Linguistic intervention strategies SLPs use with children using cochlear implants.

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Abstract

The aim of this study was to explore the strategies that speech-language pathologists (SLPs) use during their linguistic interventions on children with cochlear implants (CIs). The sample comprised 7 SLPs in interactions with 62 children, 31 with cochlear implants and 31 with typical hearing (TH), from 5 to 7 years of age. Two linguistic activities were used: conversation and naming. With children with CIs, the SLPs used 3.8 times more adaptation strategies and 5 times more educational strategies in the conversation activity, and 1.4 times more educational strategies in the naming activity than with children with TH. Communication strategies were significantly more frequent in the conversation activity than in the naming activity while educational strategies were more frequent in the naming activity than in the conversation activity. The auditory age of children with CIs also influenced the use of these two types of strategies, increasing the use of communication strategies by 0.6% and decreasing the use of educational strategies by 1.2% for each month of increase in the auditory age. In order to foster linguistic development, the SLPs used a wide variety of strategies with the children with CIs, adjusting them to the activity and the auditory age.

Keywords: *Intervention strategies, cochlear implant, speech-language pathologist, children, conversation, naming.*

Introduction

Thanks to cochlear implants (CIs), a great deal of children with prelinguistic hearing loss are able to access the world of sound at an early age. However, CIs don't provide sound perception that is identical to typical hearing, nor do they allow automatic language development. Therefore, children with CIs require intervention that is designed, planned and executed by speech-language pathologists (SLPs) via a series of intervention strategies (Veyvoda, et al., 2019; Vilaseca, 2002).

In the rehabilitation process, parental involvement contributes positively in children's development (Kaiser & Hancock, 2003; Zaidman-Zait et al., 2018). The study of the strategies used by mothers during their interactions with their children with typical hearing (TH) is one of the areas of study that have served as models in the field of language intervention (Vilaseca, 2002). Del Río & Gràcia (1996) classified maternal strategies into three groups: communication strategies, which manage parameters of the conversation; adaptation strategies, when the adult adjusts the complexity of their speech to the linguistic level of the child; and educational strategies, when adults correct, modify or facilitate correct responses from the children.

The interactive strategies used by mothers with their children with CIs have also been studied. Majorano et al. (2017) compared the maternal adaptation strategies used with children with CIs and TH in two interactive situations: free play and shared book reading. The study included 60 mother-child dyads: 20 dyads included children with CIs, 20 included children with TH of the same chronological age as the children with CIs, and 20 dyads included children with TH of the same auditory age as the children with CIs (time elapsed since the children received the cochlear implant). The authors indicated that the mothers of children with CIs adapted the complexity and length of their utterances to the linguistic level of the children, so that they used a less varied vocabulary and shorter

sentences than the mothers of children with TH of the same chronological age. A subsequent study by Lavelli et al. (2018), carried out with the same study sample, compared the use of communication strategies and educational strategies of mothers of children with CIs and mothers of children with TH. The results indicated that mothers of children with CIs responded to children's communicative initiatives, encouraged their children to participate in the interaction, regulated children's behavior, and corrected and expanded incorrect answers in similar proportions to mothers of children with TH of the same chronological age as the children with CIs. The reported group differences indicated that the mothers of children with CIs corrected a greater number of incorrect statements compared to the group of mothers of children with TH of the same auditory age. The results also highlighted that the number of strategies to correct errors was higher in the shared book reading activity than in the play activity. The authors concluded that the mothers used the visual support of the images to enrich children's utterances and give feedback, thus supporting the linguistic development of their children.

Cruz et al. (2013) carried out a longitudinal study with the aim of exploring a group of communication and educational strategies, such as directives and comments, open-ended questions, recasts and expansions, that were used in the interaction of 93 mother-child dyads over the 3 years after CI implantation. The children had congenital hearing loss and had received a cochlear implant at or before two years of age. The authors indicated that the mothers of children with CIs used the same types of communication and educational strategies during the entire period of time observed, that is, they did not use more complex strategies as the children increased in auditory age. However, differences were found in the number of strategies used by the mothers, such that as the auditory age of the children increased, the number of educational strategies increased and the number of communication strategies decreased. When mothers' strategies were

compared in a free play activity and in a structured conversation activity, the results indicated that mothers used longer sentences in structured conversation than in play. However, there were no differences in the type of strategy used according to the activity.

The reviewed studies analyze maternal intervention strategies in children with CIs; however, little is known about the intervention strategies that SLPs use in language activities. Raver et al. (2012) studied the interaction between a teacher and 3 children with hearing loss, 2 of them with CIs and 1 with a hearing aid. The authors analyzed the effectiveness of parallel talk, a communication strategy in which the adult verbalizes the child's actions. The study was carried out over 26-29 intervention sessions while the children played. The results indicated that, at the end of the study, all 3 children with hearing loss took speaking turns more frequently, and two of them increased the number of comments and verbal responses in the interaction. The authors attributed these results to the fact that, when using the parallel talk strategy, the teacher fostered joint attention, increased the wait time, followed the children's interests, and used phrases adapted to the children's language level.

In the same vein, Ronkainen et al. (2017) explored the type of educational strategies used by 3 SLPs in their lexical intervention with 3 children with CIs between 4 and 7 years old. The study analyzed the strategies used by the SLPs to correct phonological errors, promote vocabulary expansion and increase the understanding of lexical-semantic categories in different play activities. The authors observed that, to correct phonological aspects, the SLPs used the implicit correction strategy, repeating the correct form of the word without making the child’s error explicit, and the explicit correction strategy, contrasting the correct phonological form with the child’s error. In addition, to support the learning of new words, the SLPs systematically repeated the lexicon worked on and emphasized suprasegmental aspects that accompany speech

(acoustic enhancement strategy). To expand vocabulary, the SLPs completed the children's sentences without changing their meaning. The study also showed that SLPs corrected aspects of word meaning, using explicit corrections and inviting children to imitate correct production. SLP intervention strategies such as those described by Ronkainen et al. (2017) have been observed in studies with a population of children with language disorders (Gardner, 2005; Tykkyläinen, 2005).

This study aimed to analyze the intervention strategies that SLPs used with children with CIs in two linguistic activities: a conversation activity and naming activity. It intended to explore whether SLP intervention is influenced by:

(1) The hearing status of the children, i.e. CI or TH.

(2) The type of linguistic activity, i.e. conversation or naming.

(3) The auditory age of the children with CIs.

Methods

Participants

The study involved 7 female SLP graduates who finished their studies between 1 and 3 years ago. They were studying the postgraduate master program in Communication and Language Disorders (*Màster Oficial en Trastorns de la Comunicació i del Llenguatge*) to complement their professional training at the time of the investigation. Sixty-two children were chosen for the study, of which 31 had CIs and 31 had TH. The group with CIs was composed of 18 girls and 13 boys between 5 and 7 years old, of which 21 had unilateral implants and 10 had bilateral implants. The aided thresholds with the CIs were between 10dB and 35dB ($\overline{X}$= 20.78dB; Standard Deviation= 6.29dB). See Table 1.

