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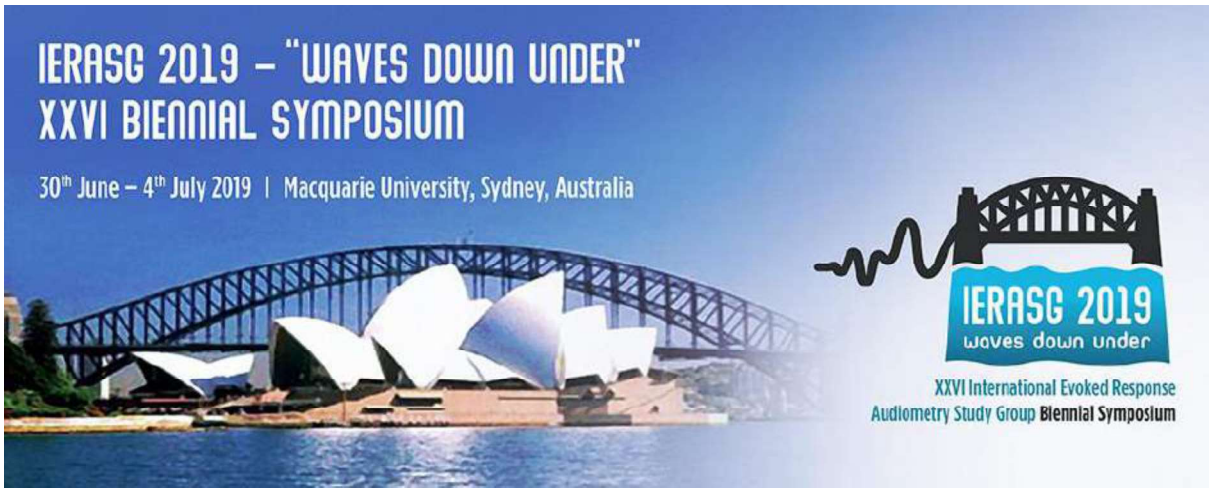
PROGRAM & ABSTRACTS



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Towards the recording of brainstem and cortical evoked potentials from the fine structure of natural speech.

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Background Auditory evoked potentials (AEPs) are typically elicited by artificial stimuli like clicks or tone bursts. However, these stimuli do not represent real-world sounds and do not characterize how the auditory system of an individual encode speech. This research presents a novel procedure to obtain both brainstem and cortical neural activity evoked from the glottal pulses of real running speech.
Methodology Eight normal-hearing adults (3 females, [24-56] year) listened to 80 short sentences of unprocessed speech while their electroencephalogram (EEG) was being recorded. Signalprocessing analysis consisted of: (1) identifying the time instants in the speech stimulus signal in which the glottal pulses occurred; (2) categorizing the pulses according to their preceding ISI [based on a pilot study using bursts of clicks, we predicted that AEPs from the pulses with a preceding interstimulus interval (ISI) larger and shorter than 1 second would show different levels of adaptation]; and (3) applying the iterative-randomized stimulation and averaging (IRSA) method to deconvolve (or disentangle) the two types of overlapping evoked potentials. AEP signals were represented in the logarithmic time scale in order to facilitate the evaluation of brainstem and cortical components simultaneously.
Results As predicted, the morphology of the two AEPs was notably different. On the one hand, the AEP obtained from the glottal pulses with long preceding-ISI presented a large-magnitude cortical response, consistent with the cortical auditory evoked potential (CAEP) N1-P2 component, as well as earlier evoked potentials whose latencies were consistent with the middle latency response (MLR) components. On the other, the AEP resulting from pulses with short preceding-ISI showed early components consistent with the waves I to V of the auditory brainstem response (ABR), as well as later components consistent with adapted MLR and CAEP.
Conclusions Taken together, these results indicate that the proposed methodology is adequate to evaluate brainstem and cortical evoked activity from unprocessed natural speech. This tool provides a more accurate modelling of how the auditory system encodes speech, and may facilitate objective tests of attention and language comprehension. In addition, results also point out that natural speech evokes AEPs of different morphology, thus the assumption of a single-type neural response typically made in speech-evoked AEPs should be reconsidered.
Research highlights
1. We present a methodology that allows the simultaneous evaluation of brainstem and cortical neural activity evoked by the fine-structure of natural speech.
2. The fine-structure of speech evokes auditory evoked potentials with different morphology, thus the single-type-response assumption typically made in studies evaluating speech evoked AEPs should be reconsidered.
3. This tool may provide a more accurate modelling of how the auditory system encodes speech; and may facilitate the development of objective tests of attention and language comprehension.
Keywords speech-evoked neural response; speech fine-structure; brainstem and cortical evoked potentials.