PRAGMATIC COMPETENCE OF CHILDREN WITH COCHLEAR IMPLANTS IN LINGUISTIC ACTIVITIES

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Abstract

The objective of this study was to analyze the pragmatic competence of children with cochlear implant (CI). This study explored whether children with CI participated in communicative exchanges in a similar way to children with typical hearing (TH), as well as how their participation was regulated by the activity they performed. The sample consisted of 31 children with CI (prelingual deafness and hearing age equal to or greater than 2 years) and 31 children with TH. The study was carried out using two activities: conversation and picture naming. The results showed that children with CI participated in longer communicative exchanges than their peers with TH and they had greater difficulties in adjusting to the production of their interlocutor. The type of linguistic activity and their hearing age influenced the responses of children with CI.

Keywords: pragmatics, cochlear implant, speaking turns, Gricean maxims.

Introduction

Pragmatics, understood as the study of the use of language in an interactive context, involves using language appropriately and effectively in a communicative exchange between two or more people (Zaidman-Zait & Most, 2018). Pragmatic abilities have been widely studied in the literature on infantile language using the analysis of conversational exchanges with the objective of understanding how children participate in communicative exchanges. Conversation involves the organization of utterances using speaking turns, comprehension of the language of the interlocutor and appropriate formulation of the message for the communicative aim (Pérez Pérez, 2016).

Within the study of deaf or hard of hearing, investigations into pragmatics have developed more slowly than research on language content and form. Despite the growing interest in studying the benefits of cochlear implants (CI) in children with prelingual deafness (deafness prior to language acquisition), there have only been a limited number of studies into the use of language with inconsistent results.

In relation to the analysis of speaking turns, Toe & Paatsch (2010) performed a study on a question-and-answer activity between children with typical hearing (TH) and deaf or hard of hearing children between 7 and 12 years old. In the group of deaf or hard of hearing children, 22 were children with CI and 13 were children with hearing aids. The results indicated that children with CI and hearing aids were able to understand and respond correctly to their peers' questions at a higher rate than children with TH. In a subsequent study, whose objective was to analyze the conversations between 20 dyads of CI-TH and TH-TH children aged between 9 and 12 years, Toe & Paatsch (2014) found that children with CI exhibited similar response times to their counterparts with TH and used a similar number of turns.

Along the same lines, Toe et al. (2007) studied conversation in dyads of adults and

children with TH, ranging in age between 6 and 16. The authors confirmed a low number of communication breakdowns within the dyads. The younger children used a higher number of simple answers than the older ones. The researchers concluded that, the high level of communicative knowledge of the teachers might have contributed to supporting the skills of their students and therefore avoided communication breakdowns.

These results were echoed in a study by Most et al. (2010) on the performance of children with CI and with TH, ranging in age between 6 and 9, in a spontaneous conversation with an unknown adult that used Prutting & Kirchner's (1987) pragmatic protocol. The study found that children with CI had more non-responses or exhibited response times > 2 seconds more often than their peers with TH. Furthermore, the children with CI responded to the questions with insufficient amounts of information and none of them consistently responded with relevant information. In contrast, Toe and Paatsch (2014) indicated that adolescents with CI's response times were similar to their TH peers in the conversation activity.

In addition to speaking turns, conversational competence involves the ability to ask for clarification. The study of referential communication performed by Ibertsson et al. (2009a) showed that adolescents with CI asked for clarification of information in a similar manner to their peers with TH and executed the task without communication breakdowns in a referential communication task. In the same line, Socher et al. (2019) indicate that children with CI between 5 and 8 years old gave and requested information in a similar way to their peers with TH in everyday situations. Conversely, the study by Church et al. (2017), which analyzed the conversation between peers with CI and TH between 7 and 12 years old, showed that children with CI requested a greater number of repairs and clarifications than their peers with TH.