[Insert Table 1 near here].

The sample was selected through the Educational Resource Centers for Deaf or Hard of Hearing Children (CREDAs) of the Catalan Government's Department of Education (*Departament d'Ensenyament de la Generalitat de Catalunya*) where the SLPs work. In Catalonia, unlike in other countries, teachers of the deaf do not exist, and therefore are not the main professional interventionists with children who use CIs. For this reason, SLPs are tasked with planning and executing the linguistic intervention for children with CIs.

All 10 CREDAs that exist in Catalonia participated in the study, meaning that the sample is representative of the entire population of children with CIs in Catalonia that fit the inclusion criteria of the study.

The inclusion criteria for the group with CIs were: a) prelinguistic hearing loss (hearing loss prior to the acquisition of language); b) auditory age (period after implantation) of at least 2 years; c) hearing parents that communicate orally with the children; d) attendance at regular inclusive schools in Catalonia; e) absence of modified curricula; and f) absence of other additional disabilities.

A TH child was selected for each one with CI according to the following inclusion criteria: a) the same school year; b) the same age and gender; and c) a family with a similar socioeconomic level. The children with TH were selected based on information provided by each CI child's tutor.

All families gave informed consent for their children to participate in the study, according to the guidelines of the Ethics Committee for Human and Animal Experimentation (CEEAH) of the *Universitat Autònoma de Barcelona* with number CEEAH 5810.

Materials

To explore the intervention strategies employed by SLPs, two activities were used: conversation and naming.

The conversation activity consisted of 12 questions that the SLPs asked about daily activities. Some examples include: What do you like most about your school? Who do you play with in the playground? What do you do when you get home from school? and What will you do this weekend?

The naming activity consisted of 73 questions that SLPs asked about 28 pictures. The pictures were obtained from the AREPA (Aguilar & Serra, 2003) which measures the phonology of 3 to 6 year olds, ensuring that the lexical content was age appropriate. In this activity, questions are used to elicit nouns (what is this?), adjectives (what is it like? how is it?), verbs (what is it for?), adverbs of place (where do you use it?), semantic categories (what is it?) and responses about causality (why do you think so?). The questions varied depending on the images. For example, for the picture of the drum, they were only asked about the name (what is it?) and the semantic category "instrument" (what is a drum?), while for the picture of the queen, they were asked for the name (what is it?), followed by the questions "why do you think so?" and "what is the queen like?"

Procedure

The two activities were performed by 7 SLPs that collaborated with the investigation group. Each SLP was assigned a geographical area and was entrusted with carrying out the activities on all children enrolled in schools in that area, regardless of hearing status. The SLPs did not know the objectives of the study, nor did they personally know the children who were part of the sample, nor did they know the audiological

characteristics of the children with CIs, such as their hearing loss, their aided thresholds with the CIs or their auditory ages. This was to ensure that the SLPs were blinded to the nature of the data collection. A training session was held with the SLPs, in which the script of questions they had to ask in each of the activities was presented. The SLPs were told that they could include other questions to get the correct answer from the children; however, they were not given instructions on the type of intervention strategies they could use.

The activities were administered individually with each child in a quiet room in the child's school. The conversation activity was followed by the naming task. Neither activity included a time limit for the responses.

Audio of the activities was recorded and transcribed word for word. The transcriptions were analyzed, codified and reviewed by two raters. Two training sessions were held: in the first session, the analysis categories were explained in detail with examples, and in the second session, the judges practiced codifying transcripts of cases unrelated to the study, in order to resolve doubts. According to the criteria proposed by Fleiss (1986), the Concordance Correlation Coefficient (CCC) (Lin, 1989) showed excellent inter-rater reliability (CCC=0.784; 95% CI: 0.743, 0.819).

Due to technical difficulties with the audio recording, the conversation activity could not be transcribed for 6 children with CIs and 9 children with TH, and therefore they were not included in the analysis of this activity. Consequently, the analysis of the conversation activity was carried out with 25 children with CIs and with 22 children with TH, while the naming activity was carried out with all 62 children (31 with CI and 31 with TH).

Measures and categories of analysis

The hearing status (CI, TH), gender (boy, girl), and chronological and auditory age (both in months) was recorded for every participant.

To analyze the types of strategies that the SLPs used when the child did not respond to a question or gave an incorrect response, the communicative interactions were segmented into adjacent pairs that were understood to be semantically related (Pérez, 2013).

The strategies were classified into 3 groups: communication strategies, adaptation strategies and educational strategies (Table 2). Some of these strategies have been taken from previous studies that analyzed maternal interactions with children with TH (del Río & Gràcia, 1996; Rivero & Vilaseca, 2019) and with CIs (Lavelli et al., 2018; Rezzonico et al., 2014) or intervention strategies of SLPs with children with language disorders (Aguado, 1999; Clark, 2013; Pérez, 2013; Rondal, 1990) and with CIs (Estarbrooks, 2006; Ronkainen et al., 2017), while others have not previously been described, but were observed during the present study.

[Insert Table 2 near here].

Data analysis

Due to the non-experimental nature of the study and the fact that the measurement scale of the response variables is an integer, Poisson regression models were adjusted to analyze the differences between the responses between the two groups of children (with CI and with TH) as well as the influence of auditory age in children with CIs. The Incidence Rate Ratio (IRR) was calculated as the measure of effect size, its confidence interval (95%), and p values (Lindsey, 1995; Long, 1997; Vives et al., 2006). All regression models included the number of adjacent pairs as the exposure variable. The adjustment variables used were gender and age.

It was not possible to perform a regression on the following variables from the conversations due to the low frequency of their use: “regulation of behavior and attention”, “morphosyntactic adaptation”, “imitation”, “modeling”, “explicit correction”, “phonological bootstrapping”, “cognitive conflict”, “decontextualizing strategies”, and “attention direction”.

The Wilcoxon signed-rank test was applied to study the differences between the responses in the conversation and naming activities. The threshold for statistical significance was set at a p-value < 0.05 for all analyses. The statistical analyses were performed with Stata/SE v16 (StataCorp, 2019).

Results

The influence of hearing status on speech therapy strategies

The results of the analysis of the three groups of strategies (Table 3) indicated that, compared to the children with TH, the SLPs used a similar number of communication strategies with children with CIs in both activities, however, significant differences were found in the use of adaptation and educational strategies. The analyses indicated that in relation to children with TH, the SLPs used 3.82 (CI 95%: 1.58, 9.23) times more adaptation strategies only in the conversation activity, while educational strategies were 4.95 (CI 95%: 2.63, 9.32) times more frequent in the conversation activity and 1.41 (95% CI: 1.25, 1.59) times more frequent in the naming activity with children with CIs.

