

**LISTENING EFFORT BETWEEN AUDITORY-ONLY, VISUAL-ONLY, AND AUDITORY-VISUAL SPEECH PERCEPTION IN NORMAL HEARING LISTENERS AS MEASURED USING PUPILLOMETRY**

**Saiful Adli Jamaluddin**<sup>1\*</sup>, Nur Asyiqin Khairol Azmi<sup>1</sup>, Mohd. Zulfaezal Che Azemin<sup>2</sup>, Nurlin Ali Hanafiah<sup>1</sup>, Greg O'Beirne<sup>3</sup>

<sup>1</sup>Department of Audiology and Speech-Language Pathology, Kulliyah of Allied Health Sciences, International Islamic University Malaysia, Kuantan, Pahang, Malaysia.

<sup>2</sup>Department of Optometry and Visual Sciences, Kulliyah of Allied Health Sciences, International Islamic University Malaysia, Kuantan, Pahang, Malaysia.

<sup>3</sup>Department of Speech and Hearing, School of Psychology, University of Canterbury, New Zealand.

\*Corresponding author's email: [jsaiful@iium.edu.my](mailto:jsaiful@iium.edu.my)

**ABSTRACT**

**Background:** Listening effort is the purposeful allocation of the mental resources used to overcome difficulties when listening to speech in a noisy environment. Increased cognitive load may result in decreased speech perception performance and mental fatigue. Pupillometry can be applied to investigate listening effort where changes in pupil diameter can be measured as a function of cognitive load. This study aims to establish the baseline of listening effort in normal hearing young listeners in three modalities of speech perception which are auditory-only (A-only), visual-only (V-only), and auditory-visual (AV).

**Methodology:** In total, 10 participants aged between 22 and 25 years old with normal hearing were recruited in this study. The peak pupil dilation (PPD) and peak latency were recorded throughout speech perception trials which were presented monaurally in three different modalities: auditory-only, visual-only, and auditory-visual speech perception at three different signal-to-noise ratios (SNR).

**Results:** The PPD were largest in A-only modality at low SNRs. In contrast, no effect of PPD were observed in AV and V-only across SNRs. The peak PPD latency across SNRs in AV were inconsistent with previous studies. The finding suggests that the PPD increased significantly with decreasing SNR in A-only modalities.

**Conclusion:** The finding of this study showed PPD, and peak latency systematically increases as SNR decreases in A-only modality, revealing more cognitive effort is exerted at acoustically demanding conditions. Additional data may help to further explore the relationship between listening effort and speechreading.

**Keywords:** listening effort, pupillometry, speech perception