Efficient conversation requires that partners not only follow the rules of organization, but also that they participate cooperatively in the communicative exchange. Grice (1975) explained the cooperative principle as a universal principle which allows speakers to provide

adequate content in responses to their partners by conforming with 4 rules or maxims: the maxim of quantity (transmitting neither less nor excessive information than necessary), the maxim of quality (telling the truth), the maxim of relation (saying only what is relevant), and the maxim of manner (speaking in an orderly manner, avoiding ambiguity and excessive prolixity). Many of the studies exploring the development of the maxims analyze the age at which children start to understand them. One of them, by Eskritt et al. (2008), invited children with TH from 3 to 5 to choose which of two puppets followed the maxims. The results of the study indicated that the younger children could understand the maxim of relation but, in contrast, they found it more difficult to understand the maxim of quantity and quality. A similar study by Okanda et al. (2015), carried out with children from 4 to 6, showed that the younger children understood the maxims of quantity and quality better than the maxim of relation and the maxim of manner, while the older children understood all the maxims in the same way that adults do. The studies mentioned previously analyze the understanding of the Gricean maxims in children with TH. Nonetheless, no research is known that has addressed the cooperative participation of children with CI in communicative exchanges.

The only study on the use of Gricean maxims in child development was carried out by Pellegrini et al. (1987) in children with TH, between 2 and 4 years old, interacting with their mothers and fathers in play sessions. The results revealed that younger children frequently used the maxims of quality and mode. Adequate application of the maxims of quantity and relation was only observed in the oldest participants. The authors attributed these results to young children's difficulties in delivering contingent responses and suggested that children who did not follow the maxim of relation may not have understood the semantic demand of the preceding utterance.

The variability of results in the pragmatic performance of children with CI can be explained in part by the different communicative contexts, the wide range of skills analyzed in

various studies and with the hearing experience. Hilviu et al. (2021) analyzed the pragmatic skills of children with CI between 6 and 9 years old; the authors pointed out that the younger children had difficulties in understanding and respecting the dialogical structure of conversation, understood as the ability to use speaking turns appropriately, however, as the age of the children increased, their difficulties lessened. According to the authors, this is because older children have access to a greater number of linguistic experiences in different contexts and, consequently, were more likely to develop language. However, there is no evidence that correlates hearing age with aspects of organization and cooperative participation in the interactions of children with CI.

Another factor to consider is the activity in which the children are participating. In relation to this, Shatz (1983) indicated that, despite having a quantity of relevant communicative knowledge, children do not always manage to use it adequately. The variability in the use of children's communicative knowledge could be related to the context, the information processing demands and the level of organization of the knowledge involved in the task. The author concluded that in order to achieve a complete understanding of communicative knowledge it is necessary to examine it in a wide range of activities.

The purpose of this study was to find out whether children with CI participate in communicative exchanges in a similar way to children with TH and how this participation is regulated by the activity they carry out. To this end, communicative exchanges will be studied in two activities of different linguistic complexity, conversation and picture naming, a structured task widely used to study the process of lexical access (Pérez Pérez, 2016).

The study aims to characterize the pragmatic competence of children with CI relative to their peers with TH and as a function of task (conversation and naming) across five specific measures:

1. Length of communicative exchanges.

2. Adjustment to the speaker's production.
3. Difficulties with speaking turns.
4. Response latency.
5. Failures to follow Gricean maxims (only for the conversation task).

Given that studies on the population with CI have reported differences depending on hearing age, the influence of this variable on each of the previous specific objectives has been analyzed, as well.

Methods

Participants

A total of 62 children participated in the study, of which 31 have IC and 31 have TH. The sample under study was made up of 18 girls and 13 boys with CI (21 with unilateral implants and 10 with bilateral implants), between 5 and 7 years old ($\overline{X}$= 6.0; SD= 0.72). Their hearing age (time elapsed since the children received the cochlear implant) was equal to or greater than 2 years and their aided thresholds with CI were between 10dB and 35dB ($\overline{X}$= 20.78dB; SD= 6.29dB). See Table 1.

---------- Insert Table 1 near here ----------

The children with CI all had prelingual deafness (deafness before language acquisition) and hearing parents. They used spoken language and were educated in regular inclusive schools in Catalonia following the same curriculum as their peers with TH. None of them presented any other associated disabilities.

