



Effects of Hearing Protection on Speech Intelligibility in Pediatric Dentistry

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BACKGROUND

- Pediatric dentists are at risk of experiencing noise-induced hearing loss (NIHL) from intermittent noise levels that may reach over 110 dBA^{1,2}
- The use of hearing protection devices (HPD) may help protect against NIHL¹¹
- HPDs may affect communication among dental team members
- Purpose: To examine the effects of passive hearing protection devices on speech intelligibility in a simulated pediatric dental environment

MATERIALS & METHODS

Simulated Pediatric Dental Environment "Soundscape"

- Recall and Restorative Soundscapes were created
 - Commercially available sounds and recordings from a hospital dental clinic
 - Audio files mixed via GarageBand

Intervention (Cross-Sectional Study)

- 4 types of passive hearing protection devices (HPDs) were tested:
 - Etymotic ER-20
 - Loop Experience 2
 - Mack's Ultrasoft Foam
 - Ohropax Classic Wax

Digital Signal Processing

- Audacity software was used to attenuate the soundscapes based on attenuation charts provided by manufacturers

Survey Design:

- A modified MUSHRA survey was created on Qualtrics (Fig 1)
- 7 audio clips: Reference (unedited), 4 HPDs, 1 negative & 1 positive control
- Participants rated the clarity of speech on a sliding scale from 0 ("Bad") to 100 ("Excellent") when compared to the reference

Survey Distribution to Participants:

- A modified MUSHRA survey was delivered to AAPD's e-mail list

Data Analysis:

- Speech clarity scores were summarized for the six groups (Fig 2, 3)
 - 4 earplugs, 1 negative control & 1 positive control
- Repeated Measures ANOVA assessed statistical differences between groups
- Post-hoc pairwise comparisons assessed for differences between paired groups in each scenario

RESULTS

- 83 AAPD members participated in this survey, including 45 females (54.2%) and 38 males (44.8%). Most respondents had 30+ years of dental practice (33.7%)
- All HPDs had significantly lower clarity of speech for Recall and Restorative Soundscapes
- Between the positive controls, the Recall soundscape had significantly better clarity than the Restorative soundscape.
- The mean scores of ER-20 and LoopExp2 were not statistically different from each other in either scenario.

The following audio scenario depicts a Restorative appointment. Please listen and rate the clarity of speech in each sound clip from 0 (Bad) to 100 (Excellent) relative to the reference sample below. You may listen as many times as needed.