[Insert Table 3 near here].

Although the group analysis of strategies did not show significant results in the use of communication strategies, the analysis of the use of the different types of communication strategies indicated significant differences in the use of regulation of

behavior and attention, waiting in silence, waiting and then repeating, requests for repair of misunderstandings and positive feedback (Table 4). So in relation to the children with TH, the SLPs used with children with CIs: 4.87 (CI 95%: 1.55, 15.27) times more regulation of behavior and attention in the naming activity; 2.17 (CI 95%:1.58, 2.99) times more waiting in silence in the conversation activity and 1.45 (CI 95%:1.25, 1.67) times more in the naming activity; 2.72 (CI 95%:1.22, 6.07) times more strategies of waiting and then repeating in the conversation activity and 3.14 (CI 95%:2.07, 4.75) times more in the naming activity; and 2.34 (CI 95%:1.00, 5.48) times more requests for repair of misunderstandings in the naming activity. In the opposite direction, the positive feedback strategy was used less frequently in the group of children with CIs compared to the group with TH. Analyses indicated that this strategy was used 44.5% (IRR-1*100: 57.8, 27.1%) less in the conversation activity and 25.6% (IRR-1*100: 16.6%, 33.6%) less in the naming activity. No significant differences were observed in the use of the strategies of waiting and then prompting, principles of cooperation and responding to children's initiatives in either group of children in any linguistic activity.

The analysis of the use of the different types of adaptation strategies indicated that SLPs made 3.00 (CI 95%:1.23, 7.33) times more semantic adaptations in the interaction with children with CIs than with children with TH. This difference was only significant in the conversation activity (Table 4).

The analysis of the use of the different types of educational strategies indicated that, in relation to the children with TH, the SLPs used a greater number of implicit corrections to phonetic or semantic mistakes produced by children with CIs. The higher number of corrections was due to a higher number of errors produced by the CI children. This number was 6.95 (CI 95%: 2.12, 22.79) times higher in the conversation activity and 4.26 (CI 95%: 2.82, 6.44) times higher in the naming activity. The SLPs prompted the

children with CIs 2.51 (CI 95%: 1.25, 5.02) times more with imitations, modeled 1.67 (CI 95%: 1.04, 2.69) times more utterances, and used 33.7% (IRR-1*100: 4.4%, 71.1%) more phonological bootstrapping than with the TH children. These significant differences were only observed in the naming activity.

The SLPs asked 9.66 (CI 95%: 1.09, 85.20) times more multiple-choice questions and expanded the answers of the children with CIs 9.55 (CI 95%: 1.26, 72.35) times more often than those of the children with TH. These significant differences were only observed in the conversation activity (Table 4).

No significant differences were found in the use of explicit corrections, restatements, semantic bootstrapping, priming, cognitive conflict, decontextualizing strategies, or directing attention between the two hearing statuses in either linguistic activity (Table 4).

[Insert Table 4 near here].

Influence of the type of activity on the use of SLP intervention strategies

The results of the inter-subject Wilcoxon signed-rank test to compare the strategies used by the SLPs with the two groups of children as a function of activity (Table 5) showed that the SLPs used a greater number of communication strategies in the conversation activity than in the naming activity in both the CI group (Conv: 48.52%, Nam: 36.89%) and the TH group (Conv: 44.71%, Nam:33.79%). No influence of the activity was observed in the use of adaptation strategies. Regarding the use of educational strategies, the SLPs used a greater number of educational strategies in the naming than in the conversation activity in the CI group (Conv: 10.09%, Nam: 16.86%) and in the TH group (Conv: 1.77%, Nam: 12.48%).

[Insert Table 5 near here].

The results of the analysis of the types of communication strategies by activity (Table 6) indicated statistically significant differences in the use of waiting in silence and principles of cooperation. Thus, the SLPs waited in silence for longer in the conversation activity than in the naming activity only for the children with CIs (Conv: 19.13%, Nam:13.50%), they requested a greater amount of information through principles of cooperation without a misunderstanding in the conversation activity than in the naming activity with the CI group (Conv:5.09%, Nam:1.01%) and TH group (Conv: 6.53%, Nam:1.11%), and they used principles of cooperation to clarify a misunderstanding more often in the conversation activity than in the naming activity only with the group with CIs (Conv: 0.81%, Nam:0.05%). The influence of the activity was not observed in the use of attention and behavior regulation strategies, waiting and then prompting, waiting and then repeating the question, responding to the child, requests to repair misunderstanding and positive feedback.

The results did not show a significant influence of the activity on the use of morphosyntactic or semantic adaptations (Table 6).

The analysis of the influence of the activity on the type of educational strategies showed that SLPs used significantly a greater number of these strategies in the naming activity than in the conversation activity. Some educational strategies showed significant intergroup differences. Such was the case with modeling, whose use was greater in the naming activity than in the conversation only with children with CIs (Conv: 0.13%, Nam:1.35%), while the number of multiple-choice questions (Conv: 0.11 %, Nam: 0.39%) and priming questions was higher in the naming activity than in the conversation activity only with the TH children (Conv: 0.27%, Nam: 1.44%).

On the other hand, there was a group of educational strategies whose use was significantly higher in the naming activity than in conversation, both with children with

CIs and with children with TH. Such is the case of phonological bootstrapping (CI group Conv: 0%, Nam:3.71%; TH group Conv:0.27%, Nam:2.78%), semantic bootstrapping (CI group Conv: 1.54%, Nam: 1.62%; TH group Conv: 0.17%, Nam: 2.16%), cognitive conflict (CI group Conv: 0.07%, Nam: 1.19%; TH group Conv: 0%, Nam:1.09%), decontextualizing strategies (CI group Conv: 0%, Nam: 0.63%; TH group Conv: 0%, Nam: 0.79%), and attention direction (CI group Conv:0%, Nam: 1.19%; TH group Conv: 0%, Nam: 1.32%).

The activity did not influence the use of imitation, explicit correction, expansion or restating strategies (Table 6).

[Insert Table 6 near here].

Influence of the auditory age of the children with CIs on the use of SLP intervention strategies

The analysis of the influence of the auditory age of the children with CIs (Table 7) showed that as children's auditory age increased by one month, the SLPs used significantly more communication strategies and less educational strategies only in the naming activity. The results showed that the SLPs increased the use of communication strategies by 0.6% (IRR-1*100: 0.2%, 0.9%) per additional month of auditory age. Auditory age was not found to affect the use of adaptation strategies. The analysis of educational strategies indicated that the SLPs decreased the use of educational strategies by 1.2% (IRR-1*100: 0.7%, 1.7%) per month of auditory age.

[Insert Table 7 near here].

