International Journal of Pediatric Otorhinolaryngology 79 (2015) 561–569

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Noun plural production in preschoolers with early cochlear implantation: An experimental study of Dutch and German

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ARTICLE INFO

Article history:
Received 22 October 2014
Received in revised form 22 January 2015
Accepted 25 January 2015
Available online 31 January 2015

Keywords:
Cochlear implantation
Language development
Elicitation task
Noun plurals
Dutch and German

ABSTRACT

Objectives: Studies investigating language skills of children after cochlear implantation usually present general measures of expressive/receptive vocabulary and grammar and rarely tackle the acquisition of specific language phenomena (word classes, grammatical constructions, word forms, etc.). Furthermore, research is largely restricted to children acquiring English. Cross-linguistic comparisons among children acquiring different languages are almost inexistent. The present study targets the acquisition of noun plurals (e.g., *dogs*, *balls*) by Dutch- and German-speaking children implanted before their second birthday. Given its structural complexity and irregularity, noun plural formation is a good indicator of grammatical proficiency in children at risk for a developmental delay.

Methods: The study sample consisted of 14 cochlear-implanted (CI) children ($M = 55$ months of age), 80 age-matched normally hearing (NH) controls, and 40 normally hearing controls matched by Hearing Age (HA). The children were administered an elicitation task in which they had to provide plural forms to a set of singular nouns. The analysis focussed on the following variables: Hearing status (CI, NH), Language (Dutch, German), and Suffix Predictability/Stem Transparency of the plural words.

Results: There was no significant difference between children with CI and their NH peers in correct plural production. In both child groups, plural responses followed the predicted pattern of Suffix Predictability/Stem Transparency. However, children with CI significantly more frequently replied to the test item with a recast of the singular noun instead of the plural, and the probability of these responses increased with later age of CI implantation. Furthermore, Dutch-speaking children showed an overall better performance than German-speaking children.

Conclusions: The findings suggest that after 3 years of implant use, preschoolers with early cochlear implantation show age-appropriate patterns of noun plural formation, but still have to catch up with respect to associating a particular singular with its plural form.

1. Introduction

1.1. Language development after cochlear implantation

Nowadays, many profoundly deaf children are given access to auditory information by means of a cochlear implant (CI). Thanks to this device, these children are able to develop speech and language skills that often surpass those of children using hearing aids [1–3]. It is, however, not surprising that cochlear implanted children often display significant delays in the acquisition of both vocabulary and grammar, as compared to their normally hearing (NH) peers [4–6]. The acquisition of spoken language grammar by children with CI was shown to be significantly delayed, especially in the domain of bound morphemes and function words, such as determiners, copulas, and modal verbs [7–12]. These elements are often/mostly unstressed, perceptually less salient, and hence, less easily identifiable for children with a hearing impairment.

Most studies thus far have presented a very broad picture of language development in the CI population, presenting general measures of expressive/receptive vocabulary and grammar [3,13–17]. There have been relatively few attempts to trace the development of specific language phenomena, such as the acquisition of noun, verb, or adjective morphology [7,8,18–20]. Moreover, most published results on children with CI include English-speaking children and may not be directly applicable to

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http://dx.doi.org/10.1016/j.ijporl.2015.01.029
0165-5876/

deaf children who are acquiring other languages. Cross-linguistic comparisons among children with CI acquiring different languages are almost non-existent.

Another point of interest concerns the impact of Age-At-Implantation on children's speech and language skills. Early implantation results in a shorter period of sound deprivation and, thus, a longer auditory experience. Studies have demonstrated that children who received a CI by 24 months made better linguistic progress than children who were implanted thereafter [21–24]. Moreover, there has been found evidence that further improvement may come from implantation in the first year of life [25]. Another observation repeatedly made in the literature is that there exists high inter-individual variability in the performance of children with CI [5,17,21,26].

1.2. The acquisition of noun plurals by children with CI

In this study, we focus on the category of noun plurals in the speech of children with CI. Plural is a basic morphological category that emerges early on in child language [27–30]. It plays a central role in the morphology of noun phrases and as a trigger for grammatical agreement. It has a large cross-linguistic distribution, including sign languages [31], yet often exhibits much structural complexity and irregularity [32]. Therefore, across different languages, gaining command of the full complexity of noun plurals is a protracted developmental process that may continue across the school years [33–37].

