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The influence of parents' speech on the development of spoken language in German-speaking children with cochlear implants

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Abstract

The present study examines the effect of parents' language input on the linguistic progress of children with cochlear implants. Participants were 21 children with cochlear implants and their mothers. Age at implantation ranged between 14 and 46 months. The study was longitudinal with data collections every 4 $^1/_2$ months for a period of 27 months. Spontaneous speech in a free play situation with a parent was recorded at each data point. Children's grammar was measured in terms of Men Length of Utterance (MLU) and the use of noun plurals, verb markings, and case and gender markings on articles. Mothers' child-directed speech was analysed in terms of MLU, self-repetitions and expansions. Time-lagged correlational analyses were performed relating properties of maternal speech at an earlier data point —while controlling for the child's language level at this data point— to child language at subsequent data points. The results showed that maternal MLU and expansions are positively related to child linguistic progress. Higher maternal MLU and more expansions are related to higher child MLU subsequently. More specifically, expansions of specific grammatical structures are related to an increased correct use of these structures by the child subsequently. This was the case particularly for case and gender marking on articles, but also for noun plurals and verb markings. Maternal self-repetitions were negatively related to child progress in grammar. The results demonstrate an effect on mothers' language input on the linguistic progress of young children with cochlear implants. Rich language input leads to better language growth.

Key words: Cochlear implants, language development, input.

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La influencia del habla de los padres en el desarrollo del lenguaje en niños germanohablantes con implante coclear

El presente estudio examina el efecto del lenguaje de los padres en el progreso lingüístico de niños con implante coclear. Participaron 21 niños con implante coclear junto a sus madres. La edad de implantación oscilaba entre los 14 y los 46 meses. El estudio fue longitudinal con recogida de datos cada 4 meses y medio durante un período de 27 meses. Se analizó el lenguaje espontáneo en una situación de juego libre con la madre en cada registro de datos. La gramática de los niños se evaluó en función de la LMPV (Longitud Media de Producción *V*erbal medida en morfemas) *(MLU, Mean Length of Utterance measured in morphemes)* y respecto al uso de nombres plurales, formas verbales y el uso del género y número en los artículos. Se analizó el discurso directo de cada una de las madres en función de la LMPV, repeticiones y expansiones. Se llevaron a cabo análisis correlacionales del tiempo diferido teniendo en cuenta las propiedades del discurso materno en una toma anterior de datos —mientras se controla el nivel del lenguaje del niño en esta toma de datos— respecto al lenguaje del niño en posteriores tomas de datos. Los resultados mostraron que la LMPV y las expansiones maternas están directamente relacionadas con el progreso lingüístico del niño. En consecuencia, una LMPV superior y un mayor número de expansiones se relacionan con una LMPV mayor en el niño. Más específicamente y como consecuencia, las expansiones de estructuras gramaticales específicas se relacionan con un mayor uso correcto de estas estructuras por parte del niño. Este fue el caso, en particular, en la aplicación del número y género en los artículos, pero asimismo para los nombres plurales y las formas verbales. Las repeticiones maternas se relacionaron negativamente con el progreso gramatical del niño.

Estos resultados demuestran un efecto del lenguaje de las madres sobre el progreso lingüístico de los niños pequeños con implante coclear. El uso de un lenguaje enriquecido conduce a un mejor crecimiento del lenguaje.

Palabras clave: Implante coclear, desarrollo del lenguaje, *input*.

Introduction

The development of language in children with cochlear implants (CI) displays an enormous variability (Fryauf-Bertschy, Tyler, Kelsay, Gantz and Woodworth, 1997; Szagun, 2001a; Svirsky, Teoh and Neuburger, 2004) which far exceeds that of children with normal hearing (Szagun, 2001a). Furthermore, whereas in typical development children with initially slow linguistic progress catch up with faster children after some time, this is not the case for children with CI. On the contrary, in this group the gap between children with fast and slow linguistic progress becomes more pronounced – at least during the first three years of language development (Szagun, 2001a). It is far from clear how these individual differences can be explained. A number of factors have been identified as contributing to the observed variability, notably age at implantation, communication mode and quality of pre-operative hearing (Fryauf-Bertschy et al., 1997; Szagun, 2001a; Svirsky et al., 2004; Tomblin et al., 2005; Nicholas and Geers, 2007).

