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ORIGINAL ARTICLE

Mismatch negativity in children with specific language impairment and auditory processing disorder☆

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KEYWORDS
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Abstract
Introduction: Mismatch negativity, an electrophysiological measure, evaluates the brain's capacity to discriminate sounds, regardless of attentional and behavioral capacity. Thus, this auditory event-related potential is promising in the study of the neurophysiological basis underlying auditory processing.
Objective: To investigate complex acoustic signals (speech) encoded in the auditory nervous system of children with specific language impairment and compare with children with auditory processing disorders and typical development through the mismatch negativity paradigm.
Methods: It was a prospective study. 75 children (6–12 years) participated in this study: 25 children with specific language impairment, 25 with auditory processing disorders, and 25 with typical development. Mismatch negativity was obtained by subtracting from the waves obtained by the stimuli /ga/ (frequent) and /da/ (rare). Measures of mismatch negativity latency and two amplitude measures were analyzed.
Results: It was possible to verify an absence of mismatch negativity in 16% children with specific language impairment and 24% children with auditory processing disorders. In the comparative analysis, auditory processing disorders and specific language impairment showed higher latency values and lower amplitude values compared to typical development.
Conclusion: These data demonstrate changes in the automatic discrimination of crucial acoustic components of speech sounds in children with specific language impairment and auditory processing disorders. It could indicate problems in physiological processes responsible for ensuring the discrimination of acoustic contrasts in pre-attentional and pre-conscious levels, contributing to poor perception.

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PALAVRAS-CHAVE
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Transtornos do desenvolvimento da linguagem

Mismatch negativity em crianças com distúrbio específico de linguagem e transtorno do processamento auditivo

Resumo
Introdução: Mismatch Negativity (MMN), uma medida eletrofisiológica, mede a habilidade do cérebro em discriminar sons, independente da capacidade atencional e comportamental. Assim, esse potencial mostra-se promissor no estudo das bases neurofisiológicas que subjaz o processamento auditivo.
Objetivo: Investigar a discriminação de sinais acústicos complexos (fala) no sistema auditivo por meio do MMN, com crianças com distúrbio específico de linguagem (DEL), comparando com transtorno do processamento auditivo (TPA) e desenvolvimento típico (DT).
Método: Estudo Prospectivo. 75 crianças (6-12 anos) participaram deste estudo: 25 crianças com DEL, 25 com TPA e 25 em DT. O MMN foi obtido por meio da subtração das ondas obtidas pelos estímulos/ga/(frequente) e/da/(raro). Foram analisadas as medidas de latência do MMN e duas medidas de amplitude.
Resultados: Foi possível verificar ausência do MMN em 16% no TPA e 24% DEL. Na análise comparativa, os grupos TPA e DEL apresentaram maiores valores latências e menores valores de amplitude em relação ao DT.
Conclusão: Estes dados demonstram uma alteração na discriminação automática de componentes acústicos cruciais dos sons de fala em crianças com TPA e DEL, o que poderia indicar alterações nos processos fisiológicos responsáveis pela discriminação precisa de contrastes acústicos em níveis pré-atencionais e pré-conscientes, contribuindo para uma percepção deficiente.

Introduction

Abnormalities in auditory temporal processing have been one of the main theories used to try to explain the etiology of language development disorders. This theory suggests that one of the causes for language development disorders (among them, specific language impairment [SLI]) is related to changes in the ability to process sounds and abnormalities in neural coding of auditory information,[1–3] contributing to changes in the perception of fundamental acoustic cues in speech sound signals.

Despite nearly a century of research, no consensus has yet been reached on the physiological basis of causality concerning this language development disorder, as the results of studies have failed to find evidence of changes in the auditory processing of children with SLI.[4,5] Therefore, the etiological causes of language development disorders still remain controversial.

Although studies using behavioral measures have shown inconsistent results, electrophysiological evaluations been proven to be ideal for investigating the neural bases of speech perception; they due not interfere with the subjective behavioral response and are independent of it and they are useful in establishing anatomical and functional associations in the human auditory system.[6]

Mismatch negativity (MMN) is an electrophysiological measure that reflects the brain's capacity to discriminate sounds, regardless of the individual's attentional and behavioral capacity. Initially described by Näätänen et al.[7] (1978), MMN is a cortical evoked potential that is detectable when a change occurs in the middle of a sequence of repeated acoustic stimuli.[8,9]

Characterized by a negative deflection that occurs after the P2 response, MMN usually occurs between 150 and 250 ms after the stimulus presentation, with latency and amplitude varying, depending on the stimulus.[10–12]

Most studies use simple paradigms, in which frequent and infrequent stimuli (e.g., 1000 Hz and 1100 Hz tones, respectively) are presented in an oddball paradigm, similar to that used for the P300, with the infrequent stimulus eliciting MMN.[7,10,12,13]

However, MMN can also be elicited by changes in complex stimuli such as speech sounds.[14–18] The speech signal consists of harmonically rich elements that change rapidly with respect to frequency. This complex, spectrum-temporal structure requires neural integrity for accurate coding of its signal.[19] The acoustic properties of speech sounds are encoded at all levels of the auditory system and these acoustic parameters are represented differently along the auditory pathway. Additionally, there is evidence that they are probably modified at each level of the auditory nerve pathway.[20] Thus, simultaneous and coordinated activation of large and different populations of neurons is required for speech processing and understanding, from the eighth cranial nerve signal transduction to the cortex.[19]

Based on previously established associations, this study aimed to assess the discrimination of complex acoustic signals (speech) in the auditory system through MMN in individuals with specific language impairment (SLI), compared to children with auditory processing disorder (APD) and typical development (TD).

Methods

This study was approved by the Research Ethics Committee, Protocol #1049/07. Parents or guardians were instructed regarding the study procedures and signed an informed consent.