The analysis of the influence of auditory age on the type of communication strategies (Table 8) indicated significant differences in regulation of behavior and attention, request for repair of misunderstandings and positive feedback. In this way, as

children's auditory age increased by one month, SLPs made 8.9% (IRR-1*100: 2.3%, 15.2%) fewer behavioral regulations and waited in silence 1.3% (IRR-1*100: 0.3%, 2.4%) more than with the children with lower auditory age. These results were only observed in the conversation activity. SLPs made 2.9% (IRR-1*100: 0.1%, 5.8%) more requests for repair of misunderstandings and gave 0.9% (IRR-1*100: 0.4%, 1.4%) more positive feedback per month of additional auditory age in the naming activity. No significant differences were found in the variables waiting and then prompting, waiting and then repeating, principles of cooperation without a misunderstanding, principles of cooperation to clarify a misunderstanding, or responding to the child in any linguistic activity.

The analysis of the influence of auditory age on the type of adaptation strategies revealed that SLPs made 7.2% (IRR-1*100: 0%, 13.9%) fewer morphosyntactic adaptations for the children with more advanced auditory age in the conversation activity. No statistically significant differences were found in the use of semantic adaptation strategies in any linguistic activity (Table 8).

Analysis of the influence of auditory age on the types of educational strategies revealed that as auditory age increased by one month, SLPs used 1.9% (IRR-1*100: 0.8%, 3%) fewer implicit corrections, 2.8% (IRR-1*100: 1.8%, 3.8%) less phonological bootstrapping, 1.6% (IRR-1*100: 0%, 3.1%) less semantic bootstrapping, and 2.1% (IRR-1*100: 0.5%, 3.7%) more priming in the naming activity. Expansions were used 4.5%(IRR-1*100: 0.8%, 8.3%) more with children with greater auditory age in the conversational activity (Table 8).

Lastly, no significant differences were observed based on auditory age in the use of imitations, modeling, multiple-choice questions, explicit corrections, restating,

cognitive conflict, decontextualizing strategies, or focusing attention in any linguistic activity (Table 8).

[Insert Table 8 near here].

Discussion

The objective of this study was to examine the intervention strategies that SLPs used with children with CIs and analyze whether they were influenced by hearing status, linguistic activity or the auditory age of the children with CIs.

The results indicated that the hearing status of the children, with CI or with TH, exerted an influence in the sense that the SLPs used a greater number of adaptation strategies and educational strategies with children with CIs than with children with TH.

Regarding communication strategies, no significant differences were observed in their use between children with CIs and with TH. Regarding the type of activity, in the conversation activity the SLPs used a greater number of communication strategies, while educational strategies were used more frequently in the naming activity. Adaptation strategies were used in a similar proportion in both activities. The auditory age of children with CIs also showed an influence, in the sense that the SLPs increased the use of communication strategies and decreased the use of educational strategies with children of older auditory age. No differences were observed in the use of adaptation strategies based on the auditory age of children with CIs.

Comparison of the strategies used with children of different hearing status revealed that the SLPs regulated the attention and behavior of the children with CIs more often than the children with TH. The frequent use of this communication strategy by SLPs suggests that the difficulties that children with CIs manifest in maintaining joint attention still persist (Raver et al., 2012). These results contrast with those found by Lavelli et al.

(2018), who indicated that the mothers of children with CIs regulated the behavior of their children in similar proportions as the mothers of children with TH did.

These opposite results regarding the use of the attention regulation strategy could be accounted for with two explanations: the role played by the adult during the interaction and the type of activity performed. In this sense, the SLPs in this study, aware of their role as language therapists, needed to maintain the attention of the child with CI so that he or she could adequately respond to the demands made during a linguistic activity that may have been more demanding for them than for children with TH. In contrast, in the study by Lavelli et al. (2018), it is possible that no differences were found in the use of the strategy of regulating behavior and attention used by mothers of children with CIs and children with TH because the type of activity they were doing with their children was not based on structured education, but in a context of free play and shared book reading.

Another of the communication strategies that SLPs used more frequently with children with CIs than children with TH was waiting longer for them to respond. To do this, they either remained silent after they requested an answer, or they repeated the question, thus giving them more time to respond. Both strategies are positive since, as indicated by Raver et al. (2012), they help reduce communication pressure and can facilitate children's participation in the activity. In addition, the use of the question repetition strategy not only allowed excessively long pauses to be avoided, but also gave children with CIs the opportunity to hear the auditory stimulus again. Similarly, in a study carried out by DesJardin et al. (2014), they explored the interactive reading skills in dyads of parents and children with CIs and parents and children with TH and observed that both groups of parents did not talk continuously to fill the silence, allowing time for their children to process the information, look at the images and give an answer.

In the study it was observed that repair of misunderstandings occurred frequently in the interactions of the SLPs with the children with CIs. Similarly, the SLPs asked the children with CIs to correct misunderstood words or phrases more often than the children with TH, and, consequently, they used the positive feedback strategy less often, in both activities. These results are possibly related to language production difficulties observed in children with CIs (Geers et al., 2016).

On another note, the greater number of communicative strategies used with children with CIs indicated that the speech therapists supported not only the production of the correct answers, but also the children's participation in the linguistic exchange. These results should be interpreted positively and agree with the study by Lloyd et al. (2001), who observed that in the interaction of teacher-child dyads with hearing loss and with TH, teachers produced a greater number of turns with children with hearing loss than with TH, in order to encourage them to participate in the activity. In this sense, the fact that SPLs know and use a wide range of strategies to effectively support the participation of children with hearing loss in linguistic activities is relevant.

In terms of the use of adaptation strategies, the SLPs only made a greater number of semantic adaptations for the children with CIs in the conversation activity. As indicated by Fagan & Pisoni (2010), children with CIs may acquire vocabulary at a slower rate than children with TH, manifesting more difficulties in understanding vocabulary than their peers with TH. These results are similar to those obtained by Majorano et al. (2017) in their study on the interaction of mothers with their children with CIs in a play scenario and story reading activity, in which it was observed that, like the SLPs in the present study, the mothers adapted the complexity of their vocabulary to the language level of their children.

In relation to the use of educational strategies, although the SLPs used both implicit and explicit corrections to correct phonological errors produced by children with CIs, as also observed by Ronkainen et al. (2017), it is worth noting the high frequency of implicit corrections used by the SLPs in the current study.

Other frequently observed educational strategies that were intended to give more support to children with CIs in the production of correct words were saying a part of the word that should be produced (phonological bootstrapping), giving the correct model of the word without asking for its repetition (modeling) or asking for the repetition of the word (imitation).

The SLPs also asked questions with two alternative answers (multiple-choice questions) and expanded the responses of the children with CIs at a greater rate than the children with TH, although only in the conversation activity. These results conflict with the findings of Lavelli et al. (2018) in the sense that the mothers of children with CIs used a similar proportion of expansions to the mothers of children with TH. The differences in the use of expansions in the maternal context could be explained by the fact that the SLPs, in their role as language therapists, intentionally tried to incorporate morphosyntactic elements and expand the children's vocabulary, while the mothers sought to support the participation of their children in the interaction.

