N95 masks.

The study by Atcherson et al. [9], 2020, presents the maximum reduction of sound pressure level (SPL) reduction (in dB) of the different mask types as well as each type of mask in conjunction with a standard facial shield when compared to the condition without a mask (Table 1).

With small exceptions, the preliminary data of Atcherson et al. [9], 2020, closely reflects the results of Goldin, Weinstein, Shiman [8], 2020, and the presence of the face shield has had a more dramatic effect. On average, the presence of the face shield produced a total reduction by up to 29 dB. It also surprises that each of the three transparent masks has mitigated the talk more than the non-transparent masks, and produced a resonant peak between 5000 and 7000 Hz.

Although transparent masks have reduced the level of sound pressure and possibly degraded even more speech than non-transparent facial masks, they play an important role in preserving non-verbal

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**Table 1**

Maximum Sound Pressure Level Reduction (in dB) for Masks Only and Masks Plus Shield Compared to the No-Mask Condition.

DEVICE	MASK ONLY	MASK + SHIELD
Surgical Mask	5.0 dB	20.0 dB
KN95 Mask	8.7 dB	29.2 dB
N95 Mask	10.9 dB	28.7 dB
FaceView Mask (transparent window)	12.0 dB	24.9 dB
Safe 'N' Clear Mask (transparent window)	13.3 dB	24.7 dB
Transparent Cloth Mask	21.2 dB	29.2 dB

communication slopes on face [9].

The transparent masks used with or without the facial shields help maintain access to the mouth, which can help some listeners with lip reading and other non-verbal clues such as emotion. However, it is also possible that the degradation of speech acoustics will overcome supplementation to speech understanding provided by any transparent windows [9].

The degradation of speech quality, combined with the noise/reverberation of the room and the absence of visual cues, makes speech almost unintelligible for many individuals, especially for children who are in the process of acquiring and developing speech, language, in the process of literacy and acquisition of new knowledge.

Parents and teachers need to be aware of these changes so that they try to avoid more implications in the academic life of children, already greatly impaired by the removal of the school. To do this, we drew up a list of guidance to help parents and teachers in this pandemic of COVID-19:

#### Recommendations to Parents:

- Awareness the parents about how facial masks, associated or not to the face shield, can harm the intensity and quality of speech and how much this can impact on the school performance of their children.
- Be aware of your children's daily school performance.
- Report what was given in class to certify the correct school understanding.
- Talk to children about the day at school and about the difficulties they may have
- Observe behavior changes that may indicate school difficulties.

#### Recommendations to Teachers:

- Speak slowly and articulate.
- Use features and visual support and images in the activities.
- Reduce environmental noise and keep the child's attention before speaking.
- Consider using a portable microphone.
- The teacher should ask the child to repeat the instructions received, making sure that the child has really understood.
- Repeat the instructions or rephrase your speech if the child is not understanding what is being requested.
- Do not speak loudly, do not overemphasize, or exaggerate your words.
- Do not talk to the child while walking; always make eye contact.
- Avoid using flashy masks as they can compete for the child's attention, dispersing the listener's focus.

#### Author's contribution

All authors actively participated in the writing of this text, having an equal share of contributions.

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