The influence of age at implantation has been the focus of much research. Children's language development is best if they receive their CI by four years of age (P. Spencer, 2004; Svirsky et al., 2004), and there is some evidence that children who receive their cochlear implant in their second year of life make better linguistic progress than children who are implanted in the third and fourth year of life (Svirsky et al., 2004; Tomblin et al., 2005; Nicholas and Geers, 2007). According to some results (Nicholas and Geers, 2007; Geers, Moog, Biedenstein, Brenner and Hayes, 2009) children can be expected to achieve age-appropriate language skills when they are five and six years old - an age when children prepare for or enter school in many countries - particularly if they receive their implant before they are two years old. However, children's linguistic skills differed in different areas of language. They did particularly well in tests of vocabulary but less well in tests of grammatical skills, such as inflectional morphology and syntax (Nicholas and Geers, 2007; Geers et al., 2009). At present, it is unclear whether there are benefits of very early cochlear implantation, but it is undisputed that implantation by four years of age is associated with better development of spoken language than implantation thereafter. This behavioural evidence from children with cochlear implants fits in with neurophysiological evidence on sensitive phases in the development of neural systems for processing auditory and linguistic information (Sharma et al., 2002; Neville and Bavelier, 2002).

While age at implantation has been a major issue, there is growing recognition that social environmental factors may account for a substantial proportion of the variance in cochlear-implanted children's language development. Recent research has shown that parents' educational level and parental IQ are associated with children's linguistic progress (Szagun and Stumper, 2007; Geers et al., 2009). Indeed, in a large study with 153 children by Geers et al. (2009) parental IQ and parental educational level explained a larger proportion of the variance in measures of receptive and productive language in five- and six-year olds than age at implantation. What the study leaves open is in which way parents' educational level and IQ exert an influence on the children's language development. What mediates their effect on the child's development of language? According to a study by Hoff (2003) in typical language development the effect of social class and parents' educational level is mediated by the particular language input parents provide. Language which is rich in vocabulary and grammatical structure is associated with better linguistic progress in children (Hoff, 2003). It is known that for atypical language development, i.e. under conditions of some form of child impairment, the effect of parental language input and interaction strategies exerts an even stronger influence on children's progress (Snow, 1994; Gallaway and Woll, 1994). While in typical development children acquire a basic grammar more or less by four years of age in a variety of different environmental conditions, children with some form of impairment are much more dependent on favourable environmental conditions when they acquire language (Snow, 1994; Gallaway and Woll, 1994). This would apply to children with cochlear implants, as these children remain moderately to mildly hearing-impaired. However, there is hardly any research on the particular type of language input which may be beneficial for these

children. One study has shown that parents who are highly involved in learning activities at home had children with faster linguistic progress (P. Spencer, 2004), but it does not address the specific language input offered by parents.

In the present analysis we want to examine the influence of parental language input on the language development of children with cochlear implants. In particular, we will examine the influence of properties which are characteristic of a rich versus impoverished input and the influence of parents' expansions of child utterances. Language input is rich, if it offers structurally varied sentences of moderate length. It is rather impoverished if it is repetitive with short sentences. An expansion is a repetition of a preceding incomplete or incorrect child utterance with the correct form. For instance, if a child says «baby's foots» an expansion would be «baby's feet». Expansions occur in natural child-adult dialogues (Brown and Bellugi, 1964). Their positive influence on the child's acquisition of grammar is thought to occur because they offer the correct grammatical form when the child is attentive to the topic and has free memory capacity to attend to form.

The richness of mothers' speech as well as expansions have been shown to have an effect on children's language development (Newport, Gleitman and Gleitman, 1977; Hoff-Ginsberg, 1985; Farrar, 1990; Hoff, 2003). Longer MLU (Mean Length of Utterance measured in morphemes) in mothers' speech is associated with faster linguistic growth (Hoff, 2003). Maternal expansions of child utterances have been found to be associated with more rapid acquisition of auxiliaries and inflectional morphology (Newport et al., 1977; Hoff-Ginsberg, 1985; Farrar, 1990). The effect of expansions is particularly evident when one can show that specific grammatical structures which are expanded are subsequently used more correctly by children. Farrar (1990) was able to show this for English-speaking children. He found that noun plurals and present progressives which mothers had expanded were used more frequently and correctly by the children six months later.

