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Listening Effort and Speech Intelligibility in Quiet and in Noise in Normal Hearing Adults

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INTRODUCTION

- The "cocktail party" effect is a term that is commonly used to describe noisy environments, where a person is trying to listen and attend to one target talker, while at the same time ignoring other speech and noise[1].

- **Multi-source auditory environments** require individuals to exert more effortful listening than quiet environments with only one auditory source.

- **Listening effort** can be described as "a component of auditory perception involving cognitive processing or cognitive load".[2]
  - **Pupillometry**, a way to capture change in pupil dilation, is an objective measure that is used to quantify listening effort.

Less effort

More effort

Purpose

The overall **purpose** of this project was to investigate listening effort and speech intelligibility for normal hearing adults when listening to speech in noise.

- These results helped to develop and solidify a testing paradigm that will be later used to assess listening effort and speech intelligibility in children and adults with hearing loss. This is a pilot study and the results can be used in future studies with hearing impaired listeners.

METHODS

- *Participants*
  - 2 adults with normal hearing
    - TJA: 19 years old, female
    - TAW: 25 years old, female
- *Stimuli*
  - **Target:** Harvard IEEE sentences[5]
    - Example: "It snowed, rained, and hailed the same morning."
  - **Masker:** AzBio sentence corpus[6]
    - Example: "I baked those cookies myself."
- *Procedure*
  - Participants sat in a soundproof booth with their head in a chin rest.
  - They were instructed to fixate their gaze on a small cross in the center of the computer screen.

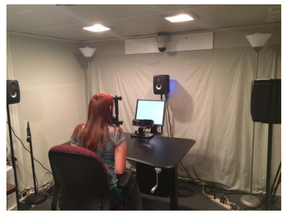


Figure 1. Participant in experimental testing soundproof booth sitting comfortably with head placed in the chin rest.

  - During the presentation of auditory stimuli, the EyeLink 1000 Plus recorded pupil dilation.

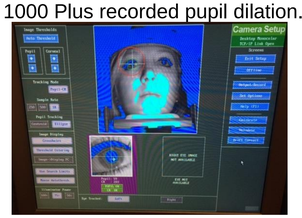
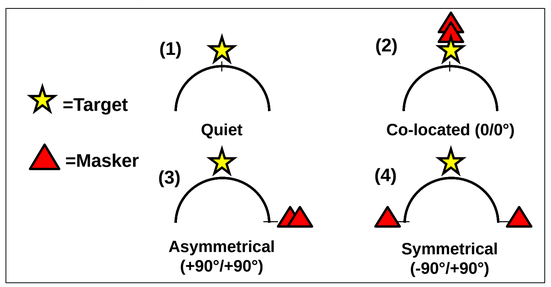
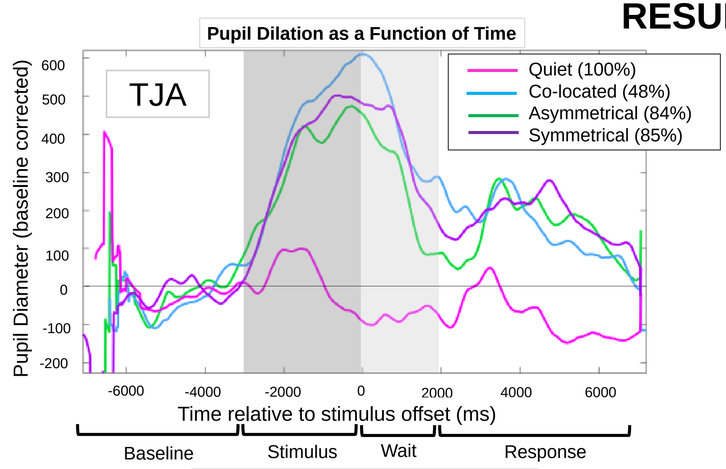


