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Inferences and metaphoric comprehension in unilaterally implanted children with adequate formal oral language performance

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ABSTRACT

Objectives: To assess skills in inferences during conversations and in metaphors comprehension of unilaterally cochlear implanted children with adequate abilities at the formal language tests, comparing them with well-matched hearing peers; to verify the influence of age of implantation on overall skills.
Methods: The study was designed as a matched case–control study. 31 deaf children, unilateral cochlear implant users, with normal linguistic competence at formal language tests were compared with 31 normal hearing matched peers. Inferences and metaphor comprehension skills were assessed through the Implicit Meaning Comprehension, Situations and Metaphors subtests of the Italian Standardized Battery of "Pragmatic Language Skills MEDEA". Differences between patient and control groups were tested by the Mann–Whitney *U* test. Correlations between age at implantation and time of implant use with each subtest were investigated by the Spearman rank correlation coefficient.
Results: No significant differences between the two groups were found in inferencing skills ($p = 0.24$ and $p = 0.011$ respectively for Situations and Implicit Meaning Comprehension). Regarding figurative language, unilaterally cochlear implanted children performed significantly below their normal hearing peers in Verbal Metaphor comprehension ($p = 0.001$). Performances were related to age at implantation, but not with time of implant use.
Conclusions: Unilaterally cochlear implanted children with normal language level showed responses similar to NH children in discourse inferences, but not in figurative language comprehension. Metaphors still remains a challenge for unilateral implant users and above all when they have not any reference, as demonstrated by the significant difference in verbal rather than figurative metaphors comprehension. Older age at implantation was related to worse performance for all items. These aspects, until now less investigated, had to receive more attention to deeply understand specific mechanisms involved and possible effects of different levels of figurative language complexity (presence or absence of contextual input, degree of transparency and syntactic frozenness). New insight is needed to orient programs in early intervention settings in considering and adequately responding to all these complex communicative need of children with hearing loss.

1. Introduction

With early intervention programs and the advent of cochlear implants, more and more deaf children with severe/profound hearing loss are able to reach language abilities similar to that of their normal hearing (NH) peers [1,2] and have successful academic achievements [3–6]. Intervention at an early age, in particular around the first years of life, promotes restoration of adequate auditory function [7,8] within a time frame when is still possible to take full advantage of the neural plasticity and establish normal ways of learning and development [9].

On average, in the absence of associated handicaps an early intervention enables deaf children to master the verbal linguistic code early on [9,10] so that they can more effectively communicate and have more frequent and significant opportunities for a natural and meaningful interaction with adult caregivers and peers [11].

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Sharing experiences and really interacting in their own cultural environment are the conditions needed to adequately develop finer language competencies [12–14], such as inferences and metaphoric language comprehension.

Verbal inferencing refers to the abstraction or "filling in" of information that is not explicitly expressed in a conversation or in a story thus forming connections amongst concepts and events, in order to derive its logical overarchic organization and to capt its exact meaning [15]. Metaphors are a form of figurative language, in which an expression normally associated with one concept (target) is used to communicate something about another concept (vehicle), thanks to a common ground (or link) established though a comparison or analogy [16], that could be more or less explicit [17].

The ability to infer information or to understand metaphors is complex and requires a number of different skills: adequate comprehension of verbal information presented in words, sentences and grammar [18]; working memory to process verbal information and logical sequences [19–21]; world knowledge [15]; ability to meta-represent [22] and to operate on information available across different modalities [15]; social and cultural knowledge and perspective-take skills to consider the conversational context (time, place, circumstances and motives), the speakers' characteristic and possible relationships between verbal and non-verbal (proxemics, gestures, mimics) intents [21,23–25].

Inferences and metaphors are important to be successful both in school and in social situations, as they are used commonly in everyday conversations and interactions [26–28], they facilitate the coherent representation of discourse [21] and provide a way to understand and organize new ideas [29,30]. They occur not only in the language and verbal domains, but are pervasive also in other communicative domains, such as art, commercials, films, stories, etc. [31]. Moreover they are frequently used as an educative tool to teach new concepts [32,33].

Verbal inferencing and metaphoric language learning starts in early infancy [34,35] and continues during childhood [36] while children naturally interact with adults and share language with them in meaningful discourse contexts [35]. So in an informal and incidental way, as long as children's general conceptual knowledge and socio-linguistics capacities develop, repeated joint participations with a shared linguistic code used in a well defined discourse context allow them to gather relational links between an implicit content and his external referent (inference) or between a vehicle and his target (metaphor). When children start school – at 2.6–3 years of age – they start to infer meanings, and the exposition to metaphor language increases exponentially in both spoken [33] and written language [37]. Formal instruction take place alongside incidental learning and verbal inferencing and metaphors comprehension/production skills continue to raise and ripe during late childhood, adolescence and adulthood [38].

