HAAT Summary

Team Kate, 6.811 PPAT Fall 2014

Client

Our client is Kate. She is 35 years old and is a project coordinator at the Cambridge Commission for Persons with Disabilities. Kate was born with mild hearing loss, which rapidly progressed to profound in both ears when she was thirteen years old. To improve her hearing, she underwent surgery about six years ago to implement cochlear implants (CI), which she has greatly benefitted from.

"Without cochlear implants I have no residual hearing so I would have to put it at profound…"
"With implants, I tend to do well, so I would say mild or moderate… "
"Implants have completely changed my life."

Figure 1. *Our client Kate, and her hearing dog, Cheyenne.*

Current Gaps in Appropriate Context

Background noise, unable to follow group conversation and problems with accent

There are certain situations which can cause problems for Kate. As already mentioned, background noise is one of them. Her cochlear implant is unable to completely filter out noise, which can lead to a squeaking sound in her ear while in noisy environments. Background noise also makes it difficult for Kate to comprehend speech during a conversation. Adding to the difficulty, it is also not possible to lip read in the dark and hence, it is more difficult for Kate to converse in dim lighting, which is common during social situations such as eating at a restaurant or going to a bar. During multi-party group conversations it takes time for her to follow and locate who is speaking by looking at the lip movements of others and using cues, such as determining the direction others look at the speaker in. Sometimes, this causes her to miss crucial parts of conversation because of the inefficiency of this method: *"When people talk simultaneously, it needs a second for me to locate who is speaking. I miss things that way."*

Another problem that Kate has is that it is particularly difficult for her to understand people with different accents, for example:
Dhruv (in Indian accent, to Kate): "What kind of social problems do you face due to your hearing loss?"

Kate: "Sorry?"
Dhruv (repeating carefully): "Any social problems?"
Kate (struggling to listen): "This [the requests to repeat] is a good example of the social problems that I face."

***Figure 2**. Our first meeting with Kate. This is an example of a multi-party conversation in which Kate had trouble in quickly identifying who is speaking.*

Cochlear implants become wet in rain and sweating

Kate's cochlear implants are not waterproof. When exposed to water, whether it be from unexpected rain or from sweating, they can be damaged. MED-EL, the company that makes Kate's implants, does not currently offer a waterproof case or other solution to this problem, unlike other cochlear implant companies. Kate does use a few products to help protect her implants from water. The first is from a company called Ear Gear. It is a set of water resistant sleeves made of a nylon-spandex material that fits around each cochlear implant processor. The sleeves are attached to a cord with a clip on the end that can be clipped to clothing so that if the cochlear implants fall off Kate's ears, they won't fall to the ground. The two main issues with these is that (1) they are not water proof, and even have large openings in them in which water can easily get in, and (2) tend to make the implants fall off more because of the layer of material between the implant and the ear.

Target Activity

After discussion between Kate and the team, we mutually decided to focus on the idea of designing cochlear implants covers to (1) protect her CIs from rain and sweat, and (2) limit sound from behind her ears. A bonus piece would have been an implant add-on that could help prevent her CI from falling off her ear (but we were not able to successfully achieve that).

Our Solution: Cochlear Implant Covers

We have designing separate MED-EL cochlear implant covers to solve three problems:

1) *Water resistance:* Protect the water-sensitive cochlear implants from rain and sweat.
2) *Sound directionality:* Limit sound from behind to enhance hearing in field of view.

***Figure 3**. Final prototypes deliverables for sound directionality, made of black Sugru and Dycem.*

For sound directionality, the final prototype includes the sleek covers made out of (i) Sugru, Dycem and (ii) instamorph, waterproof lycra and (Figure 3) to block sound from behind (background noise) and enhance listening from front (people in conversation). Both, quantitative experiments and qualitative interview demonstrated success. In addition, the covers fit perfectly on the cochlear implant.

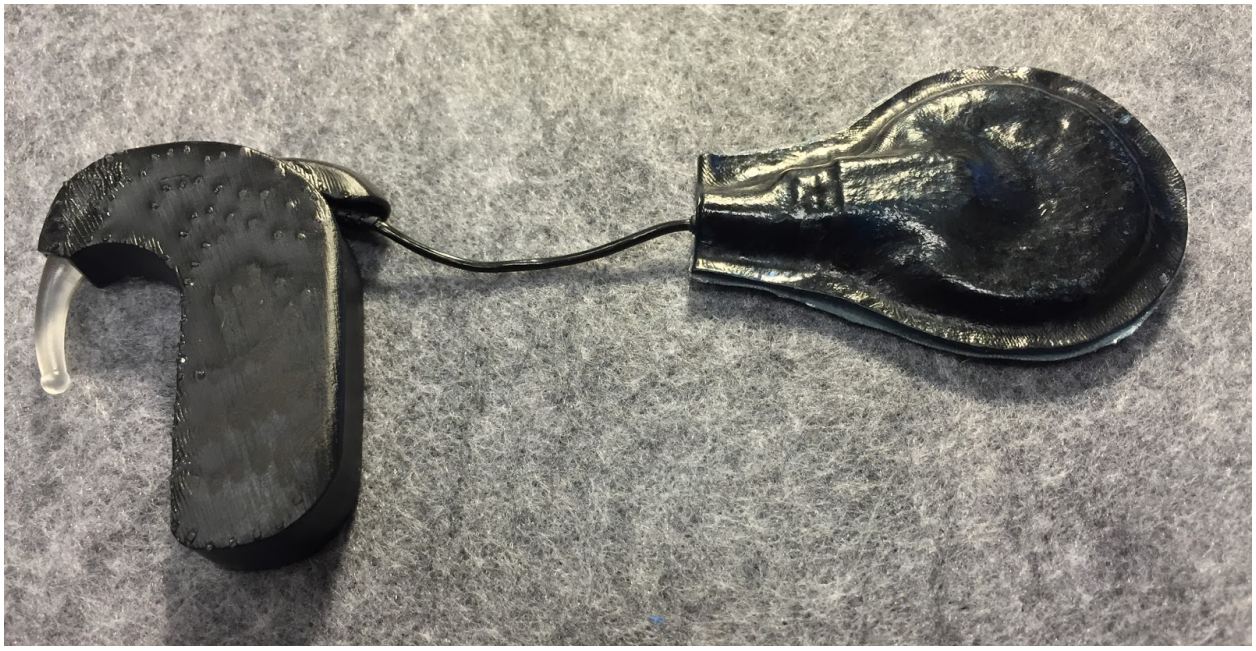

***Figure 4**. Final prototypes deliverables for water resistance. Left piece is a 3D printed half-cover. Right coil cover is made of dyed instamorph with waterproof lycra backing.*

For water resistance, the final prototype includes (i) snap-fitted 3D printed half-covers, and (ii) vinyl, waterproof lycra (which attach perfectly on the cochlear implant, are comfortable to wear and block rain. The water bead test and rain experiment demonstrated success in blocking water.