# Final Design, Participant Comments and Reflection

PROBLEM DESCRIPTION

Our project explored the lived experiences of Grace Meno (she/her), a sixth-grade Social Studies and English teacher at Lake Stevens Middle School with severe hearing loss. Severe hearing loss is categorized as the ability to detect loud sounds between 71 and 90 dB but not normal levels of conversational speech (Definition of hearing loss 2022). Grace's hearing loss affects both her ears (bilateral), developed in her early childhood prior to speech acquisition (pre-lingual), and is caused by damage to her inner ear and auditory nerve (sensorineural; Anastasiadou & Al Khalili, 2022). To assign meaning to sound, she relies on the use of a hearing aid and speech reading which refers to watching the speaker's lip and facial movements, gestures, and body language (Speech reading 2022). In virtual settings, such as teaching online classes or watching videos on her phone, she uses captions and live transcriptions to communicate effectively.

During our initial brainstorming session, Grace expressed a strong interest in exploring solutions that could help her to better access intercom announcements in her classroom setting. Her current classroom intercom system consists of an audio speaker built into the wall with no alternative modalities of information (see photo of intercom system). When announcements occur, she must rely on her students and colleagues to relay information to her. Grace is concerned that this approach would be ineffective during emergency situations such as fire evacuations and lockdowns, or when there are language barriers between her and the students. Thus, our main objective in this project was to engage Grace in co-designing a solution that would help her to effectively and independently access intercom announcements.
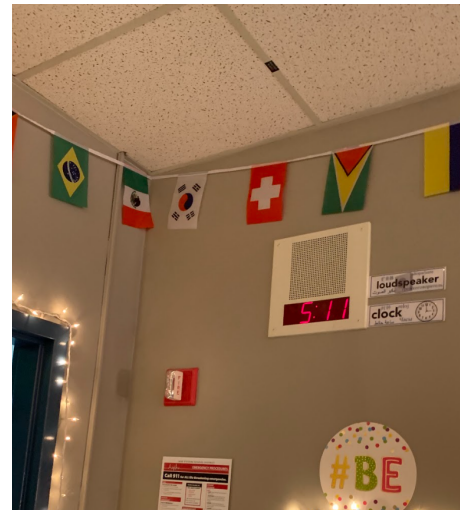
To understand the scope of this challenge, we began by conducting foundational research on existing solutions. We learned about various types of commonly-used technologies d/Deaf and hard-of-hearing individuals such as hearing aids, speech transcribers, mobile apps, and built-in iPhone functions (see Appendix A for documentation). Some notable ideas included integrating live captions from the "Ava" app (Coldewey, 2022), adding color-coded lights to the current system (Goddard; Jain et al., 2019), or replacing the current system with a digital intercom system (Wagner, 2023). We also briefly explored the implications of these ideas in other contexts with intercom systems beyond the classroom.

REFINED FINAL DESIGN SOLUTION

Description of the Ava app

Our design solution builds on the functionalities of an existing platform called Ava. Ava is a service that provides d/Deaf and hard-of-hearing people and inclusive organizations with live captioning solutions. The platform is compatible with most desktops and smartphones (iOS and Android). Users can choose from several specialized services that best fit their individual needs, whether it is for captioning at school, the workplace, or in everyday life. Ava offers a cost-free basic subscription plan for individual use with the option to upgrade to a paid premium subscription plan for those who require higher transcription accuracy. To learn more about the Ava platform, visit their official website at www.ava.me.

Description of the prototype

Currently, the gap with live captioning solutions is that it requires our participant to open the app and activate the feature, which can cause her to miss portions of intercom announcements. Our design solution incorporates adding a custom sound recognition functionality to the Ava app. The participant would be able to record and save custom sounds (e.g. the beep before the intercom announcement) that prompts the app to immediately start live captioning the announcement on her iPhone and Apple Watch.

Currently, Ava is available on most desktops and smartphones (iOS and Android), however, we envision this product to be compatible with a smartwatch as well in order to better suit our participant's needs.

Prototype screens

Our prototype for the sound recognition functionality includes the following screens:

On the smartphone:
- A user profile screen with the "Custom Alerts" listed as a function;
- A blank custom alert recording screen with instructions on how to record the first custom alert;
- A library of custom alerts screen with names of the custom alerts assigned by the user. The custom alerts are listed in the order of when they were last recorded;
- A confirmation screen of whether the user wants the recording deleted;
- A screen with live transcription of the announcements with an option to end live transcription;
- A confirmation screen of whether the user wants the live transcript saved; and
- A library of saved transcripts listed in the order of when they were last generated.

On the smartwatch:
- A screen with live transcription of the announcements with an option to end live transcription;
- A confirmation screen of whether the user wants the live transcript saved.