Obstacles to the acquisition of adequate inferring abilities and of figurative language understanding/using skills could result in serious impairments in conceptual learning [18,39] and social communication [40].

The amount of development in inferencing in everyday interaction and of the comprehension of metaphors has received very little attention in deaf children. The first aspect has been studied mainly during reading comprehension tasks and reported as a lacking skill in deaf subjects [41].

Figurative language comprehension has been investigated only through a few empirical studies between the '70s and '90s and showed deaf children as performing significantly worse than their NH peers [42]. The deficits were considered not as a specific impairment, rather the consequence of the reduced experience with societal language that could deprive deaf children of the same degree of exposure as NH children. In fact, the deaf children showed no difficulties in understanding metaphors when expressed in American Signed Language [43] and, if adequately instructed, they were able to learn to interpret verbal metaphors [44]. However these studies, although they showed interesting outcomes, included children with different degrees of hearing loss and listening abilities, different communication modalities and consequential heterogeneous oral language competence. So nowadays we do not know if access to hearing via cochlear implantation and the acquisition of adequate linguistic skills can fill the gap between deaf and hearing children also in these domains.

The present study was implemented with the following aims:

- to assess skills of unilaterally cochlear implanted (CI) children with adequate abilities in formal language tests for inference of the meaning in an implicit situation and in metaphors comprehension, comparing them with well-matched hearing peers;
- to verify the influence of age of implantation on overall skills.

A hypothesis was set up whereby, in the absence of linguistic delay, differences between unilaterally CI children and NH peers may not be significant and the two groups may be more homogeneous in inferential skills and figurative language elaboration; more appropriate answers could be related with the earliness of intervention.

2. Methods

2.1. Study design

The study was designed as a matched case–control study with a control group of matched normal hearing peers.

The protocol was approved by the local Ethics Committee; informed consent was given freely by the parents of each patient. To reduce bias induced by age, social-cultural and linguistic differences, the eligibility criteria for the study group were as follows:

- Congenital profound/severe deaf children (Pure Tone Average in the better ear $\geq$70 dB HL for 500–4000 Hz);
- age between 6.1 and 15 years at test administration;
- good speech perception abilities, defined as bisyllabic word recognition and sentence comprehension $>$90% in a silent room;
- aural–oral rehabilitation setting;
- absence of associated disorders or socio-economic difficulties;
- schooling: mainstreamed;
- formal Italian Language Test within -1;

The control group was formed after all children in the study group were selected and evaluated, matching each subject for gender, chronological age and language skills. The components of the control group attended the same classes as the unilaterally CI children. Absence of socio-economic difficulties and associated disorders was verified through clinical history. All subjects of the control group underwent audiological assessment to verify absence of hearing loss, which was defined as hearing threshold $\leq$20 dB HL at frequencies between 250 and 6000 Hz.

2.2. Study procedures

Language abilities to include unilaterally CI children with adequate competences and to match them with NH subjects were assessed using three Italian Standardized Language tests: the Boston Naming Test [45] for the assessment of lexical production;

the Peabody Picture Vocabulary Test for lexical comprehension [46] and the Test for Reception of Grammar-TROG-2 [47] for morphosyntactic comprehension assessment.

Assessment of abilities in inferencing and metaphoric comprehension was carried out using the Italian Standardized Battery of "Pragmatic Language Skills MEDEA" [48]. The test was implemented by Lorusso in 2009 to give a quantitative evaluation of pragmatic skills during comprehension and use of oral language. We used 3 of the 5 subtests included in the battery: Implicit Meaning Comprehension (IMC) and Situations (S) to evaluate inferencing skills; Metaphors (M) to focus on figurative language comprehension.

The IMC subtest includes 3 items (IMCa–IMCb–IMCc), each of which illustrate a short story presented as a dialog. The examiner is instructed to read the stories using different intonation to interpret the characters acting in the dialog, in order to facilitate their identification. After reading, the child is requested to repeat what he had heard, to verify that words and sentences had been understood. After reading and repeating each story, the child is requested to reply to five questions, the contents of which is not explicit in the text, but must be inferred by the general information given by the dialogic structure. Scoring was performed as 0 = completely incorrect; 0.5 = partially correct; 1 = correct answer. The subtest includes 14 items for a max total score of 14 (see appendix 1 for details).

The S subtest included 5 items (S1–S2–S3–S4–S5), that have the aim to verify the ability of the subject to understand the meaning taken on by particular expressions during social interaction: to respond adequately the subject must be able to contextualize the sentence, referring to his/her own everyday experience and world knowledge. The examiner reads each of the 5 situations using an expressive intonation and then asks a question about it. Scoring attribution was 0 = incorrect answer and 2 = correct answer for S1, S3, S4, S5; whereas for S2, 0 = incorrect answer 1 = incomplete, not conformed to social rules; 2 = incomplete, conformed to social rules; 3 = complete correct answer. Max total score was 11.

