The impact of age of acquisition on the processing of agreement verbs in deaf children perceiving German Sign Language sentences

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Most deaf children are born into hearing families and are, therefore, at the risk of language deprivation meaning that they are not exposed to a fully accessible sign language from birth. Previous research on deaf adults has shown that the age of sign language acquisition (AoA) has long-lasting and pervasive effects on various aspects of sign language processing and comprehension including morphosyntax (e.g., Skotara et al., 2012, Cheng & Mayberry, 2019). Sign languages use the three-dimensional signing space to mark syntactic information. Agreement verbs move between locations in the signing space, that were linked with referents previously. Thus, the starting and end point of agreement verbs may mark the subject and object of an utterance. How deaf children process violations of these syntactic markings and how this is affected by delayed AoA has not been investigated yet using event-related brain potentials (ERP). During sign language processing of semantically or syntactically violated sentences, deaf adults with an early AoA demonstrate similar neural correlates as hearing adults for spoken languages (e.g., Capek et al., 2009; Hänel-Faulhaber et al., 2014). Deaf adults with a later AoA demonstrate comparable effects for semantically violated sentences, however, for syntactically sentences the LAN was absent and the P600 appeared with a different scalp distribution (Skotara et al., 2012). Whether similar neural correlates are present in deaf children using sign language and how AoA shapes potential effects is currently unknown. We hypothesized that deaf children would show an N400 for semantic violations and a P600 for morphosyntactic violations that might vary in latency and amplitude compared to deaf adults.

This ERP study investigated the neural processes engaged during sign language processing of agreement verbs in deaf children. Participants were 26 early signers (mean age = 9;11 years [8;7-11;11 years]), who were exposed to German Sign Language (DGS) before the age of three years (mean AoA = 10 months [0-30 months]), and 13 late signers (mean age = 10;6 years [8;6-11;11 years]), who acquired DGS after the age of three years (mean AoA = 5;5 years [3;0-8;1 years]). Children were presented with videos of 45 signed DGS sentences that were grammatically correct or contained either a semantic (implausible object) or a morphosyntactic violation (incorrect direction of movement). A probe verification task was used to keep the children engaged during the study. ERPs were recorded from 32 scalp electrodes.

We analyzed mean amplitudes from the point in time when the handshape of the verb sign was fully recognizable (target handshape) until 1000ms in 100ms time windows using generalized additive mixed effects models. The data in each time window was modeled as a function of electrode position and experimental condition. Early signers showed a higher negativity at central-posterior locations that was particularly pronounced between 500-600ms for semantic violations compared to correct sentences. Morphosyntactic violations compared to correct sentences elicited a central posterior distributed negativity between 600-700ms in early signers. Thus, deaf early child signers demonstrated an N400 effect for sentences containing semantic violations in a time window later than in adults, as previously shown for hearing children. However, deaf early signers differed from hearing children in the effects for morphosyntactic violations suggesting that deaf early signers process this violation more like a semantic violation.

By the time of the workshop, the data of the late signing children will be analyzed, which will allow for a comparison of effects in early and late signing children. Comparing signers that differ in their age of acquisition of a sign language allows to understand how language deprivation shapes neural mechanisms underlying language processing from an early age on.

References:

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