DESIGN REQUIREMENTS

Based on the findings from our co-design sessions with Grace, we identified 8 requirements that our design solution should satisfy:

1. **Automatic live transcription:** The solution provides accurate live transcription of announcements without the user needing to manually activate the transcription function through a device.
2. **Time-efficient:** The solution is able to relay announcement information to the user as soon as possible given the time-sensitive nature of emergency situations. This is a high-priority requirement as Grace currently relies on her students and colleagues to relay information to her after the announcements occur and has expressed concern about the inefficiency of this method.
3. **Uses existing technology:** The solution leverages existing technologies that are both accessible, practical, and easy for the user to adapt to.
4. **Minimizes administrative barriers:** The solution allows the user to implement it without the need for direct approval or involvement of school administration or the district office. This is a high-priority requirement as Grace has expressed that she has previously been denied approval from school administration to use assistive technologies in her classroom.
5. **Compatible with personal internet connection:** The solution is compatible with the user's personal internet connection and should not need to rely on the school's WiFi as the latter requires pre-approval of external app installations.
6. **Discreet:** The solution can be used discreetly.
7. **Portable:** The solution is compact and can accompany the user wherever they go. This requirement would address the limitation of being unable to use the solution beyond her own classroom setting.
8. **Cost-effective:** The solution is cost-effective and does not require purchasing additional technology or wearables. The Ava app is free for individual use; if the participant wishes to use live captioning with higher accuracy, she may subscribe to the premium version at $10/month.

METHOD USED TO COLLECT FINAL PARTICIPANT COMMENTS

To collect final participant feedback, our team conducted a 5-minute remote usability test during which we had the participant interact with the final prototype to complete two scenario-based tasks. Task 1 was to set up the app to recognize her school's intercom sound that would automatically trigger live captioning. The next task was to respond to the live caption notification, first on the mobile device screen (Task 2a), then on the smartwatch screen (Task 2b).

During the test, we asked the participant to share her screen over Zoom while she interacted with the clickable prototype on her laptop. We asked her to think aloud throughout the process and encouraged her to candidly share both positive and critical feedback. After each task, we asked her to rate the ease of use on a 5-point Likert scale and elaborate on why she chose that rating.

Once she completed each task, we asked a series of post-test questions to assess her impression of how helpful the solution would be, as well as the likelihood that she would utilize the solution in the classroom and beyond. For details on the exact tasks and questions we prepared, please refer to Appendix A: Detailed Session Protocol.

FINAL PARTICIPANT COMMENTS

Our participant found the sound recognition functionality to be helpful and the interface to be intuitive and easy to use.

Upon seeing the first screen for Task 1, our participant commented that the interface is user friendly. She appreciated how the different options on the profile page (i.e., Settings, Custom Alerts, Help Center., etc.) were laid out in front of her and she found the process of recording a custom sound alert to be straightforward. She also felt confident about experimenting and exploring the functionalities in the app by herself.

For Task 2a, our participant loved that the font used for live captioning was large and bold and that it was black text on a white background, making it easy to read and non-distracting. She thought it was helpful that she could save the transcript, as well as organize the saved transcripts by chronological order.

For Task 2b, our participant liked that live captioning was also built into her smartwatch as it would be easy for her to check her wrist during class time. She appreciated that there were very few menu options to select from on her smartwatch (e.g. she's only able to to start captions, see her profile, and check her transcripts on her smartwatch), making it less overwhelming to use. One suggestion she had for the smartwatch interface was making the live captioning text black

on a white background, matching it to the color used on the smartphone. We incorporated this feedback into the final version of our prototype.

Our participant was excited about the solution and stated that it would be very likely for her to utilize it in her daily life. This solution would allow her to be immediately informed about intercom announcements, and she would be able to act quickly in case of emergencies. With this solution, she would be able to access the announcements herself and not rely on her students, which made her confident in her abilities to be an authority figure to her students.

Lastly, our participant found this solution to be easily applicable to other areas of her life, for example, with boarding announcements or doctor's appointments (where she could set the custom alert to be her name so she would know when her name was called). She also found this solution to be helpful for other users such as her family members (many of whom also have hearing loss) and students in her classroom (many of whom are non-native English speakers and could use the saved transcription feature to relay the important information to their parents).

HOW THE SOLUTION ADDRESSES THE PROBLEM

We believe that our final design solution effectively addresses the participant's pain points with the current school intercom system. The sound recognition functionality allows our participant to stay informed during announcements and be able to respond to an emergency in a timely manner. The solution is portable and can accompany our participant wherever she goes, as well as cost-effective so there's no need to purchase additional equipment.

