Speech comprehension in reverberant virtual soundscapes in logopenic variant primary progressive aphasia and Alzheimer's disease

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INTRODUCTION

Difficulty understanding speech in noisy environments is a key challenge for everyday communication in people with dementia, especially those with logopenic variant primary progressive aphasia (lvPPA), the language-led variant of Alzheimer's disease (AD) [1].

Here we investigated this using a novel paradigm that assessed speech comprehension in virtual everyday acoustic environments that varied in listening difficulty.

METHODS

In a cohort of patients with lvPPA (n = 9), AD (n = 13) and in healthy age matched controls (n = 18), we assessed 50% comprehension thresholds for spoken words (adapted from the modified rhyme test [2]) under four conditions of listening difficulty, in an adaptive staircase psychoacoustic protocol. All patient groups met diagnostic consensus criteria [3, 4].

Listening difficulty was manipulated by applying background multi-talker babble in four digitally-simulated, real-world soundscapes with different levels of acoustic reverberation (anechoic, office, hotel lobby and lecture hall).

VIRTUAL SOUNDSCAPES

No Reverb **Anechoic** → **Office** → **Lobby** → High Reverb **Lecture room**

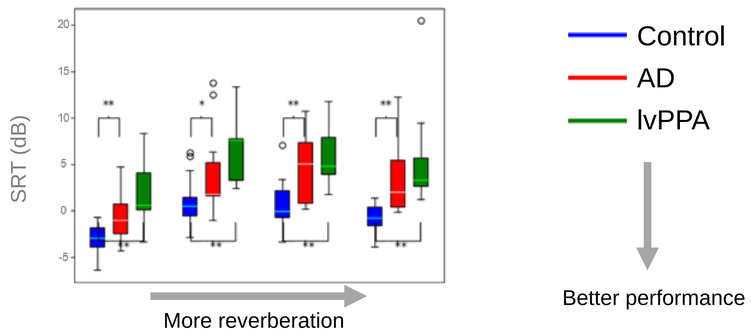
Each condition had 40 trials. In each trial, the participant heard the following sentence and was asked to repeat the target word

Now we will say [target word] again

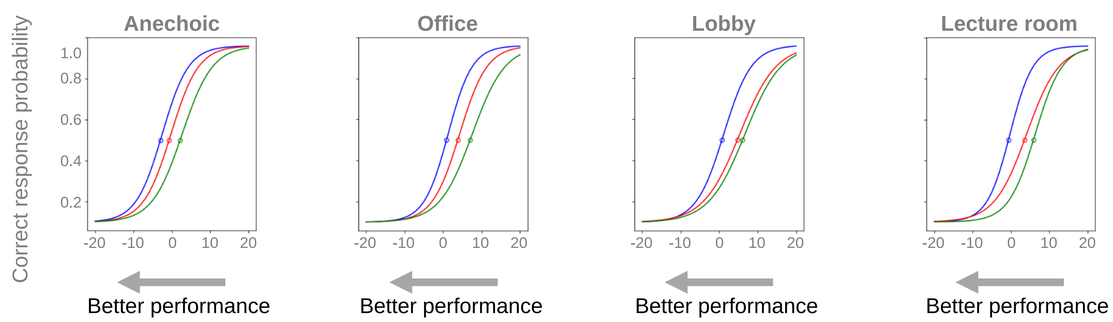
The level of reverberation remained the same in each condition, but the **level of background noise varied** using an adaptive staircase

RESULTS

Final speech reception threshold (SRT) per reverberation condition



Mean psychometric functions



CONCLUSION

Increased reverberation reduced task performance in all groups, with the AD and, particularly, lvPPA groups performing significantly less well than controls across all conditions. Furthermore, a qualitative interpretation of the initial psychometric functions is that patient groups may have a slower rate of adaptation to increased noise at higher levels of reverberation compared to controls, as indicated by the gradient of the curves, but this warrants further investigation. Our findings illustrate how novel virtual digital techniques can capture impaired real-world listening function in people with lvPPA and AD. Further work is warranted to assess how acoustic features in virtual everyday acoustic environments may best inform the development of bespoke communication interventions in people living with dementia.

REFERENCES

[1] Holmes & Griffiths (2019). Scientific Reports, 9(1), 16771-11. [2] House et al. 1963. The Journal of the Acoustical Society of America, 35(11_Supplement), 1899. [3] Dubois et al. 2014. The Lancet Neurology 13(6), 614-29. [4] Gorno-Tempini et al. 2011. Neurology 76(11), 1006-14.

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