

processing (CAP) (Musiek, 2007; Katz, et al., 2009); furthermore, they complain of difficulty in understanding speech in noisy environments (signal degradation and/or competitive noise) (Schochat, 1997; ASHA, 2005). Musiek & Baran (2001) consider that the use of a set of tests – including behavioural and electrophysiological tests – in a CAP assessment is wise and necessary. So far the N400 has been excluded from most CAP assessment protocols.

Objective: To assess the semantic auditory processing in individuals with and without APD using behavioral and electrophysiological tests.

Methods (behavioral): The sample was 37 adults who were Portuguese native speakers (3 with confirmed diagnosis of APD). In a semantic categorization task subjects listened to a series of words denoting entities belonging to a lexical field (objects, fruits, animals); three words in the series belonged to the same field and a fourth unrelated item belonged to another semantic field (total 236). Subjects had to decide via a button box whether the word heard belonged to the current semantic field or not. Reaction times (RT) and accuracy were recorded.

Methods (electrophysiological): Another sample of 21 adults (3 with APD); experimental conditions as above were adapted for ERP methodologies.

Results: In the behavioral tests, individuals without APD produced 85.7% correct answers, being faster at congruous items than at incongruous ones (574.55 ms vs. 624.97 ms), a statistically significant difference. Individuals with APD presented 92.8% correct answers, but their results did not point in the same direction as the previous group, as they had faster RT for the incongruous words compared to the congruous ones (615.66 ms vs. 671.81 ms). The electrophysiological data (ERPs) showed that in individuals without APD the N400 appeared in the recording channels F3, T3, T5, Cz, and T4. Such an effect was not observed in individuals with APD.

Conclusions: In the behavioral tests individuals without APD were faster in congruence situations. In the ERP studies, the N400 appeared for incongruous words in F3, T3, T5, Cz, and T4. For individuals with APD, the incongruence seemed to contribute to a faster decision, registered in the behavioral tests, in the same way as the ERPs, with the observation of more positive waves for the incongruous items. These observations raise the hypothesis that the processing of meaning in speech perception is qualitatively different in APD subjects, and underlines the importance of including the N400 ERP semantic testing in CAP assessment.

Cognitive Auditory Evoked Potentials: Advances and Insights in Neuroaudiology

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Clinicians can now assess the peripheral auditory pathway with fair precision and reliability. There are psychoacoustic

methods, such as pure-tone and speech audiometry, physiological methods, such as otoacoustic emissions and immittance measures, and electrophysiological techniques such as auditory brainstem response. However, it is in the auditory cortex that auditory and language neuroprocessing takes place. Auditory event-related potentials (AERPs), interpreted via cognitive psychophysiology, provide a theoretical rationale for assessing and investigating auditory linguistic neuroprocessing. This is important when we wish to consider clinical conditions which display language and auditory processing impairments, such as certain neurodevelopmental disorders.

AERPs are changes in the ongoing EEG which are time- and phase-locked. They reflect sensory central processing and cognitive activity, which might involve memory, expectation, attention, or changes in mental state. AERPs are one of the most informative, dynamic, and non-invasive methods for studying cognition and the dynamics of neural systems. They provide a continuous measure of processing between stimulus and response, revealing neural reactions not evident in behavior. Processing can also be measured under conditions that do not normally involve a behavioral response, and under some conditions neural systems can be identified. Moreover, its high temporal resolution (milliseconds) facilitates capture and study of neural processes such as auditory and language processing.

Here we draw attention to achievements in understanding the neurofunctional meaning of each AERP component. N1 reflects pre-attentive discrimination and early synchronization between primary and secondary auditory cortices in the lateral and supratemporal planum (Liasis et al., 2006). The significance of P2 is largely unknown, but it is reduced in schizophrenia (Salisbury et al., 2010). The N2 (N2b) is interpreted as a correlate of the controlled detection of stimulus changes and phonological categorization (Amenedo & Díaz, 1998). MMN currently provides an objective measure of auditory perception and discrimination based on the presence of short-term memory (sensory memory; Näätänen, 2001). P3a is related to the engagement of attention, especially orienting, involuntary shifts to changes in the environment, and the processing of novelty (Donchin, 1981). P3b is widely studied in terms of information processing, decision making, and can even measure how demanding a task is cognitively (Polich, 2007).

Other AERPs peaking after 300 ms are widely studied as endogenous language-related components, and are not studied with auditory oddball. The N400 response is seen in response to all meaningful or potentially meaningful stimuli, thus indexing semantic processing (Kutas & Hillyard, 1980). Lastly, the P600 or syntactic positive shift (SPS) is a late centroparietal positivity associated with the processing of syntactic anomalies (Friederici, 1995). A fundamental goal is understanding the basic neural processes which underpin more complex cognitive systems and operations. In terms of assessing central auditory processing, audiology can contribute significantly to cognitive neuroscience.