Same processing costs for encoding sameness and difference in the developing brain: An fNIRS study with 6-7-month-olds

Silvia Rădulescu (Utrecht University), Sergey Avrutin (Utrecht University), Frank Wijnen (Utrecht University), Judit Gervain (CNRS Paris)
S.Radulescu@uu.nl

Introduction. How does encoding of linguistic regularities such as identity (e.g. ABB "wo fe fe") develop in infancy? Previous research suggested different cognitive mechanisms, such as perceptual identity detection (Endress et al. 2007) and abstract rule learning (Marcus et al. 1999) to account for the encoding of repetition-based regularities. The nature, the developmental trajectory and the neural correlates of these mechanisms remain heatedly debated. Here we tested whether and how 6-month-old infants, never tested before in such tasks, are able to discriminate repetition-based linguistic regularities (ABB, e.g. "bu ra ra") from random controls (ABC, e.g. "bu fa zo").
Methods. In an fNIRS study, 6-7-month-old infants (n=21) were exposed to a low complexity grammar (9 ABBs & 9 ABCs, 2x) and a higher complexity grammar (18 ABBs & 18 ABCs, 1x). In a simple block design, infants were exposed sequentially to both grammars in a balanced order. We used a NIRx NIRScout 8-8 system with a source-detector separation of 3cm, using two continuous wavelengths of 695nm and 830nm. The channels were overlaid on the temporal, parietal and frontal areas.
Results. The channel-wise *t*-tests revealed significant activation compared to baseline for both the ABC and ABB conditions in channels 2, 6, 14, and 17. However, overall there was no significant difference between ABB and ABC conditions, or between low and high complexity stimuli (Figure 1).
Discussion. These results suggest that both repetition and non-repetition patterns were being processed, but there was no significant difference in processing costs between them. In contrast to findings that showed different activation for repetition vs non-repetition grammars in newborns (Gervain et al. 2008), our results show similar processing demands for encoding both repetition/sameness and difference. This might point to a cognitive developmental change in rule learning between birth and 6 months when the encoding of difference comes online.

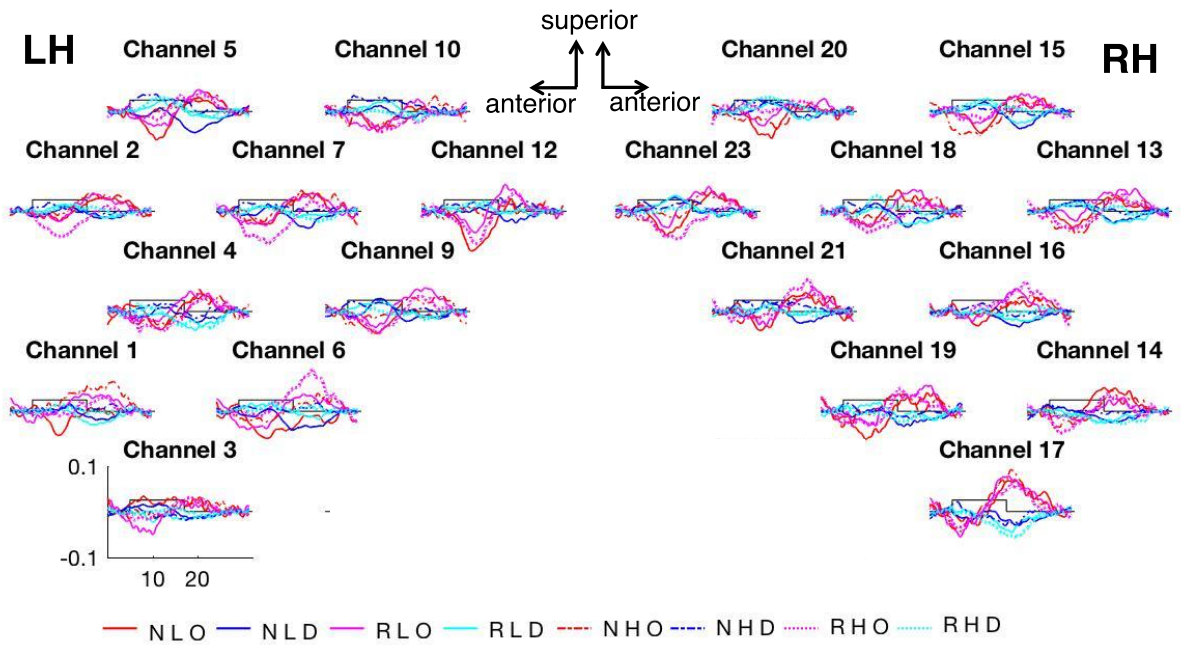

Figure 1. The NIRS responses obtained in the 4 experimental conditions. The x axis represents time in seconds, the y axis concentration change in mmol x mm. Legends: N: no repetition (ABC), R: repetition (ABB), L: low complexity, H: high complexity, O: oxyHb, D: deoxyHb