It is surprising that the effect of properties of parental language input on the development of language in children with cochlear implants has not been studied in any detail. In Germany the rehabilitation process of children with cochlear implants relies almost exclusively on an auditory verbal framework (Diller, 1997; Löwe and Schmid-Giovanni, 1999). Advice given to parents regarding their speech to their hearing-impaired children tends to stress the value of repetition, clear articulation, and rephrasing of the child's utterance before an answer is given, although there appears to be no convincing empirical evidence for the effectiveness of such methods. Only the aural rehabilitation program using an interactive method of language education by Bertram (1991) stresses a naturalistic and interactive approach. It would be important to know which of the recommended properties, those of a natural dialogue style or those of a repetitive style are beneficial for the child's linguistic progress.

In the present study we hypothesise that a rich language, as expressed by grammatically moderately complex sentences within the scope of child-directed speech, and adult expansions of incomplete or erroneous child utterances are associated positively with the child's acquisition of grammar. We further hypothesise that the expansions of specific grammatical forms will have a positive effect on the acquisition of these forms. However, it may take some time before the effect of the expansions in the input becomes apparent in the child's language. With respect to repetitions we hypothesise that they will have either no effect or even a negative effect on children's acquisition of language.

Method

Participants

For this analysis we used the data of a sample of children with CI who were recorded between the years 1996 – 2000 (see Szagun, 2001a; Szagun, 2004). Participants were 22 deaf children with cochlear implants, 12 girls and 10 boys. The children were between 14 and 46 months at the time of cochlear implant surgery, mean implantation age 29 months, SD = 9 months. The children were prelingually deafened, in most cases for unknown causes (for details of the sample, see Szagun, 2001a). All the children attended Cochlear Implant Center Hannover for rehabilitation. They took part in an aural rehabilitation program using an interactive method of hearing, speech and language education (Bertram, 1991). The children are growing up in monolingual environments of spoken German with no sign language. They have no diagnosed handicap besides their hearing impairment, and their non-verbal IQ was in the normal range.

Tabla 1 *Major grammatical categories of adult expansions of incorrect child utterances with examples*

Grammatical category	Incorrect child utterance[a]	Adult expansion	English translation
Noun plural	Hu**h**ners[b]	H**ü**hner[b]	chickens
Verb markings	alle umkipp	alle umkipp**en**	turn them all over
	ein Hammer funde	**hast** einen Hammer **ge**funde**n**	found a hammer
Article, gender	**der** Badezimmer	**das** Badezimmer	the bathroom
	da is Tankstelle	da is **eine** Tankstelle	there is a petrol station
Article, case	in Zoo fahren	in **den** Zoo fahren	go to the zoo
	der sitzt auf eine Bank	der sitzt auf ein**er** Bank	he is sitting on a bench

[a] Incorrect child utterances are not translated, as the incorrect markings are not translatable.
[b] Errors and their corrections are in bold print, omissions are not marked.

Design, data collection, data transcription and coding

The study was longitudinal. For each child spontaneous speech samples were collected and audio recorded. One and a half hours of spontaneous speech were recorded every 4 $^1/_2$ months. Data were collected over a period of 27 months for all the children and for some children up to 36 months. Data collection started 5 months after the first tune-up of the device (around 6 weeks after implantation) and continued for up to 3 $^1/_2$ years after implantation. For present purposes the data points up to 23 months after first tune-up are used. These are the data points 5, 9.5, 14, 18.5 and 23 months after first tune-up of the device. At the first four of these data points mothers' speech is also transcribed. Per data point 500 maternal parental were transcribed. The children's initial MLU ranged from 1.0 to 1.23 (mean = 1.04, SD = 0.06).

Data collection took place in a playroom at Cochlear Implant Center Hannover. The situation was free play with a parent, usually the mother (in 3.5 % of the play sessions the father). There were a set of toys, such as: cars and garage, dolls, doll's house, zoo animals, farm animals, forest animals, children's picture books, puzzles, medical kit, ambulance, hospital room, fire-station. Children were free to choose what to play with. Digital auditory tape recording (DAT) were made using portable Sony DAT-recorders and high-sensitive Sony or Aiwa microphones.

