Personalizing Hearing Aids based on behavioral patterns

Benjamin Johansen[1,2], Michael Kai Petersen[2], Niels Henrik Pontoppidan[2], Per Sandholm[3], Jakob Eg Larsen[1]

1. Cognitive Systems, Technical university of Denmark, 2800 Lyngby, Denmark 2. Eriksholm Research Center, 3070 Snekkersten, Denmark, 3. Oticon A/S, 2765 Smørum, Denmark.

Introduction

The main purpose of the study is to investigate how hearing instruments are used "in the wild", and if we can infer behavior and context, based on user interactions[1] through daily activities.

We address two challenges:

1. Can we model HI user behavior based on IFTTT time series data?
2. Can we adapt HI to changing contexts throughout the day?

Methods

Subjects

- 6 subjects with symmetric hearing loss.
- Mean age 61.8 years (SD 11.1 years).
- Data from 5 test subjects were used. 1 subject excluded due to missing data.

Apparatus

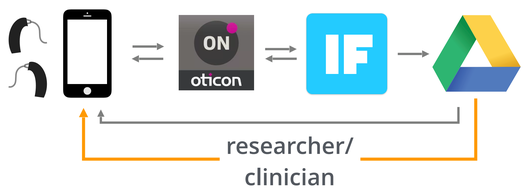

Fig. 1: iPhone and hearing aids sends data via Oticon On and IFTTT app to a google sheet (read only).

- Data collection illustrated in Fig. 1.
- 4 fitting rationals:
  - P1: Omnidirectional no NR.
  - P2: Similar to P1, increased brightness.
  - P3: Similar to P2, NR in simple and complex environments. Increased roundness.
  - P4: Frontal directional focus, NR in complex environments.

Results

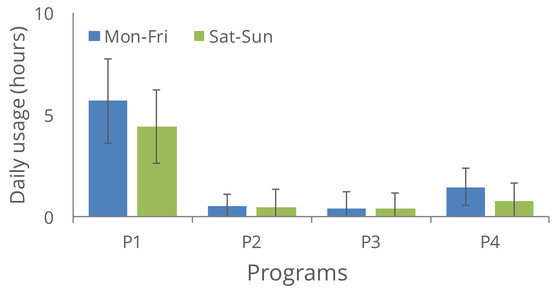

Fig. 2: Accumulated usage per program, split on Mon-Fri and Sat-Sun.

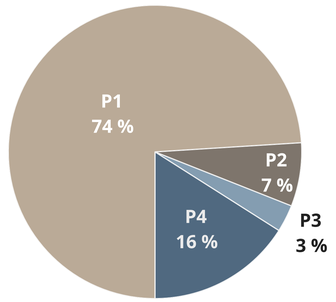

Fig. 3: Averaged relative usage per program.

- We logged in average 6.58 hours (*SD = 1.8 hours*).
- The usage patterns of programs varies both within and between subjects. For the program usage, we found a significant difference ($F_{3,4} = 23.1$, $p < 0.001$), between four programs.
- A significant difference in usage pattern is observed between Mon-Fri and Sat-Sun, ($F_{1,4} = 17.0$, $p < 0.02$).
- The omnidirectional program is preferred 74% of the time. This is higher than 30-40% reported in other studies [1][2][3].

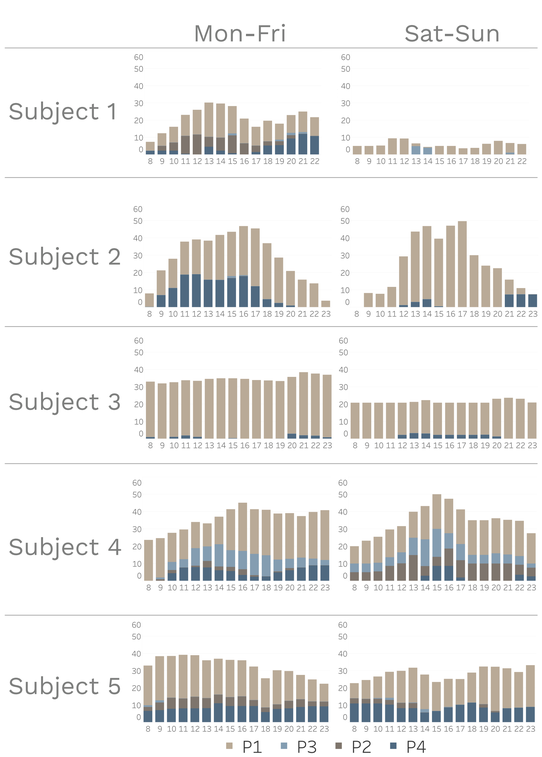

Fig. 4.a: 5 subjects usage per hour in minutes, between 8AM and 11 PM.

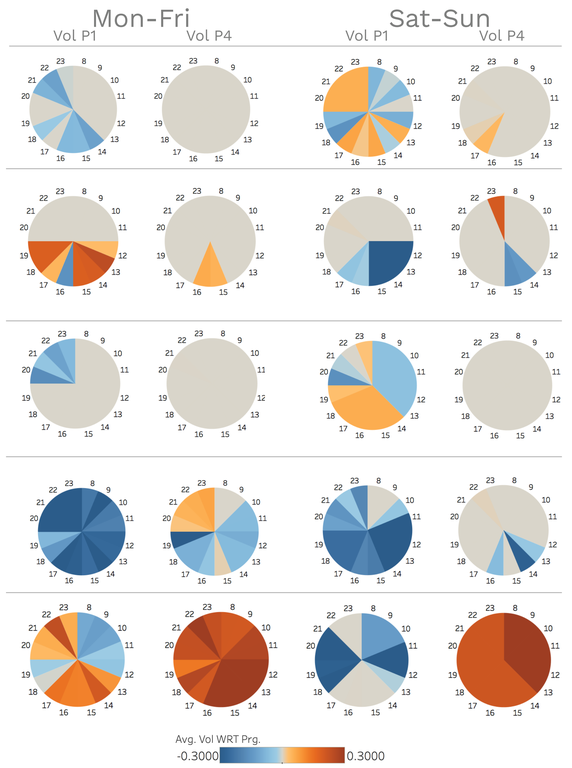

Fig. 4.b: 3 subjects vol. interactions wrt. program.

Future work

A further study is being planned including 20-30 test subjects. This further investigates interaction between volume and programs in a given context.

With increased participation, we aim to create models to reflect the individual usage patterns illustrated in Fig. 4.a & 4.b

Conclusion

- We find significant different usage pattern between Mon-Fri and Sat-Sun.
- Each subject have a unique usage pattern across four programs.
- These findings illustrates the need for considering individual behavior and context, in order to provide an optimal hearing instrument fitting.

Acknowledgement

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References

[1] Aldaz, G., Puria, S., & Leifer, L. J. (2016). Smartphone-Based System for Learning and Inferring Hearing Aid Settings. Journal of the American Academy of Audiology, 27(9), 732–749.

[2] Nelson, J., et al. "Integrating hearing instrument datalogging into the clinic." American Academy of Audiology convention: Minneapolis, MN. 2006.

[3] Walden, B. E., Cord, M. T., & Dyrlund, O. (2004). Predicting hearing aid microphone preference in everyday listening. Journal of the American Academy of Audiology, 396 (April 2003), 365–396.

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email: benjoh@dtu.dk | Twitter: @BenjohResearch