The selection of the sample was carried out through the Educational Resource Centers for Deaf or Hard of Hearing Children (CREDA), which are institutions under the purview of the Department of Education of the Generalitat de Catalunya, whose main objective is to provide speech-language therapy support to deaf or hard of hearing students. All 10 Catalonian

CREDAs participated in the study, so the sample was representative of the entire population of children with CI of the ages and characteristics mentioned.

Age- and sex- matched peers with TH from a similar socioeconomic background were selected as control participants.

Informed consent was obtained from all participating families in accordance with the guidelines of the Ethics Committee for Human and Animal Experimentation of the Universitat Autònoma de Barcelona (UAB).

Materials

The study was carried out using two activities of different linguistic complexity: conversation and picture naming.

The conversation activity took the form of a semi-structured individual interview that was initiated from 12 questions about various aspects of daily life, such as: Who do you live with at home? What do you like most about school? What do you do after school? What do you like to play on the playground? What are you doing this weekend?

The naming activity used 28 images from the AREPA test (Aguilar and Serra, 2003), which evaluates the phonology of children from 3 to 6 years old, to ensure that the vocabulary was age-range appropriate. The activity consisted of 73 questions as a starting point, in which the participants were prompted to produce a noun (What is this?), an adjective (What is it like?; What is happening to it?), a verb (What is it for?), an adverb of place (Where?), a category (What kind of thing is it?) and answer causal questions (Why do you think so?).

Procedure

The tests were administered to individual children, by speech-language pathologists (SLP) who collaborated in the research, in their own schools in a room without distractions. The conversation was conducted first, followed by the picture naming activity.

Before starting the test, the SLP explained the activity to the children and made sure that they understood the instructions. Additionally, the children were told to ask for clarification or repetition of the information as many times as they needed.

Audio of the experimental sessions was recorded and then transcribed word for word.

Subsequently, the transcripts were analyzed, codified and reviewed independently by two of the authors. Discrepancies were resolved by discussion with a third author when necessary.

Due to recording technical difficulties, 7 children with CI and 9 children with TH could not be transcribed in the conversation activity. Therefore, they were not included in the analysis of this activity. This means that the analysis of the conversation activity was made with 24 children with CI and 22 children with TH.

Measurements and categories of analysis

The hearing condition (CI, TH), sex (male, female), chronological age, and hearing age (both in months) were recorded for all participants (Table 1).

In order to carry out the analysis of both activities, the communicative exchanges were divided into adjacency pairs, understood as semantically related productions of the two speakers (Pérez Pérez, 2016). Due to the structure of the activities that have been studied, the most used type of pair was ‘question-answer.’

For each of the activities studied (conversation and naming) the following categories and quantitative variables were established (Table 2).

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All of the children's responses were analyzed; the correct responses were included in the category of adjustment to the speaker's production while the incorrect responses were included

in the categories of difficulties with speaking turns and failures to follow Grice's maxims (Table 2).

Data analysis

Based on the scale of measurement of the response variables recorded in the conversation and naming activities (counts) and the non-experimental nature of our study, Poisson regression models were adapted to analyze the differences between the answers of the children with CI and TH, as well as the influence of the hearing age of the children with CI. The Incidence Rate Ratio (IRR) was calculated as a measure of the relative risk, as well as its confidence interval (95%) and the *p*-values (Lindsey, 1995; Long, 1997; Vives, Losilla & Rodrigo, 2006). All the regression models included the number of adjacency pairs as the dependent variable, and the chronological age and sex as adjustment variables.

In order to study the differences between the answers registered in the conversation and naming activities the sign test (Miller & Miller, 1993) was applied.

In all analyses, p-values < 0.05 were considered statistically significant.

All the statistical analyses were carried out with Stata/SE v16 (Stata Corp, 2019).

Results

Length of communicative exchange.

Children with CI engaged in longer communicative exchanges than their peers with AT ($p < 0.001$) (Table 3): the length of activity of children with CI varied between 26% and 56% greater than in their peers with TH in the conversation activity and between 15% and 27% higher in the naming activity.

Sign tests comparing the results obtained in the two activities showed that the decrease in length of the communicative exchanges in the conversation activity was statistically

significant, both in the group of children with CI and in the group of children with TH (p< 0.001) (Table 4).

