

Impact of Face Masks on Audiovisual Word Recognition in Young Children With Hearing Loss

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Background

- For young children learning communication skills, mask wearing by parents, teachers, and peers presents auditory and visual barriers to verbal communication.
- Children who are deaf or hard of hearing (D/HH) are especially vulnerable, as they
 are more reliant upon visual information.
- Older children (6-8 yrs.) demonstrate advantages in auditory speech detection, discrimination, and recognition when visual speech is available (Lalonde & Holt, 2016).
- Masks attenuate frequencies above 1000 Hz to 3000 Hz (Corey, Jones, & Singer, 2020; Magee et al., 2020), especially masks with plastic barriers (Vos et al., 2021).
- The aim of this study was to determine if children who are D/HH benefit from the visual cues provided by transparent masks compared to solid face masks.

Methods

<u>Participants</u>: 13 children (3.3 – 6.9 years of age) with hearing loss in an auditory-oral school (8 M & 5 F).

All children were users of hearing aids or bone anchored hearing aids (Group1), or cochlear implants (Group 2).

<u>Exclusion criteria</u>: English not primary language, visual impairment not remedied by corrective lenses, and severe developmental delay.

<u>4 conditions</u>: No mask, transparent apron mask, ClearMask™, and standard surgical mask

Outcome Measure:

- Word Intelligibility by Picture Identification (WIPI) Test (1 list per each of the 4 conditions).
- English-speaking female recorded with an iPad camera focused on the head and shoulders and an external microphone.
- Pre-recorded audio-video stimulus controlled for sound level fluctuations and variations in visual cues. Each child was tested in a quiet room and was asked to point to the picture that best matched the word spoken.
- The percentage of correctly identified words was analyzed.

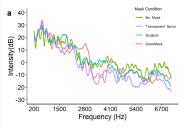






Results

Averaged spectrograms (intensity as a function of frequency) for 10 recorded words from list 1 for each mask condition.



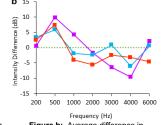


Figure a: The surgical mask had the smallest reduction in high frequencies (> 2 kHz). The apron mask had the largest overall attenuation, especially from 2000 to 8000 Hz.

Figure b: Average difference in band energy between the no mask condition (baseline) compared to the face mask conditions across the 10 words.

Overall, the surgical mask had the least effect, the ClearMask™ was attenuated uniformly at 1000 Hz and above, and the transparent apron mask had the largest enhancement at 500–1000 Hz and above 2000 Hz.

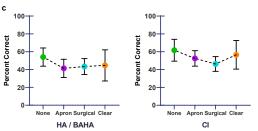
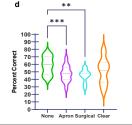


Figure c: Percent of correct words identified for each condition. One-way Repeated Measures Analysis of Variance (RMANOVA) with the mask condition as the repeated measure was not significant for either group.

Figure d: Effect of mask condition for all children. No mask and transparent apron masks were different (ρ =0.0008) as well as no mask and standard surgical mask (ρ =0.0014). No significant difference was found the no mask and clear mask conditions



Conclusions

- The spectral analysis showed that the surgical mask had a small effect on the acoustics of speech, so the observed decrease in word recognition is likely due to loss of visual cues
- The transparent apron mask had a greater impact on acoustics of speech. The size and placement of the apron mask on the face also appears to obscure some visual cues due to glare.
- Even though the surgical and ClearMask™ had relatively similar impacts on acoustics, the ClearMask™ was not significantly poorer than the no mask condition. This may be due to visual cues preserved by the ClearMask™ compared to the surgical mask.
- The standard surgical and transparent apron mask presented a significant barrier to audiovisual communication in young children who are D/HH.
- Facial cues are also important for sign language users, so non-transparent face masks would be expected to negatively impact their communication.
- Additionally, face masks obscure the reading of emotion, an important skill for communication development in young children.

References

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