In addition to the strategies mentioned above, which have already been observed in previous studies exploring maternal interaction and the intervention of SLPs with children with CIs, the study shows that the SLPs also used some of the strategies described in interventions with children with language disorders (Aguado, 1999; Clark, 2013; Pérez, 2013; Rondal, 1990), such as: request for repair of misunderstandings, positive feedback, morphosyntactic adaptations, semantic adaptations, imitation, multiple-choice questions and expansion.

Finally, this study highlights the use of novel strategies that have not been previously described in the literature, such as the use of principles of cooperation, which were used to request more information. Considering that the inclusion of a sufficient amount of information is a pragmatic skill that develops with linguistic experience, the use of this strategy is relevant in the case of children with CIs since such experiences could be affected by hearing loss (Hilviu et al., 2021; Surian et al., 2010).

The choice of the use of different strategies has been shown to vary depending on the linguistic activity carried out (Lavelli et al., 2018). Thus, this study has revealed that SLPs used communication strategies more frequently in a conversation activity. As this is an activity that is meant to deal with everyday issues with the children through dialogue, the SLPs managed the communicative exchange by giving the children more time to respond, or they sought to enrich the content of the responses, requesting more information and clarification of misunderstandings through the principles of cooperation. On the other hand, to support the naming activity, the strategies most frequently used by the SLPs were educational. Specifically, the SLPs endeavored for the children to produce the correct answers, for this they modeled the correct word and requested its repetition (modeling), they gave phonological clues (phonological bootstrapping) and clues about the meaning of the words (semantic bootstrapping), they asked questions with logical errors for the child to modify (cognitive conflict), they referred to outside situations related to the immediate context (decontextualizing strategies) and they focused the child's attention on one aspect of the image to improve their answer (attention direction).

Finally, the results of the study show that the behavior of the SLPs varied depending on the auditory age of the children with CIs. The SLPs used a greater number of educational strategies with the children who had had their CIs for less time - with a lower auditory age. In contrast, with children of more advanced auditory age, the SLPs

used more communication strategies, the most frequent being increasing waiting time. Auditory age is a measure that is associated with the development of language skills, since the longer the children are exposed to the world of sound and language, the more opportunities children have to develop oral language (Nicholas & Geers, 2008; Scarabello et al., 2020). This argument would justify the fact that speech therapists, aware that children who have been hearing for longer probably have more language skills, use fewer educational strategies with them.

In the study by Cruz et al. (2013), it was also found that mothers adapted the strategies they used based on the auditory age of children with CIs. With children of younger auditory age, mothers used strategies that required simpler responses, while as the children's auditory age increased, mothers used strategies that required more complex responses.

Conclusions

The present study explores the types of strategies that SLPs used in linguistic activities with children with CIs, as opposed to those used with children with TH. Until now, the study of these strategies had focused mainly on maternal interactions. When contrasting the results obtained in the present study with those obtained in the studies carried out on maternal interactions, it can be observed that the SLPs, like the mothers, used strategies in a manner adapted to the characteristics of the children. Thus, both mothers and SLPs responded to children's initiatives, regulated children's behavior, used semantic adaptations, and corrected and expanded children's utterances. However, the SLPs used a broader group of strategies whose purpose was to offer tools so that children could give a correct linguistic response, which is closely linked to their professional role. Furthermore, it is interesting to note that these strategies can be applied by other professionals working with children with CIs, such as the classroom teachers, and even

by the parents of children with CIs. They can use these strategies in the classroom and in the home in a way that allows children to generalize their linguistic acquisitions (Vilaseca, 2002).

The strategies most frequently used by SLPs with children with CIs are the use of waiting in silence, positive feedback and implicit correction. These results are relevant since previous studies have shown their efficacy in the linguistic development of children with TH (Dale & Ingram, 1981; Moerk, 1985; Rondal, 1980, 1984; Snow, 1972; Vilaseca, 2002).

In contrast, the least used strategies were explicit correction and imitation. This result is surprising since Ronkainen et al. (2017) observed that speech therapists commonly used these two strategies in the field of language intervention with children with CIs. A possible explanation could be due to the differences in the objectives of the two studies. The main objective of the study by Ronkainen et al. (2017) was to promote vocabulary expansion, so the SLPs applied explicit correction strategies for phonological errors and imitations to reinforce new lexical acquisition, while in the present study, the main objective of the SLPs was to obtain an adequate response to the question asked.

It is worth noting that previous studies carried out in a speech therapy context (Raver et al., 2012; Ronkainen et al., 2017) have described other strategies that were not used by the SLPs in this study, such as the use of parallel speech, acoustic enhancement and explicit corrections. It would be advisable for SLPs to also take these strategies into account in speech therapy work with children with CIs.

One of the advantages of this study is the highly representative nature of the sample, given that every child with a CI in Catalonia that met the inclusion criteria participated in the study.

Limitations and future lines of study

Among the limitations of the study, it is worth mentioning the failure to record the conversation test in part of the sample for the reasons indicated above in the procedures section. However, no statistically significant association was observed between the absence of a response and any of the variables of interest (condition, gender, and age). Due to the low frequency of use, it was not possible to perform a regression on the variables mentioned in the data analysis section.

The low statistical power to detect differences between the two groups of children (CI and TH) and between the two activities (conversation and naming) due to the small size of the study samples should also be noted as a limitation.

Another limitation of the study stems from the lack of experience of the SLPs who participated. The fact that they only had between 1 and 3 years of experience as SLPs may have influenced their use of the strategies. In other words, the differences in strategy usage could reflect the students' ongoing training and might be different for SLPs who have been practicing a long time.

As for future lines of research, it may be fruitful to correlate strategies with types of child errors, so that a more complete perspective of the strategies used by the SLPs in each case can be obtained. Likewise, it is relevant to broaden the study to the use of SLP strategies in other linguistic activities, such as image description and retelling, so that a more detailed perspective of the use of strategies in different linguistic contexts can be obtained.

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Declaration of interest

The authors report there are no competing interests to declare.

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Appendices

Table 1

Statistical description of the study sample.

	Children with typical hearing (TH)	Children with cochlear implant (CI)	Total sample
	n (%)	n (%)	n (%)
Gender			
Male	13 (42)	13 (42)	26 (58)
Female	18 (58)	18 (58)	36 (58)
Type of implant			
Unilateral		21 (67.7)	
Bilateral		10 (32.3)	
	Average (SD)	Average (SD)	Average (SD)
Chronological age (years)	6.03 (0.71)	5.97 (0.75)	6.0 (0.72)
Age at implantation (months)		26.58 (15.04)	
Auditory age (months)		52.03 (15.15)	

Table 2

Categories of analysis.