For children with CI, evidence on morphological acquisition (and on noun plurals in particular) in the literature is scarce and somewhat contradictory. Svirsky et al. [7] administered three morphological tasks to English-speaking children with CI, focusing on noun plurals, copulas, and regular past tense [38]. The authors found that success rates in the CI group were highest for the copula, followed by the noun plural, and lowest for the regular past tense. By contrast, the NH control groups showed greater proficiency in the use of noun plurals than in the copula. This difference was explained by differences in perceptual salience of the respective grammatical cues (i.e., acoustically more salient copula "is" or "are" vs. less salient word-final sibilant/s/or/z/as in the plural "doll-s"). Against this, Szagun [8,18] found no difference between German-speaking children with CI and NH children in the correct production of noun plurals in a corpus of spontaneous speech. There was also no difference with respect to the type of plural errors produced by the children, with the only exception of erroneous zero plural marking (e.g., *die *Nashorn* instead of *die Nashörner* "the-PL rhinos") being more frequent in the CI group.

The two studies, however, differ in several respects: Firstly, the study by Svirsky et al. focussed on children acquiring English, while the study by Szagun investigated German-speaking children. Previous research on speech and language skills in normally hearing children has shown that children are from very early on sensitive to the "typological imperatives" of the language they learn [39,40]. This means that every language poses its specific problems for a language-learning child and hence conclusions reached from one language cannot be directly translated into another one. Secondly, Svirsky et al. used experimental elicitation, whereas Szagun used spontaneous speech sampling. Children's performance in a plural elicitation task may be different to spontaneous speech, due to differences in task demands between the two production methods [41]. Thirdly, Svirsky et al. interpreted noun plurals relatively to two other grammatical categories, while Szagun presented results for noun plurals separately. Hence, differences between the two studies may come from any single one or from a combination of these factors, and it is difficult to assess to what extent these differences are due to structural differences between languages. This would require a direct comparison between languages. The present paper aims at illuminating the role of cross-linguistic differences in grammatical complexity for the acquisition of noun plurals by children with CI by studying a particular morphological phenomenon in two different languages using the same methodology.

1.3. Suffix Predictability and Stem Transparency in plural formation

In this paper, we target noun plural production in Dutch- and German-speaking preschoolers with CI, using an experimental plural elicitation task. We focus on two characteristics of plural formation that were shown to be good indicators of grammatical proficiency in normally hearing children acquiring Dutch and German [42,43]: Suffix Predictability (i.e., how predictable is the plural suffix given the word-final phonology and gender?) and Stem Transparency (i.e., does the phonological make-up of the noun change when pluralized?).

As to Suffix Predictability, Dutch plurals consist of basically two phonologically unrelated plural allomorphs, -s (e.g., *horloge–horloge-s* "watches") and -(e)n (e.g., *boek–boek-en* "books") that can be predicted with high accuracy (more than 90%) from the word-final phonology of the singular: hence, in terms of predictability Dutch plurals are either highly predictable or exceptional (Table 1). German plurals are formed by four different plural suffixes, -s (e.g., *Auto–Auto-s* "cars"), -(e)n (e.g., *Katze–Katze-n* "cats"), -e (e.g., *Bus–Buss-e* "buses"), -er (e.g., *Bild–Bild-er* "pictures"), or by a zero suffix (e.g., *Pullover–Pullover* "pullovers"). In contrast to Dutch, grammatical gender, besides word-final phonology of the singular, predicts the respective plural forms, yielding high, partial, and exceptional predictability (Table 2). As to Stem Transparency, in both languages, pluralization may involve no stem modification (e.g., German *Schlange–Schlange-n* "snakes"), a slight change (e.g., German word-final voicing as in *Bur[k]–Bur[g]-en* "castles"), or a substantial change (e.g., German stem vowel change or Umlaut as in *Knopf–Knöpf-e* "buttons").

To sum up: Although Suffix Predictability and Stem Transparency play a role in both languages, they may affect acquisition in different ways. Suffixes are more predictable in Dutch, with the vast majority of nouns taking a highly predictable suffix. However, there are more plural suffixes in German, and substantial stem change (Umlaut) is more frequent in German than in Dutch. Hence, if we take as point of departure the complexity of the plural systems, German-speaking children are expected to perform worse in a plural elicitation task than Dutch-speaking children. Furthermore, plural morphemes, like other bound morphemes, are unstressed, and therefore, less easily identifiable in the flow of speech. Hence, their acquisition might be problematic for children with CI.

The study reported in this paper will compare grammatical proficiency in 14 early implanted preschoolers with CI and 120 NH

Table 1
Suffix Predictability and Stem Transparency in Dutch.

Suffix/Stem	No change	Slight change	Substantial change
Highly predictable	boek–boek-en "books"	huis–hui[z]-en "houses"	gl[?s]–gl[az]-en "glasses"
Partially predictable	/	/	/
Exceptional	kok–kok-s "cooks"	/	/