Adjustment to the speaker's production

The children with CI gave less correct responses compared to their TH peers ($p < 0.001$) (Table 3): they gave between 9% and 29% less correct responses in the naming activity and between 8% and 18% less correct responses in the naming activity compared to their peers with TH.

The results also proved that the number of correct answers was statistically significantly inferior in the conversation activity, both in children with CI ($p = 0.007$) and with children with TH ($p = 0.004$) (Table 4).

Difficulties with speaking turns

Non-responses

The children with CI gave more non-responses compared to their TH peers ($p < 0.001$) (Table 3): the children with CI remained silent between 2.6 to 7.6 times more often in the conversation activity and between 1.7 and 2.5 times more often in the naming activity compared to their peers with TH.

The results of the sign test did not indicate significant differences in the number of non-responses between activities for any of the groups (Table 4).

Comprehension Errors

Children with CI exhibited more comprehension errors than their peers with TH ($p <$ 0.001) (Table 3): the children with CI showed between 3.1 y 24.6 times more comprehension

errors than the children with TH in the conversation activity and between 2.2 and 4.1 times more comprehension errors in the naming activity.

When comparing the results between activities, the sign test did not show significant differences between the activities for the group with CI, while comprehension errors were statistically less common in the conversation activity for the children with TH (p = 0.004) (Table 4).

Requests for clarification

In the conversation activity, children with CI requested more clarifications than their peers with TH (p = 0.027) (Table 3): children with CI requested between 1.1 and 9.7 times more clarifications than their peers with TH in the conversation activity. No differences were found in the naming activity

The results did not indicate significant differences in the number of requests for clarification between activities for any of the groups (Table 4).

Response latency

No statistically significant differences were observed in the response latency between the children with CI and TH (Table 3), nor in the response latency as a function of the activity (Table 4).

Failure to follow the Gricean maxims

First maxim of quantity

Children with CI had no significant differences in the number of failures to follow the first maxim of quantity in relation to the children with TH (Table 3).

Second maxim of quantity

The children with CI had less difficulty than their peers with TH in following the second maxim quantity (p = 0.002) (Table 3): the children with CI had between 53% and 95% less difficulties compared to their peers with TH to follow the second maxim of quantity.

Maxim of relation

The children with CI had more difficulty than their peers with TH in following the maxim of relation (p = 0.010) (Table 3): the children with CI had between 1.2 and 4.3 times more difficulties following the maxim of relation compared to their peers with TH.

Maxim of manner

Children with CI had no significant differences in the number of failures to follow the maxim of manner in relation to the children with TH (Table 3).

---------- Insert Table 3 near here ----------

---------- Insert Table 4 near here ----------

Influence of the hearing age

In both activities, the children with a higher hearing age (children who received the cochlear implant longer ago) showed communicative exchanges statistically shorter than their peers with a lower hearing age (p < 0.001) (Table 5): as the hearing age of children with CI increases, the length of exchanges decreased by 1% to 2% in the speaking activity and by 0% to 1% in the naming activity.

No differences were found in the adjustment to the speaker's production depending on the hearing age (Table 5).

The children with higher hearing ages did not show differences in the comprehension errors in the conversation activity. In the naming activity, the children with a higher hearing age showed less comprehension errors to the children with lower hearing age (p < 0.001) (Table

5): children with a higher hearing age showed between 0% and 2% less comprehension errors than children with a lower hearing age.

The children with higher hearing ages did not show differences in the response latency in the conversation activity. In the naming activity, the children with a higher hearing age showed a response latency to the children with lower hearing age (p = 0.042) (Table 5): children with a higher hearing age showed between 0% and 2% more response latencies than children with a lower hearing age.

---------- Insert Table 5 near here ----------

Discussion

The objective of the work was to ascertain whether children with CI participate in communicative exchanges in a similar manner to that of children with TH and if this participation depends on the communicative context.