Everything spoken by the child and 500 maternal utterances per data point were transcribed using the CHILDES system for transcribing and analyzing child speech (MacWhinney, 2000) and an adaptation for transcribing German and coding German morpho-syntax (Szagun, 2004). Transcription was performed by eight trained transcribers. Reliability checks on transcription were calculated for 7.3% of the transcripts with percentage agreements between 96% and 100% for different pairs of transcribers. All child utterances and 2,000 utterances per parent, 500 per data point, were coded for MLU (Mean Length of Utterance in morphemes (Brown, 1973) and morpho-syntax by three researchers. Reliability checks on child and maternal MLU were performed on 20% of the transcripts. Cohen's kappa was calculated as a measure of agreement. Kappas ranged between 0.94 and 0.98. CLAN programs (MacWhinney, 2000) were used for calculating MLU and frequencies of morpho-syntactic forms, such as articles, noun plurals, verb markings.

As dialogue variables mothers' speech was coded for verbatim self-repetitions and for expansions. More specifically, expansions were coded for the type of grammatical structure they expanded. The categories with examples are presented in Table 1. Expansions and repetitions were coded by two researchers and 20.5 % of the transcripts were coded by an independent coder. Cohen's kappa ranged between 0.93 and 0.97, indicating good agreement between coders.

Results

Richness versus lack of it was measured by maternal MLU. Repetitiveness was measured by verbatim self-repetitions of utterances. Longer maternal utterances and expansions are indicative of a rich language input, repetitions are taken as indicative of impoverished input.

Tabla 2 *Time-lagged partial correlations between maternal MLU and child MLU (n = 21)*

Maternal MLU at data points	Child MLU at data points: 9.5	14	18.5	23 months after first tune-up
5 months after first tune-up[a]	0.77***	0.78***	0.77***	0.74***
9.5 months after first tune-up[a]		0.68***	0.69***	0.71***
14 months after first tune-up[a]				0.50*

[a]child MLU at this data point is partialed out.
*** p < 0.001, * p < 0.05, Pearson.

In order to study the effect of maternal dialogue characteristics on the child's language time-lagged correlations (Pearson) were calculated. For one child the data base of parental speech was insufficient, and therefore the statistical analyses were performed for a sample of 21. Maternal MLU, repetitions and expansions at earlier time points were correlated with child MLU at later time points. In order to eliminate the effect of the child's language on the mother's, child MLU —or the respective grammatical structure studied— is partialed out at the time points at which maternal input variables are entered into the calculation. For instance, when maternal MLU at 5 months after first tune-up is correlated with child MLU at subsequent data points, child MLU at 5 months after first tune-up is partialed out. Equivalently, this procedure is performed per specific grammatical structure analysed (see Footnotes in Tables). Giving child-directed speech temporal precedence and controlling for the effect of the child's language on it makes a causal interpretation of maternal input plausible (Richards, 1994; Hoff, 2003).

Tabla 3 *Time-lagged partial correlations between all maternal expansions and child MLU (n = 21)*

Maternal expansions at data points	Child MLU at data points: 9.5	14	18.5	23 months after first tune-up
5 months after first tune-up[a]	0.76**	0.60**	0.76**	
9.5 months after first tune-up[a]		0.74**		0.51**

[a]child MLU at this data point is partialed out.
*** p < 0.01, * p < 0.05, Pearson.

Tabla 4 *Time-lagged partial correlations between maternal expansions of noun plurals and children's use of noun plurals (n = 21)*

Maternal expansions of noun plurals at data points	Children's use of noun plurals at data points: 18.5	23 months after first tune-up
5 months after first tune-up[a]	0.61**	0.59*

[a]child use of plurals at this data point is partialed out.
*** p < 0.01, * p < 0.05, Pearson.

Table 2 shows the partial correlation coefficients between maternal MLU and child MLU. (In this and the following tables only significant correlation coefficients are presented). Maternal MLU, particularly at the two earliest data points, is significantly associated with child MLU at subsequent data points. The partial correlation coefficients explain between 25 % and 61 % of the variance. Longer maternal MLU is associated with longer subsequent child MLU.

Table 3 shows the partial correlations between all maternal expansions and child MLU. Maternal expansions at the two earliest time points are significantly correlated with child MLU at subsequent time points. The partial correlations explain between 26 % and 58 % of the variance (see Table 3). More maternal expansions lead to higher subsequent child MLU.

