Participants were significantly faster at responding correctly in the 'Easy' listening condition compared to the 'Hard' listening condition (Zekveld et al, 2010).

Response time during a listening task may also provide information about the perceptual effort required in various listening conditions (Gatehouse & Gordon, 1990).

Currently, little is known about how speech representation may be affected by adverse listening conditions. This study adopts a novel listening task (speech-picture verification) to uncover the effect of adverse listening conditions on speech representation and pupillometric measures of listening effort in young adults.

Method

Participants
N = 8; No reported hearing loss; Aged 18 - 40 years; 4 males and 4 females.

Stimuli and Design
Novel speech passages (see ‘figure 1’ for example) were recorded by a female speaker and digitally mixed with multi-talker babble to create two listening conditions:
• Easy (+15 dB SNR)
• Hard (-4 dB SNR)

Each experiment consisted of 92 trials; 46 in the ‘easy’ listening condition and 46 in the ‘hard’ listening condition.

Half (23) of the trials in each listening condition were ‘yes’ (experimental) trials, and the other half were ‘no’ (filler) trials.

For the experimental ‘yes’ response trials, images presented after the speech in noise either matched the implied shape and/or orientation of the artefact described in the speech (match) or did not (mismatch) (see ‘figure 1’ for example).

Procedure
• For each trial, participants were presented with a speech-in-noise passage
• Following each passage, an image appeared on the screen (e.g. one of the images in ‘figure 1’)
• Participants were required to indicate by pressing ‘yes’ or ‘no’ on a button box whether or not the image presented was mentioned in the previous speech passage
• Participants were asked to respond as quickly and accurately as possible. Response accuracy and latency was automatically recorded
• Using an eyetracker, the participant’s pupil response was automatically recorded

Results and Discussion

Behavioural findings
All participants performed at ceiling level (≥ 95% accuracy).

Participants were significantly faster at responding correctly in the ‘easy’ listening condition compared to the ‘hard’ listening condition (F = 7.84, p = .031, d = .46).

This supports findings reported by Gatehouse & Gordon (1990) that response time may be more sensitive to differences in the relative ease of listening than performance accuracy alone.

Pupilmetry findings
Each value was calculated as the relative change from baseline (2 seconds of silence preceding speech-in-noise onset) to the pupil response throughout speech passage.

No significant difference in the latency to maximum pupil size change between ‘easy’ and ‘hard’ listening conditions (F = .754, p = .419).

No significant difference in the latency to maximum pupil size change between ‘easy’ and ‘hard’ listening conditions (F = 1.148, p = .325).

The mismatch effect in the ‘easy’ listening condition is nearing significance (F = 4.80, p = .071, d = .38).

The interaction effect between ‘experimental condition’ (match/mismatch) and ‘listening condition’ (easy/hard) is also nearing significance (F = 3.15, p = .119, partial η² = .31).

This suggests that participants are forming more accurate representations of speech information in the ‘easy’ compared to the ‘hard’ listening condition.

Conclusions

• In support of Gatehouse & Gordon (1990), response times may reveal differences in the ease of speech processing between more (and less) adverse listening conditions
• Adverse listening conditions may negatively affect one’s ability to accurately represent speech information
• Based on these early findings, it remains unclear whether or not pupillometric methods can provide an objective measure of listening effort

References


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