The results show that the children with CI participated in longer communicative exchanges and had greater difficulties adjusting their response to the speaker's production than their peers with TH. Regarding the use of Grice's maxims, the children with CI gave a higher number of irrelevant responses than their peers with TH. The linguistic activity influenced the length of the exchange, and the number of correct responses and comprehension errors. The hearing age of the children with CI proved to have an influence on the length of the exchanges, on the number of comprehension errors and on the response latency. These results are consistent with previous studies that indicate pragmatic difficulties in children with CI due to the dominance exercised by adults during the interaction in order to avoid communication breaks (Church et al, 2017; Hilviu et al., 2021, Most et al 2010). The results obtained in the present study, where children with CI were shown to participate in longer communicative

exchanges, could be explained by the fact that the activities were led by speech-language pathologists. Since their job is to develop the language skills of children with CI, they may have increased the number of interventions with the aim of repairing breakdowns in communication, and requesting more information.

The children with CI in this study gave fewer correct answers, had more difficulty understanding questions, and spent more time in silence than their peers with TH, which could be related to underlying language difficulties (Hilviu, et al 2021; Most et al, 2010; Rinaldi, 2013). In the same sense, the large number of irrelevant answers given by children with CI coincides with the results of the study by Most et al. (2010). This could potentially be due to difficulties in understanding the semantic demand due to a delay in linguistic development (Pellegrini et al., 1987).

Although the global results indicate pragmatic difficulties in the group with CI, the analysis of the requests for clarification are encouraging, since they indicate that the children with CI participated actively, trying to avoid communication breakdowns in the exchange in a similar manner to that confirmed by Church et al. (2017) and Ibertsson et al. (2009a). The lack of differences in response latency between the children with CI and with TH coincides with Toe & Paatsch's study (2014), providing clear evidence of how an adequate speech-language therapy intervention with children with CI can put their performance on the same level as that of their peers with TH in these aspects of pragmatics.

In the same way, we have obtained results that show some similarities in the use of Gricean maxims between the two groups. The children with CI included enough information during the exchange (first maxim of quantity) and gave the information in an orderly manner (maxim of manner) in the same way that children with the TH did. The results are encouraging, considering that the children with CI were equally as informative as their peers with TH and

avoided giving excessive and redundant information in a higher proportion than their peers. Nevertheless, the difficulties in the selection of relevant information indicate the need to include an approach to this skill in the speech-language therapy intervention program for the children with CI.

The differences found between the conversation and naming activities can be explained by the goal of each of activity. In the naming activity, which required a specific answer, the speech-language pathologists initiated more speaking turns in order to support the correct production of the target word. Conversely, in the conversation activity, where the goal was to obtain information on daily life of the child, the speech- language pathologists needed a smaller number of adjacent pairs because they sought to motivate children's participation or to expand the information in a general way.

Regarding the analysis of the influence of the hearing age of the children with CI, the results highlight the positive impact that the listening experience has on the pragmatic competence of children with CI (Hilviu et al, 2021).The children who have had the implant longer participated in shorter communicative exchanges and obtained a lower number of comprehension errors than the children with a lower hearing age. These results could reveal that hearing experience (and probably more speech-language therapy) increased their comprehensive skills, so the children experienced a lower number of comprehension errors, and consequently, the speech-language pathologists asked fewer questions, which made the communicative exchanges shorter.

Paradoxically, the results of the analysis of response latency indicated an increase as the hearing age of the children with CI increased. On the other hand, the adjustment to the speaker’s production, the non-responses, the requests for clarification and the failures to follow the Gricean maxims were not influenced by their hearing age, possibly because this is not the only factor which influences the pragmatic performance of the children with CI.

Conclusions

In conclusion, despite benefitting from aided thresholds which enable children with CI to have optimal hearing performance of the children with CI at an optimal level, having had the CI for more than two years and participating in inclusive educational environments, the children with CI did not use language in the same way as their peers with TH. The results indicate that children with CI needed more speaking turns to carry out the linguistic activity, remained silent longer, had more comprehension errors and gave fewer correct answers than their peers with TH. In terms of the information in their responses, children with CI gave a greater number of irrelevant answers than their peers with TH.

Future research should analyze the complete interaction of the dyads, including the questions asked by the speech-language pathologist, with the aim of obtaining a broader perspective of the regulation of the communicative interaction. It would also be interesting to include language and cognitive performance as variables in the adjustment of the pragmatic response of the children with CI.