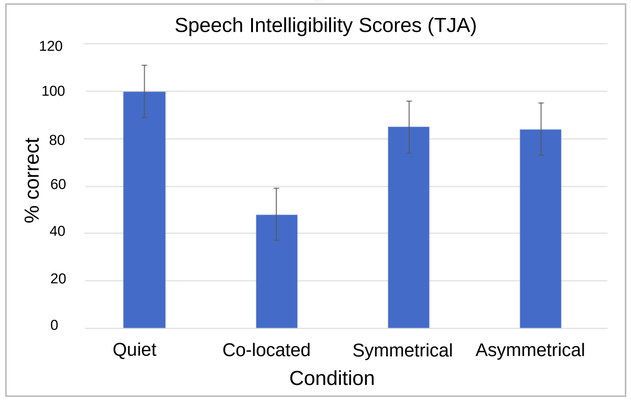
Figure 2. The examiner's view of the participant's pupil from the EyeLink's infrared camera.

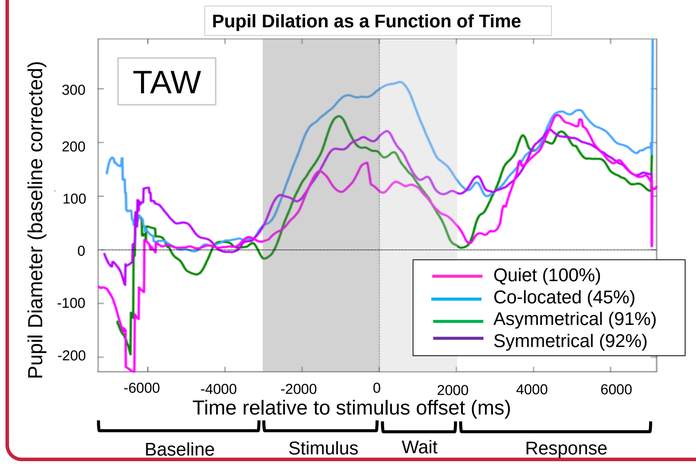
  - Auditory stimuli (target, masker) were presented in one of 4 conditions: (1) Quiet, (2) Co-located, (3) Asymmetrical, (4) Symmetrical (*shown below*)
    - 30 sentences were presented/condition
    - Speech intelligibility scores and pupil dilation was averaged within each condition.

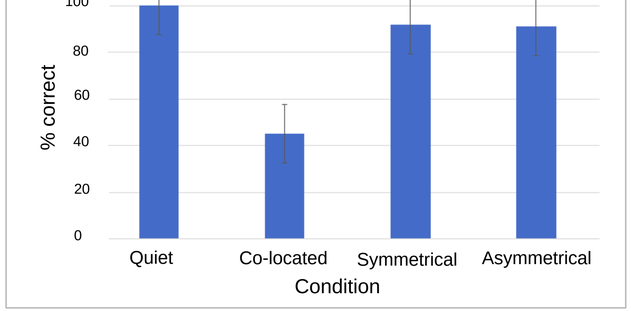


RESULTS









DISCUSSION

- Both participants scored 100% for speech intelligibility in the quiet condition and demonstrated little or almost no change in pupil dilation from the baseline pupil diameter.
  - This suggests that in quiet environments individuals with normal hearing are able to successfully understand speech, even with little listening effort.
- In the most difficult condition, when the target and maskers were co-located, both subjects demonstrated the most listening effort and the lowest speech intelligibility scores.
  - These results suggest that in the absence of spatial cues (i.e. spatial separation of the target and the maskers) understanding the target speech is very difficult, even when a large amount of listening effort is exerted.
- Both participants demonstrated similar speech intelligibility scores in the symmetrical and asymmetrical (only 1% difference in scores).
  - However, when maskers were directed to both ears, in the symmetrical condition, subject TJA demonstrated more listening effort overall than in the asymmetrical condition, with maskers only directed to one ear. This suggests that pupillometry may help to reveal binaural benefits that are not always captured with speech intelligibility scores alone.

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