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Listening Effort and Cognitive Decline: An Exploratory Study Using Pupillometry

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PhD: Listen Care-fully: Healthcare Design on Listening Effort and Cognitive Function
Project period: 2019 March – 2022 February

Background
- Around 50 million people have dementia worldwide with nearly 10 million new cases every year!
- Hearing impairment accounts for 9% of the predictive power of all risk factors associated with the development of dementia³
- Hearing loss is proposed as a potentially modifiable risk factor for dementia in midlife¹
- Even mild levels of hearing loss increase the long-term risk of cognitive decline and dementia in individuals who are cognitively intact but hearing impaired at baseline.²
- The mechanism underlying cognitive decline associated with peripheral hearing loss is not fully clear¹
- Research suggests a potential pathway between hearing and cognitive decline, with listening effort, working memory and cognitive load as principal mediators.⁵

Why measure listening effort?
A growing amount of research is using pupillometry to examine listening effort and indicate the availability or demand on cognitive resources during processing.⁴⁻⁷ Reports of effortful listening suggest that these difficulties are about more than sounds being too quiet or non-audible. These individuals may need to allocate more cognitive capacity to comprehend, remember and respond to auditory information.⁵ The pupil diameter enlarges with this increased mental effort and reflects the processing demands associated with the task in relation to available cognitive resources.⁷

Objectives
- Determine whether increased listening effort is associated with cognitive function
- Investigate the feasibility of integrating listening effort technology as a predictive tool at point-of-care in dementia and hearing care settings

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Study 1 – Clinical research

What is the intervention?
- Two groups of healthy, middle-aged and older individuals (1: aged 60-80, 2: aged 40-60)¹
- One group of older individuals (aged 60-80) with Mild Cognitive Impairment (MCI)

Eligibility
- Pure Tone Audiometry (PTA), age-matched, to rule out significant hearing loss
- Based on the broad Winblad criteria, control participants have a Mini-Mental State Examination (MMSE) score of 28 or higher

Research questions
- Is there an association between listening-effort, assessed by pupillometry, and cognitive function?
- Can the use of hearing aids reduce listening effort, and would this translate to improved performance on cognitive tests?
- Could cognitive health management practices be re-designed to account for audiology-related risks of cognitive decline?

Subject studies
- Study 1: Clinical research
  - Speech intelligibility and pupil dilation will be measured during a Hearing in Noise Test (HINT).
  - Cognitive function will be measured using a battery of attentional and memory-based cognitive tests.
  - Those who demonstrate high levels of listening effort in noise will be fitted with hearing aids and re-tested on cognitive performance after 3 months of use

Study 2: Integrative care research
- Could basic audiological testing be integrated in the management of cognitive impairment?
- Prototyping the integration of listening effort testing with dementia care professionals
- Investigating the impact on the patient journey, and factors such as training, costs and usability

Collaborating partners

References
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