

# Early electrophysiological markers in language and learning impairment: long-term follow-up from infancy to school age

**Background:** Auditory processing skills are critical for speech perception, language development, and reading acquisition. Infants with a family history of language and learning impairments (LLI), including language disorders and reading disabilities, often show deficits in these skills, reflected in electrophysiological anomalies of obligatory components (e.g., P1, N2) and the MisMatch Response (MMR). Longitudinal studies have demonstrated that early auditory processing strongly predicts later language and reading development.

**Methods:** We report findings from a large Italian longitudinal study. Approximately 150 infants with and without familial risk for LLI (defined as having a first-degree relative affected) were tested at 6 months of age using an electrophysiological auditory multi-feature oddball paradigm with non-speech stimuli presented in rapid succession. Children were subsequently assessed for language skills at 20, 24, and 36 months, for a broad range of neuropsychological and pre-reading skills at 4.5 and 5.5 years, and for reading ability at 8 years.

**Results:** The electrophysiological MMR component measured at 6 months was significantly associated with later language, phonological awareness and reading skills. Linear regression analyses showed that early auditory processing accounted for 38.5% of the variance in reading performance (reading time). The inclusion of phonological awareness abilities measured at ages 3, 4, and 6 increased the model's predictive power by 39.2%, confirming their mediating role. Path analysis revealed both direct effects of early auditory processing on reading and indirect effects mediated by phonological awareness skills.

**Conclusions:** Our findings demonstrate that early acoustic discrimination abilities measured in infancy predict reading skills eight years later through both direct and indirect pathways. These results lay the foundation for more complex developmental models capable of identifying diverse developmental trajectories in both typical and atypical populations.

**Keywords:** Auditory processing, language and reading skills, phonological awareness, EEG/ERP, developmental trajectories.