Tables 4-6 show the partial correlations between maternal expansions of specific grammatical structures with the child's use of these structures subsequently. For noun plurals only expansions at the earliest time point are significantly correlated with children's use of plurals subsequently, and that is at the two last time points, i.e. around after a delay of around 13 to 18 months (see Table 4). Mothers' expansions of verb forms are also significantly correlated with children's subsequent use of these forms. For infinitives this is the case when expansions occur at the two early time points, for 3rd person singular when they occur at the two later time points. For both forms the effect does not show up till the data point 23 months after first tune-up, i.e. with a considerable delay (see Table 5). Finally,

Tabla 5 *Time-lagged partial correlations between maternal expansions of verb markings and children's use of verb markings (n = 21)*

Maternal expansions of verb markings at data points	Children's use of verb markings at data points		
	14	18.5	23 months after first tune-up
Infinitive			
5 months after first tune-up[a]	0.69**		0.70**
9.5 months after first tune-up[a]			0.42*
3rd person singular on main verb and copula			
14 months after first tune-up[a]			0.49*
18.5 months after first tune-up[a]		0.67**	0.46*

[a]child use of these verb markings at this data point is partialed out.
** p < 0.01, * p < 0.05, Pearson.

mothers' expansions of gender and case marked forms of articles correlate significantly with children's subsequent use of these forms. For indefinite articles this effect occurs somewhat earlier than for definite articles for which most of the correlations are significant at the two latest data points (see Table 6). The proportion of variance the correlations explain varies between 18 % and 49 %. For all expanded grammatical structures the association between expansions and children's subsequent use of the structures is positive, i.e. the more expansions the more correct use of the respective inflected forms.

Table 7 shows the partial correlations between mothers' and children's repetitions and child MLU. Maternal self-repetitions at the first two data points are significantly negatively correlated with child MLU at subsequent data points. The more a mother repeats herself, the slower a child's linguistic progress. The correlations explain between 19% and 29% of the variance.

Discussion

The present results show that properties of maternal language input are associated with children's progress in grammar. These properties are: the length of utterances, as measured by MLU, expansions of child utterances and self-repetitions. Longer maternal utterances, particularly occurring at early time

Tabla 6 *Time-lagged partial correlations between maternal expansions of definite and indefinite articles and children's use of definite and indefinite articles (n = 21)*

Maternal expansions of articles at data points	Children's use of articles at data points			
	9.5	14	18.5	23 months after first tune-up
Indefinite article, gender marking in the nominative				
5 months after first tune-up[a]	0.42*	0.70**		
14 months after first tune-up[a]		0.49*		0.53*
Indefinite article, case marking in the accusative				
14 months after first tune-up[a]			0.57**	
Definite article, gender marking in the nominative				
9.5 months after first tune-up[a]		0.46*		
14 months after first tune-up[a]				0.46*
Definite article, case marking in the accusative				
9.5 months after first tune-up[a]				0.56*
Definite article, case marking in the dative				
14 months after first tune-up[a]				0.53*

[a]child use of these article forms at this data point is partialed out
** p < 0.01, * p < 0.05, Pearson

Tabla 7 *Time-lagged partial correlations between maternal repetitions, child repetitions and child MLU (n = 21)*

Repetitions at data points	Child MLU at data points 9.5	14	18.5	23 months after first tune-up
Maternal self-repetitions				
5 months after first tune-up[a]	- 0.54**	- 0.45*	- 0.45*	- 0.44*
9.5 months after first tune-up[a]		- 0.44*	- 0.48*	- 0.48*

[a]child MLU at this data point is partialed out
** $p < 0.01$, * $p < 0.05$, Pearson

points, were associated with longer child utterances at subsequent time points. More maternal expansions at early time points were also associated with higher child MLUs at subsequent time points. Going beyond that, expansions had very specific effects. The expansions of particular grammatical structures had a positive influence on the acquisition of those same structures some time later. This concerns inflectional markings in the areas of noun plurals, verb endings, and case and gender on articles. Early maternal expansions of incorrect inflectional markings in these grammatical areas were associated with an increased use of correct inflectional markings in these areas at later time points.

Our results also show that maternal verbatim self-repetitions are related to subsequent child language. However, this relation is negative. More frequent self-repetitions in mothers' speech were associated with less progress in grammar by children, as measured by MLU.

