



Listening Effort and Cognitive Decline: An Exploratory Study Using Pupillometry

Feldman, Alix; Patou, François; Waldemar, Gunhild; Maier, Anja

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Feldman, A., Patou, F., Waldemar, G., & Maier, A. (2019). *Listening Effort and Cognitive Decline: An Exploratory Study Using Pupillometry*. Poster session presented at International Conference on Cognitive hearing science for communication, Linköping, Sweden.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Listening Effort and Cognitive Decline: An Exploratory Study Using Pupillometry

Alix Feldman¹, François Patou¹, Gunhild Waldemar², Anja Maier¹

¹Engineering Systems Group, Department of Management, Technology and Economics, Technical University of Denmark – DTU

²The Danish Dementia Research Centre, Department of Neurology, Rigshospitalet, University of Copenhagen

PhD: Listen Care-fully: Healthcare Design on Listening Effort and Cognitive Function

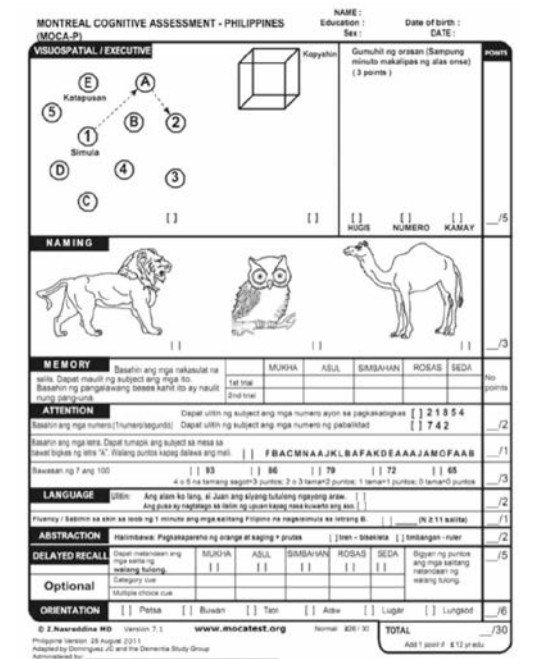
Project period: 2019 March – 2022 February

Background

- Around **50 million people** have dementia worldwide with nearly **10 million new cases** every year¹
- Hearing impairment accounts for **9% of the predictive power** of all risk factors associated with the development of dementia¹
- 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.³

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?



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

What is the intervention?

Subjects

- Two groups of healthy, middle-aged and older individuals (1: aged 60-80, 2: aged 40-60)
- 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

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

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

Contact:

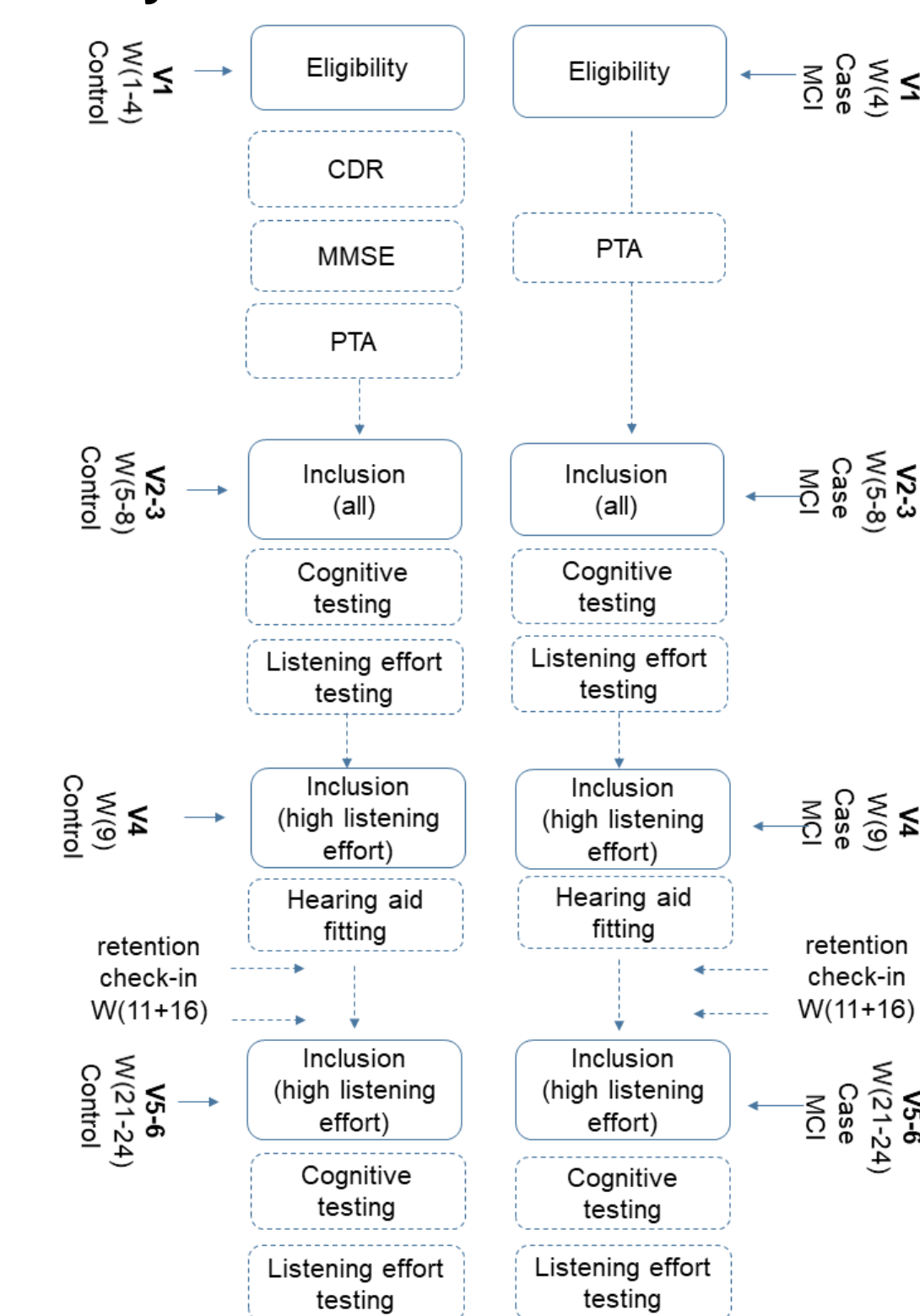


Alix Feldman
PhD student
Diplomavej
Building 371, 223
DK-2800
Kgs. Lyngby
Denmark
afeld@dtu.dk
www.es.man.dtu.dk

Scan to learn more about the project



Study 1 – Clinical research



Collaborating partners



References

- ¹ World Health Organization. (14 May 2019) *Dementia fact sheet*. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/dementia>
- ² Livingston G, Sommerlad A, Orgeta V, Costafreda SG, Huntley J, Ames D, Ballard C, Banerjee S, Burns A, Cohen-Mansfield J, Cooper C. Dementia prevention, intervention, and care. *The Lancet*. 2017 Dec 16;390(10113):2673-734.
- ³ Leon M, Woo C. Environmental enrichment and successful aging. *Frontiers in behavioral neuroscience*. 2018;12:155.
- ⁴ Mc Garrigle, R., Munro, K.J., Dawes, P., Stewart, A.J., Moore, D.R., Barry, J.G., Amitay, S. 2014. Listening effort and fatigue: what exactly are we measuring? A British society of Audiology Cognition in Hearing Special Interest Group 'white paper'. *International Journal of Audiology*, 53(7): 433-440.
- ⁵ Pichora-Fuller, M.K., Kramer, S.E., Eckert, M.A., Edwards, B., Hornsby, B.W., Humes, L.E., et al. 2016. Hearing impairment and cognitive energy: The framework for understanding effortful listening (FUEL). *Ear and Hearing*, 37(Suppl 1): 5S-27S.
- ⁶ Alhanbali S, Dawes P, Lloyd S, Munro KJ. Self-Reported Listening-Related Effort and Fatigue in Hearing-Impaired Adults. *Ear Hear*. 2017 Jan/Feb; 38(1): e39-e48.
- ⁷ Zekveld AA, Kramer SE, Festen JM. Pupil response as an indication of effortful listening: The influence of sentence intelligibility. *Ear and hearing*. 2010 Aug 1;31(4):480-90.