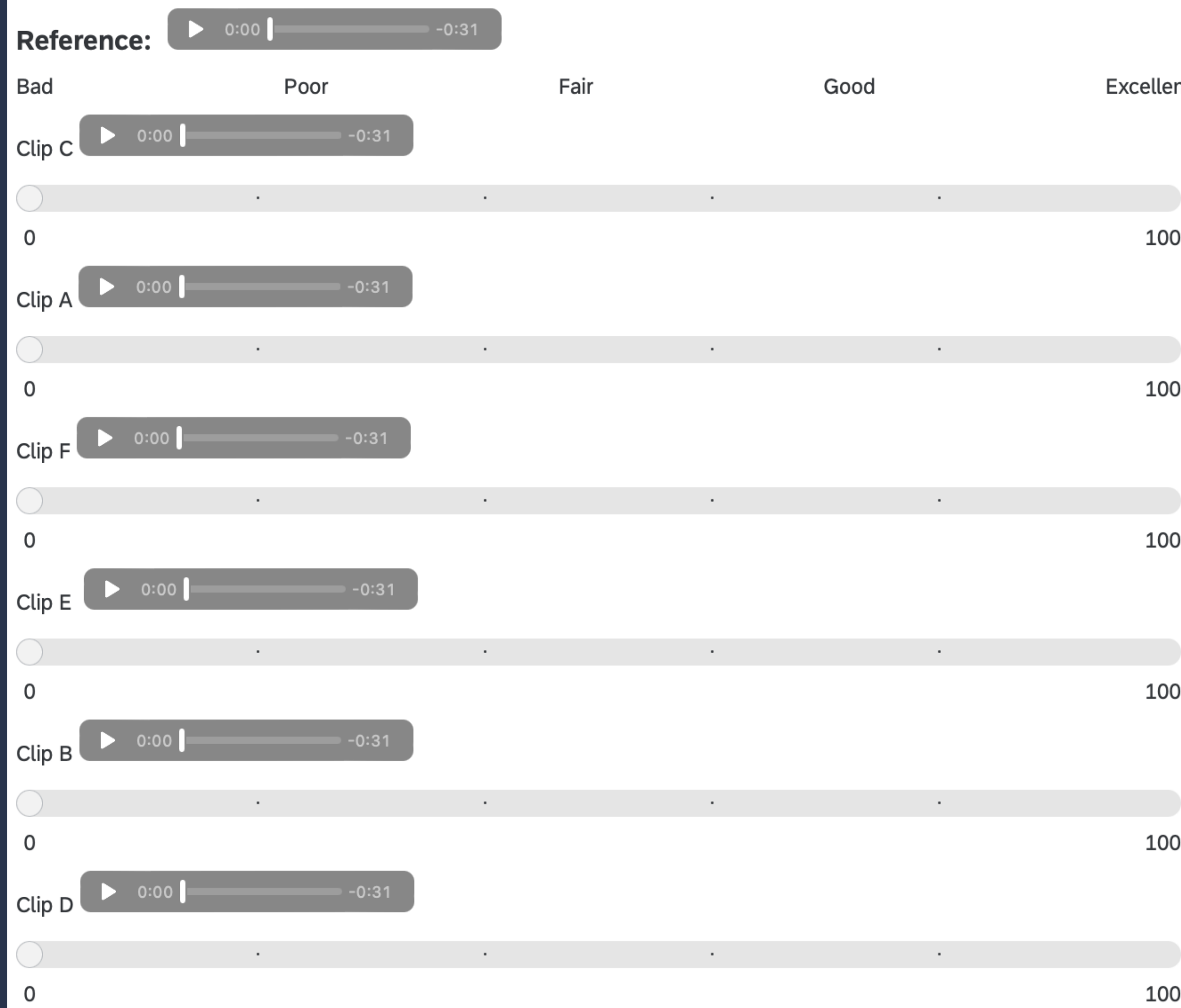


Figure 1: Modified-MUSHRA Survey Interface

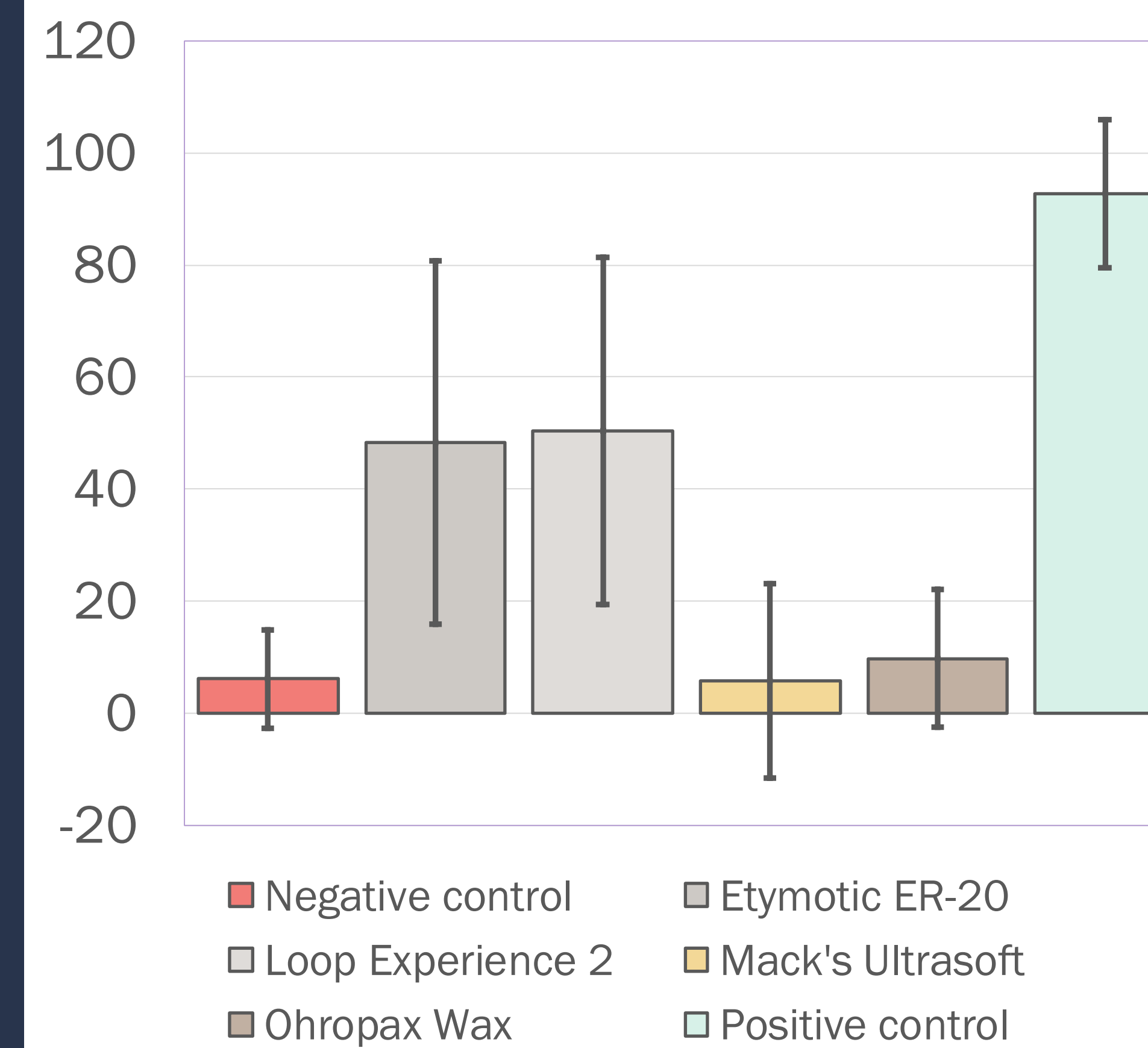


Figure 2: Recall Exam Speech Intelligibility Scores

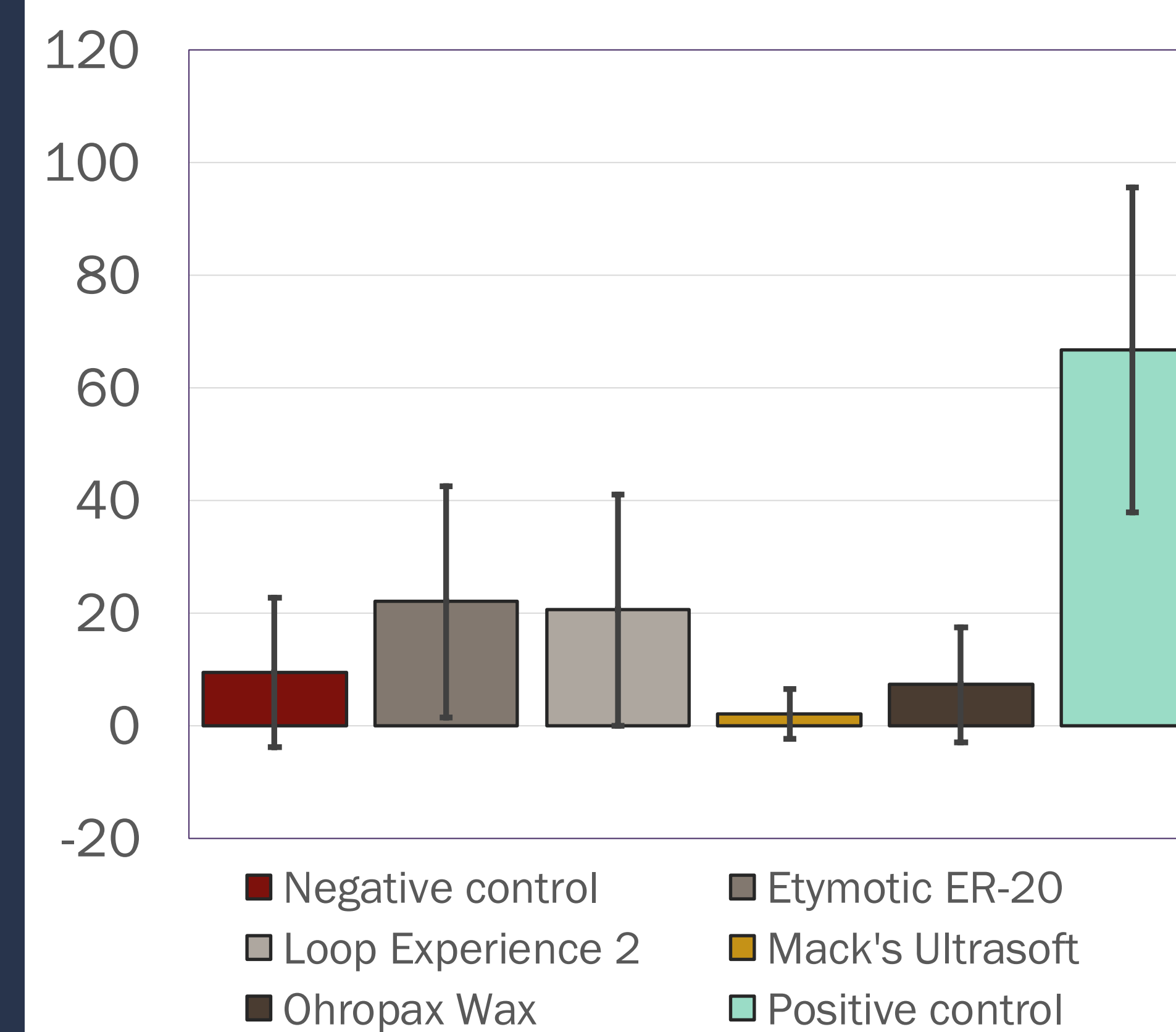


Figure 3: Restorative Appointment Speech Intelligibility Scores

Table 3: Recall Exam Post-Hoc Pairwise Comparisons

	Negative Control	ER-20	LoopExp2	Mack's	Ohropax
ER-20	p<0.001				
LoopExp2	p<0.001	p=0.351			
Mack's	p=0.894	p<0.001	p<0.001		
Ohropax	p=0.033	p<0.001	p<0.001	p=0.054	
Positive control	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001

Table 4: Restorative Exam Post-Hoc Pairwise Comparisons

	Negative Control	ER-20	LoopExp2	Mack's	Ohropax
ER-20	p<0.001				
LoopExp2	p<0.001	p=0.531			
Mack's	p<0.001	p<0.001	p<0.001		
Ohropax	p=0.194	p<0.001	p<0.001	p=0.025	
Positive control	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001

DISCUSSION & CONCLUSION

- The clarity of speech in the Recall soundscape was significantly better compared to the Restorative soundscape, as the Restorative soundscape featured much more background noise³⁰
- High fidelity HPDs ER-20 and LoopExp2 performed significantly better than traditional foam (Mack's) or wax (Ohropax) earplugs, as they provide less attenuation in the frequency range of speech
- Passive HPDs do affect speech intelligibility in a simulated pediatric dental clinic environment.
- Dentists should weigh the benefits of hearing protection against the decrease in speech intelligibility when choosing a product.

REFERENCES



Acknowledgements: This project was supported by the Indiana University School of Dentistry's Graduate Research Committee