The M subtest included 8 items: 4 verbal metaphors (VM), for which the subject was asked to explain the meaning of a sentence, and 4 figured metaphors (FM), for which he/she was requested to indicate the image that conjured up the meaning of the heard sentence. For figured metaphors each child had to choose between four alternative images, them being the target one and three distractors (one literal meaning, one semantically related to the metaphor, one showing some elements of the sentence without integrating/interpreting them).

To be sure of children's understanding of the task, the assessment was preceded by a training condition, both for VM e FM: an example item was presented (What does "Giacomo's room is a pigsty" mean?), the subject was then asked to verbally explain/indicate the correct figure and, if wrong, the correct interpretation was given.

Scoring was computed as following:

- VM: 0 = completely incorrect; 1 = partially correct; 2 = correct answer. The subtest includes 4 items for a max total score of 8;
- FM: 0 = incorrect; 2 = correct. The subtest includes 4 items for a max total score of 8.

The kind of responses (Literal meaning/incomplete answers) were computed and compared between the two groups.

2.3. Statistical analysis

Differences between patient and control groups were tested by the Mann–Whitney U test. Correlations between age at study enrolment and each subtest were investigated by the Spearman rank correlation coefficient. To investigate whether age at implant and time of implant use might have an effect on them, partial correlations were also carried out after controlling for age at study entry.

To avoid underestimating the true α-error, a Bonferroni correction for multiple comparison was applied to set the two-sided statistical significance according to subtest administered and response pattern to metaphors ($n = 10$), resulting in a level of significance of 0.005 ($\alpha/10$).

Statistical analysis was carried out using the Statistical Package for Social Sciences, version 16.0 (SPSS, Chicago, IL, USA).

3. Results

From December 2012 to June 2013, 31 children with congenital bilateral severe to profound hearing loss were identified for the study.

The mean age was 8.5 years (SD = 2.1), ranging from 6.3 to 14.6 years. All subjects used unilateral cochlear implants (11 Cochlear and 20 Advanced Bionics, AB): children wearing Cochlear® were fitted with ACE (11 subjects); children implanted with AB devices were fitted with CIS (1), SAS (1), Hi-Resolution (2) or Hi-Res 120 (16 subjects) strategies. No child wore a contralateral hearing aid. 15 children were implanted under the age of 24 months, whilst 16 were implanted between 24 and 48 months of age. Since there was no Universal Neonatal Hearing Screening protocol at time of birth for most of the children, mean age at diagnosis was 17.6 (SD = 8.7) months. Mean time of cochlear implant use at time of the study was 75.7 (SD = 20.9) months. Individual demographic characteristics are showed in Table 1.

31 Gender/age-matched healthy controls were recruited. Each group accounted for 15 females and 16 males. The mean age was 8.7 (SD = 2.2) years, ranging from 6 to 14.7 years.

The two groups were well matched according to language skills assessed through Italian language tests for lexical and morphosyntactic domains, as shown in Table 2.

Table 3 represents the main outcomes of inferencing abilities and metaphor comprehension. Analysing performances on IMC test, global scores were higher for NH than unilaterally CI, even though values were not significantly different ($p > 0.008$). The subtest IMC B, in particular, was harder to comprehend for unilaterally CI children compared to NH: they were not able to set the fact in the correct place and to identify the third character nor to interpret the expression "if you had to do in this way..." as referred to the inappropriate behavior of one of the characters. This last subtest lost its significance after Bonferroni correction ($p = 0.008$).

Responses given to the Situations Test were comparable between the two groups and both total and single situation scores were not significantly different: some colloquial expression such as "there is a stormy air (in Italian language it could insinuate an argument)" were difficult for both groups and only older children (>10yrs) were able to answer correctly.

As far as figurative language is concerned, the unilaterally CI group performed significantly worse in VM (p-value = 0.001), whilst differences showed no statistical significance for FM (p-value = 0.035). Differences regarded the amount of partial responses given (p-value < 0.001), rather than a literal interpretation of VM (p-value = 0.23 and p-value = 0.35).

Chronological age was a significant variable in unilaterally CI group: the older the age at study entry, the better the performance in both inferencing and figurative language comprehension (correlation coefficients ranging from 0.56 to 0.073, all p-values = 0.005). Exceptions to such findings were the subtests VM, IMCa, IMCb (Table 4).

Correlations between age at implant and performance in inference and figurative language are shown in Table 4: values

Table 1
Individual demographic characteristics of CI group.