COMMUNICATION STRATEGIES Procedures for structuring the communicative situation.		
Strategy	Description	Example
Regulation of behavior and attention	Focusing the child's attention on the activity.	SLP: **Sit still and look at the picture.**
Waiting in silence	Pausing for 3 or more seconds after asking a question.	SLP: What are the people playing football called? CHI: **8".**
Waiting and then prompting.	Pausing for 3 or more seconds and then prompting.	SLP: Last time you took the bus with your class, where did you go? CHI: 4". SLP: **Let's see, think**
Waiting and then repeating.	Pausing for 3 or more seconds and then repeating the question.	SLP: What is the wand for? CHI: 5" SLP: **What is the wand for?**
Principles of cooperation.	Asking for more information without a misunderstanding.	SLP: What do you like to play on the playground? CHI: The hairy spider (a game) SLP: **And what else?**
	Asking for more information to clarify a misunderstanding.	SLP: Who do you live with at home? CHI: With mom, Marc and Tania. SLP: **Who are Marc and Tania?**
Response to the child	Responding to the questions or comments of the child.	CHI: Look, there are two! SLP: **Yes, there are two.** CHI: Why are there two? SLP: **I don't know, look, here is the driver and here are the children and this way they see the road better**
Request for repair of misunderstandings	Asking the child to repeat when they cannot be understood.	CHI: xxx (incomprehensible statement) SLP: **What did you say?**
Positive feed-back.	Approving the child's answer.	SLP: What's the jar like? CHI: Full SLP: **Very good.**
ADAPTATION STRATEGIES Adapting the length and complexity of the adult statements to the linguistic level of the children.		
Strategy	Description	Example
Morphosyntactic adaptations	Reducing the length of the utterance.	SLP: What will you do today when you get out of school? CHI:3" SLP: **What do you do after school?**
Semantic adaptations	Adjusting the semantic complexity of the utterance.	SLP: What will you do this weekend? CHI: 3" SLP: **Where are you going this weekend?**
EDUCATIONAL STRATEGIES Verbal behaviors that correct, modify or facilitate correct response from the children.		
Strategies	Description	Examples

Implicit correction	Correcting phonetic or semantic mistakes implicitly.	CHI: It's a b.. a berry SLP: **A fairy**
Imitation	Providing a correct model and asking the child to repeat it	SLP: What is this girl? CHI: A butterfly SLP: **She looks like a butterfly, but she is a fairy. Can you say it?** CHI: Fairy
Modeling	Providing the right model without asking for repetition	SLP: What are these boys? CHI: They are from football SLP: **They are football players** CHI: Football players
Multiple-choice question	Providing a question with two alternative answers	SLP: What is the jar like? CHI: 5" SLP: **Is it full or empty?**
Explicit correction	Directly correcting phonetic, semantic or usage mistakes	SLP: What is it? CHI: It is a keen SLP: **It isn't called a keen, it is called a queen**
Expansion	Completing the child's production without changing the meaning	SLP: When is your birthday? CHI: six SLP: The sixth
Restating	Restating the child's production without changing its meaning	CHI: So if you fall off your motorbike you don't hit your head. SLP: **To protect your head if you fall off your motorbike**
Phonological bootstrapping.	Providing part of the word that must be produced	SLP: What are these? CHI: (2") SLP: **They are ca…** CHI: Carrots!
Semantic bootstrapping	Providing aspects of the meaning the words	SLP: What is this? CHI: I don't know. SLP: **It's something to eat. What could it be?**
Priming	Starting the utterance for the child to finish	SLP: What is a pear? CHI: I don't know. SLP: **Apples and pears are…**
Cognitive conflict	Introducing an incoherence in the question so the child modifies their answer.	SLP: What is this? CHI: A butterfly. **SLP: Are you sure it's a butterfly? Do butterflies use wands?** CHI: A fairy.
Decontextualizing strategies	Referring to outside situations related to the immediate context	SLP: What is the garage for? CHI: I don't know SLP: **What does dad use the garage for?**
Attention direction	Focusing the child's attention on an aspect of the image to improve their response	SLP: Why do you think she's a queen? CHI: I don't know. SLP: **Look what she has on her head.**

Note: SLP: Speech-language pathologist, CHI: child.

Table 3

Frequency of the use of the groups of SLP intervention strategies with children with CIs as compared to children with TH (reference group).

	Conversation			Naming		
	IRR (95% CI)	(IRR – 1) * 100	*p*	IRR (95% CI)	(IRR – 1) * 100	*p*
Communication strategies	1.110 (0.947, 1.301)	11% (-5.3%, 30.1%)	.199	1.038 (0.957, 1.125)	3.8% (-4.3%, 12.5%)	.373
Adaptation strategies	3.823 (1.584, 9.228)	282.3% (58.4%, 822.8%)	.003*	1.391 (0.964, 2.005)	39.1% (-3.6%, 100.5%)	.078
Educational strategies	4.949 (2.628, 9.318)	349.9% (162.8%, 831.8%)	<.001*	1.410 (1.248, 1.594)	41% (24.8%, 59.4%)	<.001*

Note: Poisson regression coefficients (IRR) adjusted for sex and chronological age, 95% confidence intervals(95% CI) and statistical significance (*p*). (IRR – 1) * 100 shows the effect expressed as percent change.*: Statistically significant ($p < 0.05$).

Table 4

Frequency of the use of SLP intervention strategies with children with CIs as compared to children with TH (reference group).

