EEG Progress: Detecting the Neural Struggles of Hearing Loss

Swiss Hearing Day, Bern, Switzerland, October 2016

Prof. Thomas Lunner

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PhD student
Suffering from a Hearing Loss

Can we objectively measure the cognitive load?

ELU model: Rönnberg, Rudner, Foo, & Lunner, 2008
Measuring Cognitive Load during Listening

Electroencephalography/EEG:

EEG during listening:

↑ Task difficulty

↑ neural inhibition (alpha power)

↑ focus on task

Strauss et al, 2014
Jensen and Mazaheri, 2010
Does aided hearing loss influence cognitive load?
Hearing Loss and Cognitive Load

Expectation:

Participants

- 27 older (62-86 years) listeners
- Varying degree of hearing loss
- Stimuli presented through hearing aids

Petersen et al. 2015
Hearing Loss and Cognitive Load

Auditory Sternberg task:

- **Baseline**: 1 – 2 s
- **Encoding**: 4.85 s
- **Delay**: 1 – 2 s
- **Probe**: 2 s

2, 4, or 6 digits

Three levels of individualized noise

Petersen et al. 2015
Hearing loss and cognitive load

- Worse hearing result in higher alpha power

Expectation:

Effect of Hearing Loss

Degree of hearing loss

Petersen et al. 2015
Hearing loss and cognitive load

- Worse hearing result in higher alpha power
- Alpha power ceiling reached for participants with worst hearing in the most difficult condition

Petersen et al. 2015
Does aided hearing loss influence cognitive load?

- **Yes**, hearing loss causes higher alpha power
  - Indicates higher cognitive load

- **Yes**, with worse hearing alpha power reaches ceiling in the most difficult conditions
  - Alpha power increases more for participants with worse hearing

Petersen et al. 2015
Alpha power indicates when a listening situation becomes more difficult

Could alpha power control hearing aid settings?
Neural control of hearing aids?

• Real-world recording of EEG requires wearing a headset
• EEG can be recorded from electrodes positioned within the ear canal (EarEEG)
Neural control of hearing aids? “The relaxation hearing aid”

Low alpha power
→ ‘I want to listen’
Active
→ hearing aid on

High alpha power
→ ‘I want to relax’
Relaxed
→ hearing aid off

Drawings taken from: www.backyardbrains.com
Petersen and Lunner 2014
Neural control of hearing aids?
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