This study contributes to the knowledge of the use of language of children with CI, since there are no previous studies that analyze their pragmatic performance in activities that require different linguistic demands. The analysis of the use of the Gricean maxims in the interactions of the participants with CI allows for a better an understanding of the specific obstacles that the children with CI found when using them. Finally, it is important to mention that one of the strengths of this study is that it relies on a sample of all the children with CI in Catalonia who meet the inclusion criteria described in the study, so the results obtained can be considered by speech-language pathologist for improving the pragmatic competence of the children with CI.

Limitations

One of the limitations of the study is not having recorded the conversation test in some cases of the sample because of the reasons indicated in the procedure section. Nonetheless, we did not observe a statistically significant association between the lack of response and each of the variables of interest (condition, age and sex). Another factor to consider is that due to the fact that pragmatics is sensitive to the variable of the interlocutor, it is difficult to specify the influence of the participation of different speech-language pathologists in the process of data collection.

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Declaration of competing interest

The authors declare no conflict of interest.

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Appendix

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)	
Hearing age (months)		52.03 (15.15)	

Table 2.

Categories and Quantitative Variables.

Category	Quantitative Variable	Example
Length of the communicative exchange	Number of adjacency pairs produced by the adult-child dyad.	*I: Who do you live with at home?* *C: With my mother, my father and my little brother.*
Adjustment to the speaker's production: correct responses	Number of correct responses	*I: What do you like to play on the playground?* *C: I like to play house and tag.*
Difficulties with speaking turns		
Non-responses	Number of questions with no response.	*I: How do you play on the bridge?* *C: (7")*
Comprehension errors	Number of inadequate responses	*I: Who do you live with?* *C: In Barcelona*
Requests for clarification	Number of turns requesting clarification of information given by the speaker.	*I: And what do you do when you get home?* *C: Today or Wednesday?*
Response latency	Number of responses in which the child pauses for 2 or more seconds before responding	*I: What things do you do when you get out of school?* *C: (5") mmm I like to draw and do homework.*
Failures to follow Gricean maxims		
First maxim of quantity	Number of responses with less information than the exchange requires	*I: What do you like to play?* *C: A game.*
Second maxim of quantity	Number of responses with excessive information	*I: And do you do crafts?* *C: Yes, with my fingers and my hands.*
Maxim of relation	Number of responses with irrelevant information	*I: And what would you do if you went to the mountains?* *C: I would wear warm clothes.*
Maxim of manner	Number of disorganized responses	*I: And what was this bookmark like?* *C: Well, it was diamond shaped and it had eyes like, it had eyes like those that are small, but it got stuck on a big piece of paper, we cut it out, then we stuck small eyes on it, that was the last thing, first we folded it, we stuck the mouth and the tongue.*

Table 3.

Frequency of responses of children with CI compared to children with TH (control group).

	Conversation			Naming		
	IRR (95% CI)	(IRR – 1) * 100	*p*	IRR (95% CI)	(IRR – 1) * 100	*p*
Length of communicative exchange	1.40 (1.26, 1.56)	40% (26%, 56%)	<.001*	1.21 (1.15,1.27)	21% (15%, 27%)	<.001*
Adjustment to the speaker's production: correct responses	0.80 (0.71, 0.91)	-20% (-29%, -9%)	<.001*	0.87 (0.82, 0.92)	-13% (-18%, -8%)	<.001*
Non-responses	4.39 (2.57, 7.60)	339% (157%, 660%)	<.001*	2.07 (1.74, 2.47)	107% (74%, 147%)	<.001*
Comprehension errors	8.79 (3.14, 24.62)	779% (214%, 2.362%)	<.001*	3.00 (2.18, 4.12)	200% (118%, 312%)	<.001*
Requests for clarification	3.33 (1.14, 9.67)	233% (14%, 867%)	.027*	1.46 (0.87, 2.45)	46% (-13%, 145%)	.152
Response latency	1.39 (0.98,- 1.96)	39% (-2%,- 96%)	.065	1.12 (0.92, 1.37)	12% (-8%, 37%)	.259
Grice – First maxim of quantity	0.95 (0.69, 1.32)	-5% (-31%, 32%)	.773	n.a	n.a.	n.a.
Grice – Second maxim of quantity	0.13 (0.04,- 0.47)	-89% (-96%,-53%)	.002*	n.a	n.a.	n.a.
Grice - Maxim of relation	2.28 (1.22, 4.26)	128% (22%, 326%)	.010*	n.a	n.a.	n.a.
Grice - Maxim of manner	0.71 (0.33, 1.52)	-29% (-67%, 52%)	.370	n.a	nac.	n.a.

