# Not all remote microphones are created equal

## A comparison of remote microphone technologies for pediatric hearing aid users

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## Background

Classroom noise levels can vary significantly, ranging from -7 dB to +15dB SNR, with a significant amount of a child's day being spent in the presence of noise (Crukley et al, 2011).

Roger systems have multiple clinical benefits such as better speech intelligibility in noise (Wolfe et al., 2021), better receptive discourse skills (Curran et al., 2018), and more child-directed speech (Benitez-Barrera et al., 2019) compared to hearing aids alone.

Studies comparing Roger against FM systems (Thibodeau, 2014) as well as other fixed gain remote microphone systems (Wolfe et al., 2015) have been done in the past, with Roger outperforming both solutions in adults. No studies have compared these alternatives for the pediatric population.

### Aim

Compare speech intelligibility in noise performance for school age children with hearing loss using Roger Touchscreen Mic (TSM) against a traditional fixed directional remote microphone (RM), in a simulated teaching setting and small group setting.
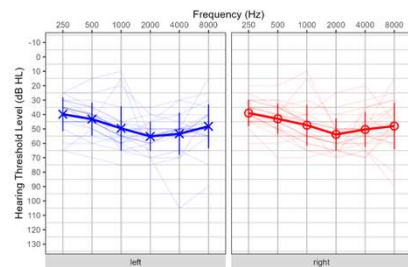
## Participants & Devices

### Participants

- Sample size: 25 children
- Age: 8-12 years old
- Inclusion: aided score of >70% AZ-Bio recognition
- Average PTA = 50dB HL (Moderate HL)

### Devices

- Hearing aid: Sky/Audéo L50 fit to DSL 5.0 targets
- Phonak Partner Mic
- Phonak Roger Touchscreen Mic, dual adaptive mode



## Experiment 1: Teaching

### Methods

- **Single speaker** played at 0° in diffuse classroom noise
- **No RM** vs **fixed directional RM** vs **Roger**
- **Participant** response scored (%)
- Tested at various presentation levels



| Signal (dBA) | Noise (dBA) | SNR (dB) |
|---|---|---|
| 69 | 65 | +4 |
| 72 | 70 | +2 |
| 73 | 75 | -2 |

Children were asked several subjective preference ratings at the end of session
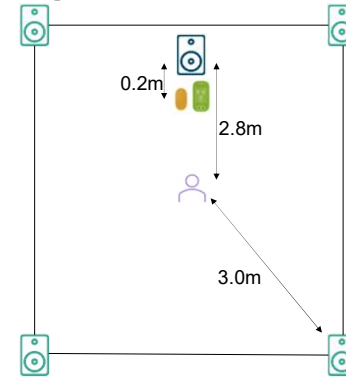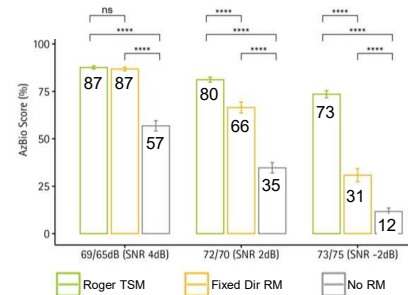
### Results



| Question | Roger | Both equal | Fixed Dir RM |
|---|---|---|---|
| Best sound | **16** | 3 | 6 |
| Comfort in Noise | **14** | 1 | 10 |
| Speech clarity | **18** | 1 | 6 |
| Overall | **15** | 1 | 9 |

Table 1. Subjective questionnaire results asking participant to rate preferences of various quality ratings of the two remote microphone conditions in the simulated teaching condition.

- Speech recognition with Roger and the fixed directional RM was significantly better than hearing aid alone
- Speech recognition with Roger was significantly better than fixed directional RM
- Roger was consistently preferred over the fixed directional RM

## Subjective Preference Questions

At the end of both experiments, participants were asked two questions:



**Which device looked nicer?**
- Roger 37%
- Both the same 17%
- Fixed Dir RM 46%

**If you had to choose one device…**
- Roger 68%
- Fixed Dir RM 32%
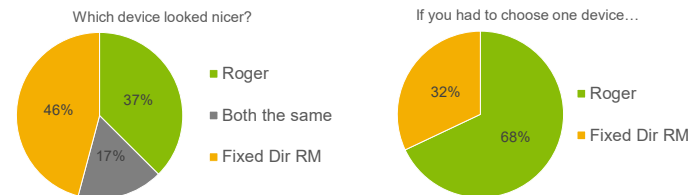
When participants were asked about design and aesthetics, there was an even split, with a slight preference towards the fixed directional RM.
However, when they were asked to choose only one microphone overall the majority of children (68%) chose Roger.
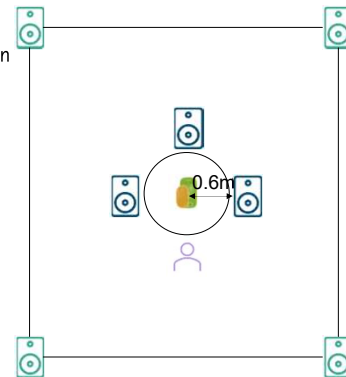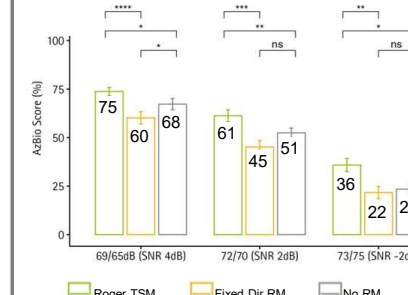
## Experiment 2: Small Group

### Methods

- **Multiple speakers** played random 0°, 90°, 270° in diffuse classroom noise
- **No RM** vs **fixed directional RM** vs **Roger**
- **Participant** response scored (%)
- Tested at various presentation levels



| Signal (dBA) | Noise (dBA) | SNR (dB) |
|---|---|---|
| 69 | 65 | +4 |
| 72 | 70 | +2 |
| 73 | 75 | -2 |

Children were asked several subjective preference ratings at the end of session

### Results



| Question | Roger | Both equal | Fixed Dir RM |
|---|---|---|---|
| Best sound | **17** | 2 | 6 |
| Comfort in Noise | 9 | 2 | **14** |
| Speech clarity | **15** | 0 | 10 |
| Overall | **18** | 0 | 7 |

Table 2. Subjective questionnaire results asking participant to rate preferences of various quality ratings of the two remote microphone conditions in the simulated small group condition.

- The traditional RM performed worse than hearing aid alone.
- Speech recognition with Roger was significantly better than both the fixed directional RM and hearing aid alone
- Roger was predominantly preferred over the fixed directional RM

## Conclusion

Speech recognition with the Roger TSM was significantly better than the fixed directional RM in loud noise situations. This may be attributed to Roger's adaptive gain.

In small group situations, the fixed directional RM compromised audibility of the off-axis talkers. This disadvantage was overcome by the Roger TSM's adaptive behavior.

Subjective ratings showed a slight preference for smaller remote microphone; however, when ask to directly select between devices, the Roger TSM was the preferred option.

**This study reinforces the significant benefits provided by remote microphones while also demonstrating that the adaptive behaviors of the Roger TSM also provide benefits over traditional remote microphones.**

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