	Conversation			Naming		
	IRR (95% CI)	(IRR – 1) * 100	p	IRR (95% CI)	(IRR – 1) * 100	p
Regulation of behavior and attention	n.c	n.c	n.c	4.868 (1.552, 15.273)	386,8% (55.2%, 1,427.3%)	.007*
Waiting in silence	2.170 (1.577, 2.985)	117% (58%, 199%)	<.001*	1.448 (1.253, 1.672)	44.8% (25.3%, 67.2%)	<.001*
Waiting and then prompting	1.966 (0.871, 4.436)	96.6% (-12.9%, 343.6 %)	.104	0.887 (0.597, 1.318)	-11.3% (-40.3%, -68.2%)	.5523
Waiting and then repeating	2.717 (1.217, 6.067)	171.7% (21.7%, %506.7)	.015*	3.139 (2.074, 4.749)	213.9% (107.4%, 374.9%)	<.001*
Principles of cooperation: asking for more information without a misunderstanding	1.053 (0.689, 1.611)	5.3% (-31.1%, 61.1%)	.811	0.908 (0.574, 1.436)	-9.2% (-42.6%, 43.6%)	.680
Principles of cooperation: asking for more information to clarify a misunderstanding	0.942 (0.310, 2.865)	-5.8% (-69%,186.5 %)	.917	0.608 (0.091 4.088)	-39.2% (-90.9%, 308.8%)	.609
Response to the child	0.569 (0.311, 1.044)	-43.1% (-68.9%,4.4%)	.068	1.101 (0.679 1.786)	10.1% (-32.1%, 78.6%)	.697
Request for repair of misunderstandings	2.671 (0.760, 9.383)	167.1% (-24%, 838.3%)	.125	2.344 (1.003, 5.479)	134.4% (0.3%, 447.9%)	.049*
Positive feedback	0.555 (0.422, 0.729)	-44.5% (-57.8%, -27.1%)	<.001*	0.744 (0.664, 0.834)	-25.6% (-33.6% , -16.6%)	<.001*
Morphosyntactic adaptations	n.c	n.c	n.c	8.119 (0.997, 66.144)	711.9% (-0.3%, 6,514.4%)	.050
Semantic adaptations	2.998 (1.226, 7.331)	199.8% (22.6%,633.1%)	.016*	1.256 (0.861, 1.832)	25.6% (-13.9%,83.2%)	.237
Implicit correction	6.953 (2.121, 22.794)	595.3% (112.1%, 2,179.4%)	.001*	4.259 (2.815, 6.444)	325.9% (181.5%,544.4%)	<.001*
Imitation	n.c	n.c	n.c	2.507 (1.252, 5.017)	150.7% (25.2%, 401.7%)	.009*
Modeling	n.c	n.c	n.c	1.670 (1.037, 2.689)	67% (3.7%,168.9%)	.035*
Multiple-choice question	9.655 (1.094, 85.199)	865.5% (9.4%, 8,419.9%)	.041*	1.995 (0.934, 4.265)	99.5% (-6.6%, 326.5%)	.075
Explicit correction	n.c	n.c	n.c	0.432 (0.161, 1.161)	-56.8% (-83.9%, 16.1%)	.096
Expansion	9.554 (1.262, 72.353)	855.4% (26.2%,7,135.3%)	.029*	2.334 (0.825, 6.601)	133.4% (-17.5%, 560.1%)	.110
Restating	4.132 (0.898, 19.015)	313.2% (-10.2%, 1.801.5%)	.069	2.006 (0.745, 5.398)	100.6% (-25.5%, 438.9%)	.168
Phonological bootstrapping	n.c	n.c	n.c	1.337 (1.044, 1.711)	33.7% (4.4%, 71.1%)	.021*
Semantic bootstrapping	3.100 (0.358, 26.860)	210% (-64.2%, 2,586%)	.305	0.774 (0.552, 1.085)	-22.6% (-44.8%, 8.5%)	.137
Priming	4.360 (0.532, 35.730)	336% (-46.8%, 3,473%)	.170	1.452 (0.992, 2.127)	45.2% (-0.8%, 112.7%)	.055
Cognitive conflict	n.c	n.c	n.c	1.235 (0.805 1.895)	23.5% (-19.5%, 89.5%)	.333
Decontextualizing strategies	n.c	n.c	n.c	0.801 (0.456 1.406)	-19.9% (-54.4%, 40.6%)	.439
Attention direction	n.c	n.c	n.c	0.957 (0.625 1.464)	-4.3% (-37.5%, 46.4%)	.839

Note: Poisson regression coefficients (IRR) adjusted by sex and age, 95% confidence intervals (95% CI) and statistical significance (p). (IRR – 1) * 100 shows the effect expressed as percent change. * IRR statistically significant ($p < 0.05$); n.c.: convergence not achieved.

Table 5

Frequency of use of the groups of SLP intervention strategies as a function of the type of linguistic activity

	Children with CI						Children with TH					
	Conv. %	Nam. %	+	-	=	*p*	Conv. %	Nam. %	+	-	=	*p*
Communication strategies	48.52	36.89	19	6	0	.006*	44.71	33.79	16	6	0	.012*
Adaptation strategies	3.78	2.15	13	11	1	.093	1.04	1.42	4	8	10	.421
Educational strategies	10.09	16.86	5	19	1	.002*	1.77	12.48	0	19	3	<.001*

Note: Conv. %: percentage obtained in the conversation activity; Nam. %: percentage obtained in the naming activity; +: number of participants with higher frequency of responses in conversational activity than naming activity; –: number of participants with lower frequency of responses in conversation activity than naming activity; =: same number of participants with equal frequency of responses in conversation activity as naming activity; P: Exact probability in the Wilcoxon signed-rank test for paired differences (Conv – Nam.); *: Statistically significant ($p < 0.05$).

Table 6

Frequency of use of the SLP intervention strategies as a function of the type of linguistic activity.

	Children with CI						Children with TH					
	Conv. %	Nam %	+	-	=	*p*	Conv. %	Nam. %	+	-	=	*p*
Regulation of behavior and attention	1.52	0.44	3	7	15	.342	0	0.11	0	2	20	.500
Waiting in silence	19.13	13.50	16	9	0	.039*	9.70	10.26	6	14	2	.297
Waiting and then prompting	2.26	1.40	10	8	7	.361	1.37	1.47	5	12	5	.450
Waiting and then repeating	3.28	2.32	12	9	4	.473	1.11	1.05	6	8	8	.695
Principles of cooperation: asking for more information without a misunderstanding	5.09	1.01	21	1	3	<.001*	6.53	1.11	18	3	1	<.001*
Principles of cooperation: asking for more information to clarify a misunderstanding	0.81	0.05	6	1	18	.031*	0.91	0.09	4	2	16	.250
Response to the child	2.05	1.00	8	7	10	.468	3.80	0.96	4	5	13	.996
Request for repair of misunderstandings	1.35	0.69	8	5	12	.270	0.36	0.21	2	4	16	.688
Positive feedback	13.04	16.50	8	17	0	.114	20.93	18.54	11	10	1	.361
Morphosyntactic adaptations	0.50	0.26	4	6	15	.758	0	0.03	0	1	21	1.00
Semantic adaptations	3.28	1.89	13	11	1	.236	1.04	1.39	4	8	10	.460
Implicit correction	3.68	3.44	10	12	3	.691	0.38	0.87	3	8	11	.176
Imitation	0	0.64	0	2	23	.500	0	0.27	0	0	22	1.00
Modeling	0.13	1.35	1	15	9	<.001*	0	0.75	0	5	17	.063
Multiple-choice question	0.88	0.56	6	7	12	.918	0.11	0.39	1	6	15	.031*
Explicit correction	0	0.16	0	2	23	.500	0.18	0.27	1	3	18	.625
Expansion	1.54	0.35	7	5	13	.347	0.12	0.15	1	4	17	.375
Restating	0.93	0.37	8	5	12	.259	0.28	0.19	2	3	17	.938
Phonological bootstrapping	0	3.71	0	13	12	<.001*	0.27	2.78	1	8	13	.023*
Semantic bootstrapping	1.54	1.62	2	17	6	.002*	0.17	2.16	1	14	7	.001*
Priming	1.32	1.66	3	10	12	.091	0.27	1.44	1	11	10	.005*
Cognitive conflict	0.07	1.19	0	15	10	<.001*	0	1.09	0	13	9	<.001*
Decontextualizing strategies	0	0.63	0	11	14	.001*	0	0.79	0	11	11	.001*
Attention direction	0	1.19	0	15	10	<.001*	0	1.32	0	11	11	.001*

Note: Conv. %: percentage obtained in the conversation activity; Nam. %: percentage obtained in the naming activity; +: number of participants with higher frequency of responses in conversational activity than naming activity; –: number of participants with lower frequency of responses in conversation activity than naming activity; =: same number of participants with equal frequency of responses in conversation activity as naming activity; P: Exact probability in the Wilcoxon signed-rank test for paired differences (Conv – Nam.); *: Statistically significant ($p < 0.05$).