Note: Poisson regression coefficients (IRR) adjusted for chronological age and sex, 95% confidence intervals (95% CI) and *p*-values. (IRR - 1) * 100 shows the effect expressed as percentage of change. * $p < 0.05$. n.a.: not applicable.

Table 4.

Response frequency according to the type of linguistic activity.

	Children with CI						Children with TH					
	Conv.	Nam.	+	-	=	*p*	Conv.	Nam.	+	-	=	*p*
Length of communicative exchange (number of adjacency pairs)	38.25	126.32	0	24	0	<.001*	27.32	107.03	0	22	0	<.001*
Adjustment to the speaker's production: correct responses (%)	61.27	73.71	5	19	0	.007*	76.19	83.69	4	18	0	.004*
Non-response (%)	13.49	10.19	14	10	0	.541	2.57	5.58	6	15	1	.078
Comprehension Errors (%)	4.62	4.51	12	10	2	.832	0.58	1.78	2	14	6	.004*
Requests for clarification (%)	3.10	1.27	10	6	8	.455	0.60	0.63	4	6	12	.754
Response latency (%)	12.12	6.59	16	8	0	.152	10.05	6.02	8	11	3	.648

Note: Conv: count (length of communicative exchange) or percentage (rest of measures) obtained in the conversation task; Nam.: count (length of communicative exchange) or percentage (rest of measures) obtained in the naming task; +: higher % in conversational task than naming task; –: lower % in conversation task than naming task; =: same % in conversation task as naming task; P: Probability in the Sign test (Conv – Nam.); *: Statistically significant ($p < 0.05$).

Table 5.

Response frequency according to hearing age of children with CI.

	Conversation			Naming		
	IRR (95% CI)	(IRR – 1) * 100	*p*	IRR (95% CI)	(IRR – 1) * 100	*p*
Length of the communicative exchange	0.99 (0.98, 0.99)	-1% (-2%,-1%)	<.001*	1.00 (0.99,1.00)	0% (-01%,- 0%)	<.001*
Adjustment to the speaker's production: Correct responses	1.00 (0.99, 1.00)	0% (-1%, 0%)	.582	1.00 (1.00, 1.00)	0% (0%, 0%)	.327
Non-responses	1.01 (1.00, 1.03)	1% (0%,- 3%)	.099	1.006 (1.00, 1.01)	0.6% (0%, -1%)	.060
Comprehension errors	1.00 (0.98,- 1.02)	0% (-2%, 2%)	.883	0.96 (0.95,- 0.98)	-4% (-5%, -2%)	<.001*
Requests for clarification	1.00 (0.97,- 1.03)	0% (-3%, 3%)	.880	1.00 (0.98,- 1.02)	0% (-2%, 2%)	.785
Response latency	1.02 (1.00,- 1.03)	2% (0%,- 3%)	.054	1.010 (1.00,- 1.02)	1% (0%, 2%)	.042*
Grice – First maxim of quantity	1.00 (0.98,- 1.02)	0% (-2%, 2%)	.952	n.a.	n.a.	n.a.
Grice – Second maxim of quantity	1.02 (0.92,- 1.13)	2% (-8%, 13%)	.682	n.a.	n.a.	n.a.
Grice - Maxim of relation	1.00 (0.98,- 1.02)	0% (-2%, 2%)	.977	n.a.	n.a.	n.a.
Grice - Maxim of manner	1.00 (0.96,- 1,04)	0% (-4%, 4%)	.792	n.a.	n.a.	n.a.

Note: Poisson regression coeficients (IRR) sorted by chronological age and sex, 95% confidence intervals (95% CI) and *p*-values. (IRR - 1) * 100 shows the effect expressed in percentage of change. * $p < 0.05$. n.a.: not applicable.