These results confirm our hypotheses that properties of parental speech are associated with cochlear-implanted children's linguistic progress in grammar and that this relation is positive for aspects of child-directed input which are rich in structure. Longer MLU in child-directed speech is indicative of a moderately complex grammar within the scope of complexity a small child at the beginning of language development can handle. Such language offers variable structures and therefore variable information. It is interesting for a child to listen to, and it offers grammatical variety which the child can use for learning. The results also confirm our hypotheses with respect to the influence of expansions. Adult expansions of formally incorrect or incomplete child utterances not only have a generally positive effect on the child's acquisition of grammar, as measured by MLU, but they very specifically further the acquisition of those grammatical structures which are expanded. While this effect has been demonstrated for English (Farrar, 1990), to our knowledge, it is the first time that such an effect has been demonstrated for children learning German and for children with cochlear implants of any language.

The results also confirm our hypotheses with respect to repetitions. Self-repetitions do not help the child's developing grammar. On the contrary, they have a negative influence. This may be due to the fact that more repetitions offer less variety. But it is variety, not limitation of variety, which is conducive to learning. Many self-repetitions may also be indicative of a generally inflexible and uninteresting dialogue style which is boring for a child and may cause him or her to pay less attention to adult speech. On the other hand, although we controlled for the child's level of grammar, it is also possible that this style is evoked by the child's limited language. Therefore, a causal interpretation in the direction from mother to child alone has to be viewed with some caution.

Most of the associations between properties of maternal speech and children's grammatical progress hold for mothers' speech at the earliest data points 5 months and 9.5 months after first tune-up. While mothers' MLU and self-repetitions are related to child MLU at all subsequent time points, this is different for expansions, particularly for expansions of specific inflectional morphemes. Their effect often does not begin to show up till about 9 months later. There may be a variety of reasons for this. One is that it may take time for specific grammatical structures to be learnt. Therefore, when we look only at the one structure, the time gap becomes apparent. But it would not show up when we look at MLU because this is a global measure which shows progress for all grammatical structures together. The other reasons may relate to the specific structure itself. The data show that the effect of expansions on the acquisition of noun plurals and forms of the indefinite article is earlier than on verb markings and forms of the definite article (see tables 4-6). This result fits in with data on the acquisition of inflectional morphology of German for typically developing children and children with cochlear implants (Szagun, 2001b; 2004,

Szagun, Stumper, Sondag and Franik, 2007). The acquisition of noun plural marking starts earlier than the acquisition of verb markings, and indefinite articles in the nominative used more frequently than definite articles. Therefore a delay in time for definite articles and verb markings is to be expected.

Inflectional marking on articles, particularly definite articles, is an area of difficulty for children acquiring German, whether they have normal hearing or are hearing-impaired (Szagun, 2004). One of the reasons for the difficulties is the low perceptual discriminability of case marked article forms in spoken language. This makes them even more difficult for hearing-impaired children, and they tend to leave case marked article forms out (Szagun, 2004). It is noteworthy that the present data show the greatest effect of expansions on the acquisition of articles, particularly definite and case marked articles. This underlines the importance of maternal expansions. They assist language learning in an area of grammar which is particularly difficult for hearing-impaired children.

In the present analyses we controlled for the effect of the child's speech on adult speech by the statistical method of partialing out children's language level at the time point at which we measured adult language properties. In this way we can reasonably conclude that the observed effects which occur over time are the effects of adult input on children's grammatical learning. The method may also explain why we find most effects when we measure mothers' speech at early time points. As time goes on mothers probably adapt their language to their child's level. Thus we find adult and child effects intertwined, and when partialing out the child's influence the association between the two measures becomes insignificant.

Our results are of relevance for language therapy with cochlear-implanted children. Parents' language is the most important input for these children. Our data show that properties which are beneficial for language acquisition, such as expansions and structurally rich language, occur in natural dialogue. It would follow that it is not necessary for parents to divert from natural dialogue if they already use a beneficial dialogue style. However, if they do not, monitoring their dialogue style and giving advice about those properties of child-directed speech which further language development may be helpful. In any case, advice to parents should not be based on assumptions which, in the case of self-repetition, have not been supported. Such advice should instead be based on empirical evidence on the effectiveness of the strategies which are recommended.

The theoretical relevance of our results is to have demonstrated that properties of child-directed language input contribute substantially to the variability in linguistic progress in children with cochlear implants. Properties of child-directed language input have substantial and very specific effects on the development of grammar in children with cochlear implants. As parental language input is an area which can be influenced, it seems to us that it should be made a focus of future research.

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