Table 7

Frequency of use of the groups of SLP intervention strategies as a function of auditory age (in months) of the children with CIs.

	Conversation			Naming		
	IRR (95% CI)	(IRR – 1) * 100	*p*	IRR (95% CI)	(IRR – 1) * 100	*p*
Communication strategies	1.006 (0.999, 1.012)	0.6% (-0.1%, 1.2%)	.089	1.006 (1.002, 1.009)	0.6% (0.2%, 0.9%)	.001*
Adaptation strategies	1.004 (0.982, 1.028)	0.4% (-1.8%, 2.8%)	.711	0.998 (0.984, 1.013)	-0.2% (-1.6%, 1.3%)	.804
Educational strategies	0.999 (0.985, 1.014)	-0.1% (-1.5%, 1.4%)	.927	0.988 (0.983, 0.993)	-1,2% (-1.7%, -0.7%)	<.001*

Note: Poisson regression coefficients (IRR) adjusted by sex, 95% confidence intervals (95% CI) and statistical significance (*p*). (IRR – 1) * 100 shows the effect expressed as percent change per 1 month increase in auditory age. *: Statistically significant ($p < 0.05$).

Table 8

Frequency of use of SLP intervention strategies as a function of the auditory age (in months) of the children with CIs.

	Conversation			Naming		
	IRR (95% CI)	(IRR – 1) * 100	*P*	IRR (95% CI)	(IRR – 1) * 100	*p*
Regulation of behavior and attention	0.911 (0.848, 0.977)	-8.9% (-15.2%, -2.3%)	.009*	0.991 (0.961, 1.021)	-0.9% (-3.9%, 2.1%)	.408
Waiting in silence	1.013 (1.003, 1.024)	1.3% (0.3%, 2.4%)	.013*	1.003 (0.997, 1.009)	0.3% (-0.3%, 0.9%)	.309
Waiting and then prompting	0.988 (0.961, 1.015)	-1.2% (-3.9%, 1.5%)	.385	1.012 (0.995, 1.030)	1.2% (-0.5%, 3%)	.166
Waiting and then repeating	0.992 (0.968, 1.017)	-0.8% (-3.2%, 1.7%)	.5362	1.002 (0.989, 1.015)	0.2% (-1.1%, 1.5%)	.817
Principles of cooperation: asking for more information without a misunderstanding	1.001 (0.983, 1.019)	0.1% (-1.7%, 1.9%)	.920	0.998 (0.978, 1.018)	-0.2% (-2.2%, 1.8%)	.809
Principles of cooperation: asking for more information to clarify a misunderstanding	1.000 (0.953, 1.049)	0% (-4.7%, 4.9%)	.994	1.004 (0.916, 1.100)	0.4% (-8.4%, 10%)	.937
Response to the child	1.011 (0.980, 1.044)	1.1% (-2%, 4.4%)	.480	1.003 (0.983, 1.023)	0.3% (-1.7%, 2.3%)	.790
Request for repair of misunderstandings	1.022 (0.987, 1.059)	2.2% (-1.3%, 5.9%)	.221	1.029 (1.001, 1.058)	2.9% (0.1%, 5.8%)	.042*
Positive feedback	1.005 (0.982, 1.019)	0.5% (-1.8%, 1.9%)	.419	1.009 (1.004, 1.014)	0.9% (0.4% , 1.4%)	.001*
Morphosyntactic adaptations	0.928 (0.861, 1.000)	-7.2% (-13.9%, 0%)	.049*	1.008 (0.966, 1.052)	0.8% (-3.4%, 5.2%)	.707
Semantic adaptations	1.019 (0.993, 1.045)	1.9% (-0.7%,4.5%)	.161	0.997 (0.982, 1.012)	-0.3% (-1.8%,1.2%)	.690
Implicit correction	0.988 (0.966, 1.011)	-1.2% (-3.4%, 1.1%)	.316	0.981 (0.970, 0.992)	-1.9% (-3%, -0.8%)	.001*
Imitation	n.c	n.c	n.c	0.982 (0.960, 1.005)	-1.8% (-4%, 0.5%)	.134
Modeling	1.057 (0.916, 1.221)	5.7% (-8.4%, 22.1%)	.447	0.990 (0.973, 1.007)	-1% (-2.7%, 0.7%)	.250
Multiple-choice question	0.952 (0.903, 1.003)	-4.8% (-9.7%, 0.3%)	.066	1.000 (0.973, 1.028)	0% (-2.7%,2.8%)	.993
Explicit correction	n.c	n.c	n.c	1.022 (0.969, 1.078)	2.2% (-3.1%, 7.8%)	.429
Expansion	1.045 (1.008, 1.083)	4.5% (0.8%, 8.3%)	.016*	0.979 (0.947, 1.012)	-2.1% (-5.3%,1.2%)	.211
Restating	0.986 (0.948, 1.026)	-1.4% (-5.2%, 2.6%)	.487	1.010 (0.976, 1.046)	1% (-2.4%,4.6%)	.572
Phonological bootstrapping	n.c	n.c	n.c	0.972 (0.962, 0.982)	-2.8% (-3.8%,-1.8%)	<.001*
Semantic bootstrapping	0.976 (0.917, 1.038)	-2.4% (-8.3%, 3.8%)	.437	0.984 (0.969, 1.00)	-1.6% (-3.1%,0%)	.044*
Priming	1.038 (0.987, 1.092)	3.8% (-1.3%, 9.2%)	.149	1.021 (1.005, 1.037)	2.1% (0.5%, 3.7%)	.010*
Cognitive conflict	n.c	n.c	n.c	0.994 (0.977, 1.012)	-0.6% (-2.3%, 1.2%)	.527
Decontextualizing strategies	n.c	n.c	n.c	0.984 (0.959, 1.010)	-1.6% (-4.1%,1%)	.230
Attention direction	n.c	n.c	n.c	1.003 (0.985, 1.022)	0.3% (-1.5%,2.2%)	.722

Note: Poisson regression coefficients (IRR) adjusted by sex and chronological age, 95% confidence intervals (95% CI) and statistical significance (*p*). (IRR – 1) * 100 shows the effect expressed as percent change per 1 month increase in auditory age. * IRR statistically significant ($p < 0.05$); n.c.: convergence not achieved.