Comparison of Speaker Cues for Deaf Viewers in Virtual Reality

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1. Background and Objectives

Mixed Reality technology is growing rapidly. Currently, the infrastructure **lacks accessibility** options for Deaf and Hard of Hearing (DHH) people. Research demonstrates that DHH people experience a cognitive burden in **identifying** and **tracking** multiple speakers while reading captions.

- We aim to establish solutions for this problem by:
  - Creating 3-4 approaches to assist the user in **identifying** the **speaker** among a panel within the virtual reality classroom environment
  - Adding captions to videos

Research Question:

- What is the most efficient approach for Deaf and Hard of Hearing adults to track and distinguish who is **speaking** with their voice in a panel within a **Mixed Reality** environment?

Hypothesis:

- If we include a speaker-identifying **indicator** in Virtual Reality then Deaf and Hard of Hearing users will have an easier time **identifying** the **speaker** instead of a caption standalone setting.

We hope that our study motivates researchers and developers to make **Mixed Reality** technology **accessible** to not only DHH people but also those who rely captions.

2. Methodology

We are comparing the participants' responses on how comfortable they felt with the 4 different approaches.

Technology Used

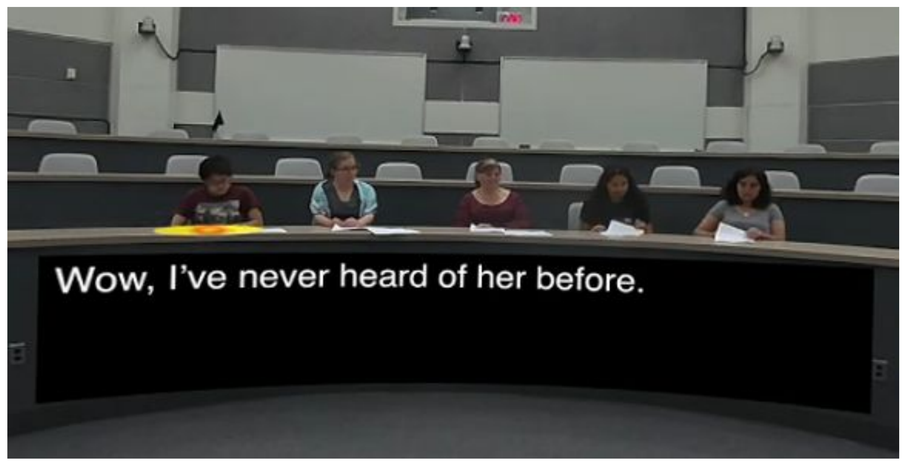
- Adobe Premiere / Adobe After Effects
- Daydream VR headset with Google Pixel phone

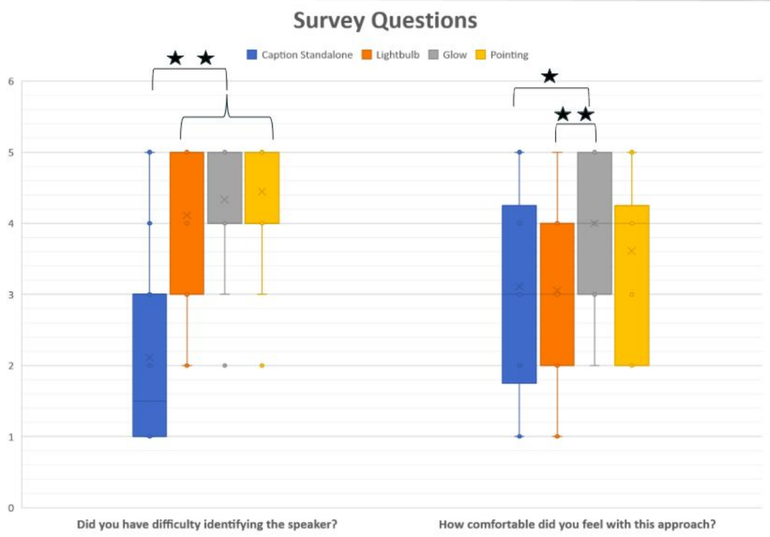
Procedure

1. Developed scripts with multiple speakers in a panel setting.
2. Recorded stimulations.
3. Added captions and indicators to the videos using software.

Participants watched videos and answered survey questions in between.

Figure 1





3. Results

Participants were asked two survey questions in between videos.

"How comfortable did you feel with this approach?"

- The T- test showed us that Caption Standalone and the indicators showed significant P-value. The Caption Standalone was significantly better (t-test, alpha = .01) than each of the indicators.
  - Average of Caption Standalone: 3.167
  - Average of Glow: 4.111
  - Average of Pointing: 3.833
  - Average of Lightbulb: 3.333

"Did you have difficulty identifying the speaker?"

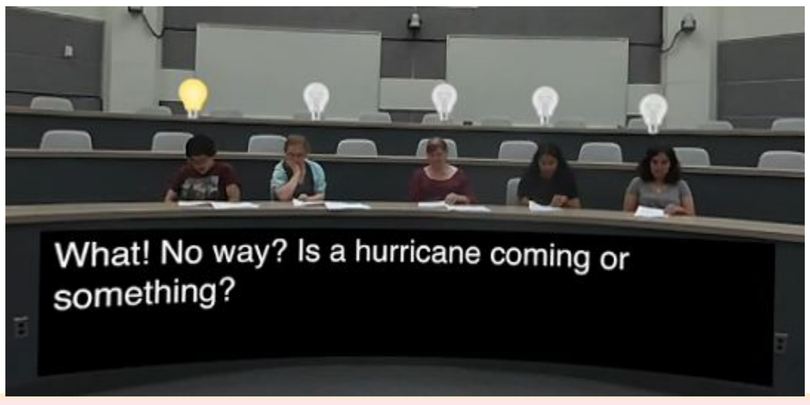
- The T- test showed us the Lightbulb and Glow have a P-value of 0.0069. Though, the T-Test showed us the the Caption Standalone and Glow have a P-value of 0.0761.
  - Average of Caption Standalone: 2.111
  - Average of Glow: 4.333
  - Average of Pointing: 4.444
  - Average of Lightbulb: 4.111

4. Qualitative Feedback

- Concerns with Blurriness of Captioning and Actors - 4
- Captions were too long and too wide to read - 7
  - Some participants expressed their concerns having to move their head to read the captions
- Wish that name/color were added to Caption - 3
  - **Amy:** Hi, my name is Amy and I like programming.
- Good font and color choices - 2

"Awesome experience to see how virtual reality can make a difference towards the Deaf/HOH community."

Figure 2



5. Conclusions

- Indicators are significantly preferred over none.
- **Glow** is generally preferred choice however the data that compares which indicator participants prefer the most is insignificant.
- 16 out of 18 participants wish to see captioning in VR
- 13 out of 18 participants hope to see indicators in VR. The remaining 5 participants said maybe.
- Pursuit of developing indicators for Deaf and Hard of Hearing Virtual Reality users in the future is strongly encouraged.
- Captions should be considered to be customizable as people have various needs and preferences.

6. References

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