PANDEMIC COMMUNICATION BREAKTHROUGH WITH CLEAR MASKS AND REMOTE MICROPHONE TECHNOLOGY

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Demo Video

INTRODUCTION

❖ Communication with masks has been particularly challenging due to an acoustic degradation from 3.0 up to 27 dB SPL.[1,2,3,4]

❖ Use of opaque masks also obstructs the visual cues of the mouth[5,6] and reduces speech recognition in noise by 15-34%.[4,7,8,9]

❖ Use of transparent masks can benefit auditory-visual speech recognition in noise by 10%. Additionally, confidence significantly improved, and concentration effort significantly reduced when the speaker wore a transparent mask.[10]

❖ Furthermore, use of remote microphone technology (RMT) can significantly improve communication in noise up to 61% as measured in auditory-only conditions.[11]

❖ Use of transparent masks and RMT can result in speech perception comparable to using RMT with no mask in auditory-only conditions.[12,13]

❖ The effects of using a transparent mask combined with RMT in auditory-visual conditions are unknown.

❖ These may be important accommodations for improving communication during the pandemic.

RESEARCH QUESTIONS

In listeners with normal hearing:

1. How was the auditory-visual speech recognition in noise when the speaker wore the ClearMask™ compared to that with the surgical mask and no mask?
2. How was auditory-visual speech recognition in noise with the use of RMT across the three listening conditions (no mask, ClearMask™, and surgical mask) different from without it?
3. How were ratings of confidence and concentration effort different when the participants received auditory-visual stimuli presented with the ClearMask™ compared to the surgical mask and with the use of RMT compared to without it?

MATERIALS

Stimuli

- Speech recognition of the last word: Six Revised Speech-in-Noise Test (R-SPIN) lists (#3-8) consisting of ten high and ten low-probability sentences[14]
- Noise: Multi-talker babble[15]
- Confidence and concentration effort subjective ratings: Connected Speech Test [16]

Masks

- Two mask types: Surgical & ClearMask™ (Figure 1)

Figure 1. A) No mask B) Surgical mask C) ClearMask™

METHODS

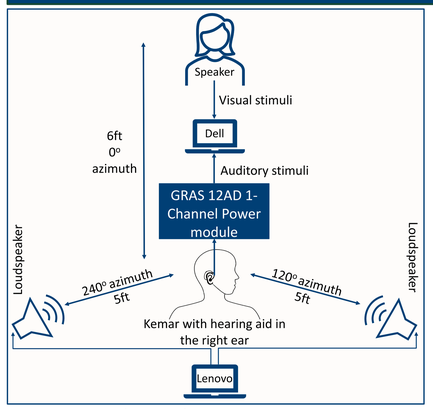

Figure 2. Stimuli recording setup

Participants (n=122)

- Adults aged 18 to 80 years
- Self-reported normal hearing
- English as first language
- Recruited via university research credit system, social media sites, and listserv posts
- Participants who reported having internet connection issues were excluded

Subjective ratings: on a Likert scale of 1 to 5

- Confidence: 1 – No confidence
  5 – Extreme Confidence
- Concentration: 1 – A lot of concentration
  5 – No concentration at all

Recording-Setup (Figure 2)

- Monitored live voice: ~65dB SPL
- Multi-talker babble: ~75dB SPL

Remote Microphone Technology (Figure 3)

Phonak Roger On microphone

- Set to Automatic Mode

Phonak Audeo Marvel hearing aid

- Programmed for a flat 60 dBHL hearing loss with proprietary fitting formula
- Installed with the Phonak Roger X(03) receiver via the Roger Installer
- Placed in Kemar's right ear with a power dome
- Activated hearing aid microphone during RMT streaming

Figure 3. Remote microphone technology (RMT) setup

Sequence of online survey (Figure 4)

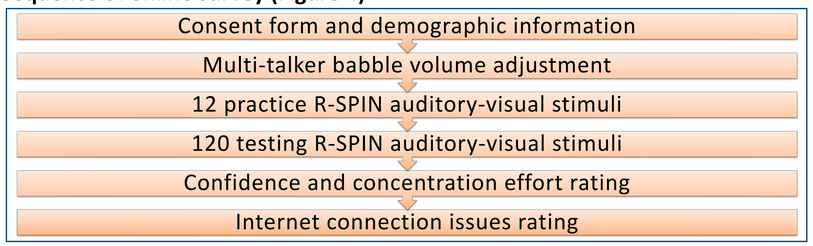

Figure 4. Online study procedure. *Note:* R-SPIN, Revised Speech-in-Noise Test[14]