REFLECTION ON THE GENERALIZABILITY OF DESIGN

Our solution is generalizable across a wide range of contexts. Given the portability and convenience of our design, the custom sound recognition functionality is operable beyond its intended use in the classroom. Our participant, Grace, expressed that she foresees using this solution to access audio-based announcements in diverse contexts such as the doctor's office, airports, airplanes and train stations.

Our solution is also generalizable to other primary and secondary users. At the design showcase, we presented our design solution to Grace as well as her father who experiences severe hearing loss and her grandfather who does not have hearing loss. Her father indicated that he would greatly benefit from the use of the solution to help him communicate in his workplace, at restaurants, and other public settings. Notably, her hearing grandfather also indicated that he would benefit from the use of transcriptioning with custom sound recognition to improve the ease

of communication with his hard-of-hearing family members and the "save transcription recordings" functionality to help him recall important information from prior events.

A key limitation of our design solution is that its reliance on modern technology including smartphones, mobile apps, and smartwatches may cause concerns of accessibility for users who are not technologically inclined or experience financial constraints. This exclusion was brought to our attention when Grace's father, who is unfamiliar with using an Apple Watch, indicated that he would prefer to use the Ava app on his personal iPad. Another limitation is the design's lack of inclusivity for users with a range of visual or sensory needs such as color-blindness or hypersensitivity to brightness. To reduce this exclusion, we recommend integrating in-app custom layout functionalities (i.e., changing font colors or size, changing background colors) that allow users to build an interface layout best suited for their individual needs.

REFLECTION ON DESIGN PROCESS

In hindsight, our participatory design process was effective for reaching our design goals although we identified a few areas of improvement. The brief usability test we ran with our participant was sufficient for gathering surface-level feedback on the prototype, however, if given more time, we would have liked to conduct a longer interview to collect more in-depth participant feedback and further iterate on improving the user experience. Additionally, it would have also been beneficial to conduct all our meetings in-person as this would have helped with communication logistics. We found that Zoom captures a lot of background noise, which made it difficult to hear our participant at times and produce accurate live transcriptions.

Although this was not a complete surprise, it was still shocking to learn from our participant that her school district is often not receptive to the use of assistive technology in the classroom and does not provide sufficient funds for upgrades in technology like the ones we were exploring. Additionally, it was insightful to learn about our participant's live experiences in her day-to-day activities at school and how much she relies on her students to tell her what was said during the intercom announcements.

Overall, we were successful in reaching our design goal which was proved when our participant and her family members validated our design as a realistic and practical solution that could be used in their everyday lives. If the project constraints allowed for more time and financial support, we would be interested in finding a way to implement our solution into the Ava app as well as keep exploring different features to add. We would also like to explore the opportunity to reimagine the physical intercom systems located in classrooms today to make them more accessible for teachers and students alike.

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APPENDIX A: Detailed Session Protocol

Final Feedback Session

Roles:

- Moderator: Juliana
- Note-taker: Connie
- Note-taker: Luka
- Recording/timekeeping: Marianna

Agenda:

- Introduce Ava App + Prototype Description
- Share the Figma prototype link
- Ask Grace to open link on laptop and screen share as she is using prototype
- Introduce two tasks to Grace
- Mention the showcase info (March 8 from 6:30-8pm)

Task 1 (Page 1): You're using the app for the first time and want to set it up to recognize the intercom sound to automatically trigger live captioning. How would you do that? Please think aloud what you are seeing, what you are looking at, and your overall thoughts (both positive and negative) as you are doing this task.

> Post-Task Question:
> Referring to the scale on page 4, how easy or difficult was it to complete this task? Can you elaborate on this?
>
> ☐ Very difficult
> ☐ Difficult
> ☐ Neither difficult nor easy
> ☐ Easy
> ☐ Very Easy

Task 2a (Page 2): Now that you've completed the set up, let's say that you're at school when the morning announcements begin. How would you respond to the notification on your mobile device?

[After Grace clicks through mobile flow]

Task 2b (Page 3): Now how would you do this on your Apple Watch?

Referring to the first scale on page 4, how easy or difficult was it to complete this task? Can you elaborate on this?

- ☐ Very difficult
- ☐ Difficult
- ☐ Neither difficult nor easy
- ☐ Easy
- ☐ Very Easy

Post-Test Questions:

Referring to the second scale, how helpful or unhelpful is this solution for improving your current experience with intercom announcements? Can you explain why? What could be improved?

Referring to the third scale, how likely or unlikely are you to utilize this solution for accessing intercom announcements in the classroom? Can you explain why?
  Follow up: What about beyond the classroom?

Any final thoughts / feedback?

APPENDIX B: Photos from Co-Design Sessions and Showcase

More photos from the co-design session

[More photos from the showcase](#)