ERP responses to lexical-semantic processing differentiate toddlers at high clinical risk for autism and language disorder

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Delays in early expressive vocabulary are among the most common reasons motivating diagnostic evaluation (Morgan et al., 2020). These symptoms might be the first signs of the presence of a neurodevelopmental disorder, including developmental language disorder or Autism Spectrum Disorder (ASD). Although many typical symptoms can differentiate children with early signs of ASD from those who specifically show delays in language development, the two populations show striking similarity when focusing only on the observed language impairment (Paul et al., 2008). It seems important to determine how the brains of these young children in the early phases of language acquisition work. We expected differences between groups suggesting different mechanisms in processing words in meaningful contexts.

Here, we directly compared two groups of 19-month-old toddlers identified via clinical assessment as being at risk for such neurodevelopmental disorders, i.e., children characterized by low expressive vocabulary (LDS score $\leq$ 15° percentile; Late Talkers, LT, N=18), children with early symptoms of ASD (ADOS-2 total score $\geq$ 6; ASD, N=18), and a group of typically developing children (TD, N=28). Specifically, we investigated the electrophysiological underpinnings of the (dis)ability to establish the first lexical–semantic representations during the critical phase of lexical acquisition, with the aim of identifying similarities and specificities among these groups in lexical-semantic processing. Event-Related Potentials (ERPs) elicited by words (either congruous or incongruous with the previous picture context; Match or Mismatch, M vs. MM) and pseudo-words (PW) are investigated within a picture-word matching paradigm (Cantiani et al., 2017) in the three groups, considering the three specific ERP components reported in toddlers for similar tasks (i.e., phonological-lexical priming effect; N400; Late Positive Component), and investigating longitudinal intra-group associations with language and socio-communications skills at age 24 months.

As expected, we found differences between the groups that might underlie specificities, but also similarities. Whereas no or subtle differences emerged across groups concerning the N400 component, the two clinical groups differed significantly from the typically developing group in the other two ERP components. On the one side, the LT group differed from the other two groups in the phonological-lexical priming effect, reflecting detection of the correspondence between the heard word and the lexical representation pre-activated by the picture ($F(4,103) = 2.998$, $p = .029$, $\eta^2 = .089$). Specifically, they showed no evidence for this effect (see Figure 1), suggesting that they miss the early automatic recognition of incongruencies between what is heard and what is expected (e.g., Torkildsen et al., 2009). On the other side, the ASD group differed from the other two groups in the Late Positive Component, reflecting the effortful semantic reanalysis following a violation ($F(2,61) = 4.306$, $p = .018$, $\eta^2 = .124$). Specifically, they were characterized by a complete lack of such component (see Figure 2), indicating that higher-level processing mechanisms of re-analysis of the violation are missing in this population (e.g., DiStefano et al., 2019). The functional interpretation of the two components is corroborated by significant correlations suggesting that the early component is associated with later socio-communication skills whereas the late component is associated with linguistic skills.

The results point in the direction of differential impaired mechanisms in the two populations (i.e., impaired automatic detection of the incongruences in LT vs. absence of high-level reanalysis of such incongruencies in the children with early signs of ASD). The differential impaired mechanisms emerged in the present study could inform the definition of early interventions for populations at high risk for neurodevelopmental disorders because showing the very first clinical signs.

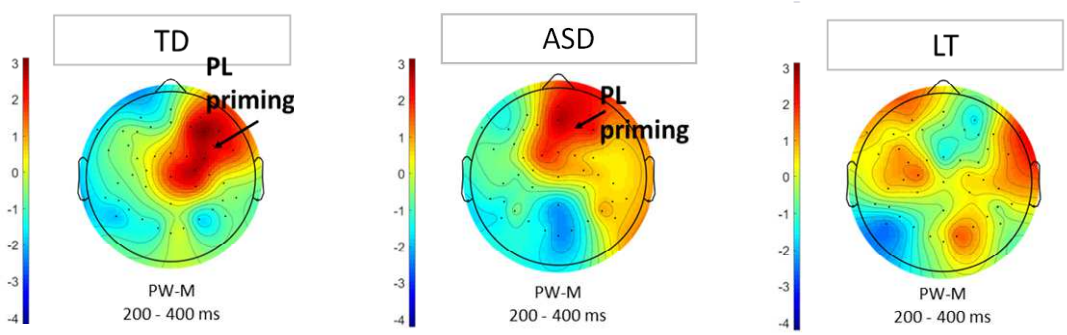

Figure 1. Topographical maps relative to the Phonological-Lexical priming effect. Distribution of difference waveforms (PW-M) is shown for the selected Time-Windows (200-400 msec).

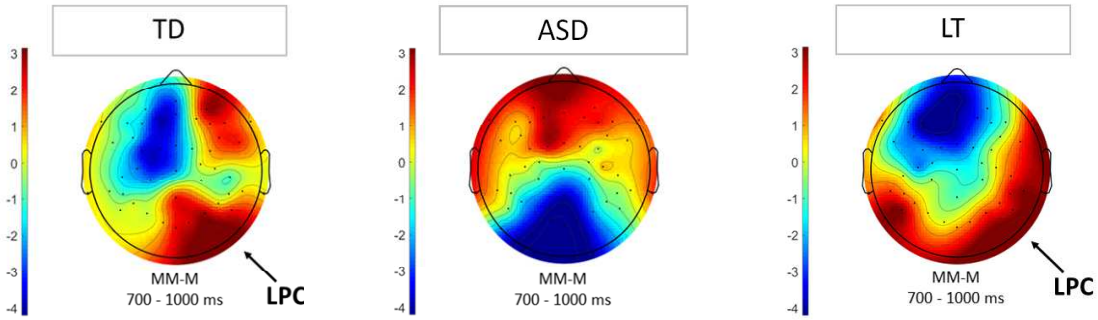

Figure 2. Topographical maps relative to the LPC. Distribution of difference waveforms (MM-M) is shown for the selected Time-Windows (700-1000 msec).

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