Data analysis

- Three two-way repeated measures ANOVA for two within subject factors (face mask type and use of RMT) were completed for
  - ✓ Arcsine-transformed percent correct speech recognition scores
  - ✓ Confidence and concentration effort ratings
- Post-hoc t-tests with Bonferroni corrections and alpha level of $\rho<0.05$

RESULTS

For speech recognition in noise, there were significant main effects of face mask type ($F(2,731)=23.69$, $\rho<0.001$) and use of RMT ($F(1,731)=1028.17$, $\rho<0.001$). The interaction between the two main effects was significant ($F(2,731)=26.29$, $\rho<0.001$). (Figure 5) Post-hoc t-tests relevant to the research questions 1 and 2 resulted in the following answers:

Q1. Speech recognition in noise performance recorded when the speaker wore a **ClearMask™** was significantly **better than** with a **surgical mask**. However, performance with no mask was significantly better than with either surgical mask or ClearMask™ conditions (all ρ's<0.001).

Q2. When **RMT** was used, average scores significantly **improved across all face-mask types** from conditions without the use of RMT (all ρ's<0.001).

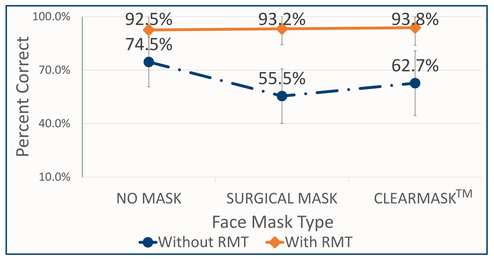

Figure 5. Speech-in-noise scores by each condition. Error bars represent ± one standard deviation.

For confidence ratings, there were significant main effects of face mask type and use of RMT. The interaction between the two main effects was significant (all ANOVA ρ's<0.001). For concentration effort, the main effects of face mask type and use of RMT were also significant (all ANOVA ρ's<0.001), but there was no interaction between the two effects. (Figure 6) Post-hoc t-tests relevant to research question 3 resulted in the following answer:

Q3. There was **increased confidence** with the use of **ClearMask™** compared to that with surgical mask without the use of the RMT. However, there was **no difference in concentration effort** rating with the use of ClearMask™ vs. Surgical mask despite use of RMT.

Performance in all three face mask conditions was rated with significantly **higher confidence** and **lower concentration** effort **with RMT** than without RMT.

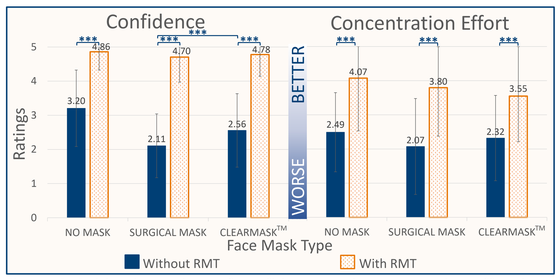

Figure 6. Subjective ratings of confidence and concentration effort by each condition. Error bars represent ± one standard deviation.
*Note.****$\rho<0.001$

DISCUSSION

❖ The improvement in auditory-visual speech recognition in noise with RMT was the greatest with the surgical mask (37.7%) compared to the ClearMask™ (31.1%) or no mask (18.0%).

❖ As expected, the benefits of RMT in auditory-visual conditions are smaller than those in auditory-only.[12,13]

❖ Such benefits would likely be of greater importance for those with hearing loss who struggle with communication during the COVID-19 pandemic.

❖ Limitations:

- Uncontrolled calibration of technology used for the online study, acoustic and visual quality of the auditory-visual stimuli, and internet connections
- Potential inconsistent attention to visual cues
- Potential speaker's articulation bias
- Sample limited to those with normal hearing
- Not representative of realistic conversation

CONCLUSION

Use of RMT and a clear mask provided significant improvement in auditory-visual speech recognition in noise. Moreover, these two accommodations significantly enhanced listener's confidence. To reduce communication barriers, the use of RMT and clear masks is recommended in noisy settings such as hospitals, workplaces, classrooms, and public places.

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