

Processing of subject-verb agreement by children with cochlear implants

This study investigates comprehension of subject-verb agreement by children with cochlear implants (CIs). We aim to find out (1) whether they use number information provided by verbal inflection for interpretation and (2) whether age, perceptual factors (like verb saliency) and cognitive factors (like digit span) play a role in their processing of subject-verb agreement.

Although typically developing children with normal hearing (NH) produce verb inflection correctly from an early age onwards (around 2) (for German: Rice, Noll & Grimm, 1997; Poeppel & Wexler, 1993; Verrips & Weissenborn, 1992), they show problems in the comprehension of verb inflection until the age of 5-6 (for English, Johnson et al., 2005; and Spanish, Perez-Leroux, 2006; but see Brandt-Kobebe & Höhle, 2010). For children with CIs, the subtle verb inflection may be even harder to comprehend, as their morpho-syntactic development is strongly influenced by the perceptual prominence of the morphological forms due to the degraded speech input (Svirsky, Stallings, Lento, Ying, & Leonard, 2002; Szagun, 2000). Furthermore, studying this group of children will further our understanding of the effects of auditory deprivation on sensitive periods of language development.

We tested 33 children with CIs (7;01-12;04, Mean: 9;07, implanted bilaterally before age 3) and 39 children with NH as a control group (age 6;05-10;09, Mean: 8;09). Eye-tracking was used in a two-picture selection task with one picture corresponding to the singular and another to the plural interpretation of the subject (see Figure 1). Sentences were presented auditorily, in which the number of the subject referent could be determined exclusively by the number marking on the finite verb, like in sentence (1).

- (1) Sie malt/malen die Prinzessin.
 ‘She/They paints/paint the princess.’

The results show that children with CIs performed significantly poorer (85% correct, in both singular and plural conditions) than children with NH (96% correct in both singular and plural conditions, GLMER: ($\beta = 1.48$, $z = 3.542$, $p < .001$). For children with CIs, hearing age ($\beta = 0.048$, $z = 3.069$, $p < .01$) and digit span scores ($\beta = 0.338$, $z = 2.690$, $p < .01$) were significant predictors. Furthermore, accuracy scores were lower on perceptually low salient forms (e.g., *filmt* ‘films’ vs. *filmen* ‘film’) than on perceptually high salient forms (i.e. with vowel change e.g., *fängt* ‘catches’ vs. *fangen* ‘catch’) ($\beta = 1.09$, $z = 2.246$, $p < .05$). At the moment, the gaze data is being analyzed to gain more insight into the online processing of subject-verb agreement.

Overall, our study shows that children with CIs are less sensitive to number information provided by the verb than children with NH. The correlation found with hearing age indicates that the underlying knowledge is immature, but not necessarily impaired. Furthermore, we found that perceptual and cognitive factors play a role in the processing of subject-verb agreement. These results will be discussed with regard to their implications for theories on a sensitive period.



Figure 1. Example of a picture pair, the left picture matches the single-subject interpretation, the right picture matches the plural-subject interpretation of sentence (1) Sie malt/malen die Prinzessin 'she/they paint(s) the princess'.

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