Subjects	Gender	Age[a]	Etiology	Age at diagnosis[a]	Age at CI[a]	CI experience[a]
1	F	78	Connexin 26	4	9	69
2	F	78	Connexin 26	5	10	68
3	M	91	Unknown	5	19	72
4	M	92	Connexin 26	6	19	73
5	M	96	Connexin 26	9	19	77
6	F	96	Connexin 26	10	18	78
7	F	98	Connexin 26	11	19	79
8	M	98	connexin 26	11	18	80
9	M	95	Rubella	12	20	75
10	M	102	Connexin 26	12	18	84
11	F	113	Unknown	12	24	89
12	M	102	Connexin 26	12	18	84
13	M	105	Unknown	12	16	89
14	M	120	Unknown	12	19	101
15	F	89	Connexin 26	13	19	70
16	F	115	Unknown	14	22	93
17	M	74	Connexin 26	21	25	49
18	F	80	Connexin 26	22	30	50
19	F	91	Connexin 26	23	31	60
20	F	90	Connexin 26	24	30	60
21	M	90	Unknown	24	30	60
22	M	79	Connexin 26	24	31	48
23	F	75	Connexin 26	24	26	49
24	F	92	Unknown	24	29	63
25	F	170	Unknown	25	43	127
26	F	144	Unknown	25	43	101
27	M	132	Connexin 26	26	46	86
28	M	135	Unknown	27	48	87
29	M	176	Unknown	28	48	128
30	M	93	Rubella	32	45	48
31	F	90	Rubella	36	41	49

[a] Months.

Table 2
Age, sex and formal language level of CI and NH groups.

	CI group $N=31$	NH group $N=31$	P-value
Mean age (SD) (mths)	102.9 (25.8)	104.2 (26.6)	0.84
Male/female	16/15	16/15	1
PEA BODY mv (SD)	95.4 (9.8)	95.2 (7.8)	0.95
BOSTON mv (SD)	35.2 (7.9)	35.7 (8.3)	0.83
TROG 2 mv (SD)	12.1 (2.9)	12.1 (2.8)	0.93

mv: mean value.SD: standard deviation.

were adjusted to account for age at study entry. Older age at implant was related to worse performance for all items, except for CSIc and Situation tests (p-values < 0.05, but >0.005).

Performances in inference and figurative language were not correlated with time of implant use, although values were adjusted for age at study entry and age at cochlear implantation.

Table 3
Main outcomes and statistical significance for inferencing abilities and metaphoric comprehension in cochlear implant (CI) and normal hearing (NH) children.

	CI group $N=31$	NH group $N=31$	P-value
VM	2.7 (1.3)	4.1 (1.8)	**0.001**
Literal response to VM (mean n°)	1.6 (0.7)	1.2 (1)	0.23
Partial response to VM (mean n°)	1.3 (0.9)	0.5 (0.8)	**<0.001**
FM	3.3 (2.5)	4.5 (2.1)	0.035
Literal response to FM (mean n°)	1.3 (0.3)	0.8 (0.8)	0.035
IMC tot	6.2 (2.9)	8.5 (3.8)	0.011
IMCa	2.6 (1.2)	3.3 (1.2)	0.013
IMCb	2.1 (3.1)	3.1 (1.5)	0.008
IMCc	1.6 (1.4)	2.2 (1.5)	0.062
S	5.8 (1.8)	6.4 (2.2)	0.24

In bold are p-value statistically significant by the U Mann–Whitney test for independent samples, corrected by multiplicity (using a Bonferroni correction) $\alpha = 0.001$.

Table 4
Correlations between age at study entry and age at implant in CI children.

	Bivariate correlations with age at study entry	Partial correlations with age at implant[a]	Partial correlations with time of implant use[b]
VM	0.40	**−0.49**	−0.08
FM	**0.71**	**−0.65**	0.28
IMC tot	**0.56**	**−0.67**	0.19
IMCa	0.22	**−0.53**	0.05
IMCb	0.23	**−0.57**	0.22
IMCc	**0.73**	−0.39	0.21
S	**0.69**	−0.26	0.14

[a] Adjusted for age at study entry.
[b] Adjusted for age at study entry and age at cochlear implantation.
In bold are p-value statistically significant by the Spearman rank correlation coefficient, corrected by multiplicity (using a Bonferroni correction) $\alpha = 0.005$.

4. Discussion

The present study aimed to investigate the inference abilities and the figurative comprehension in unilaterally CI children, categorized as having "normal" lexical and morpho-syntactic competence, as measured via formal language tests, and to compare their skills with a group of NH subjects, matched for chronological age and language level. To assess both aspects, the ability to infer information from IMC and particular situations and metaphors were chosen.

One limit was the small numbers in the study group: the low number of children recruited was a consequence of the attempt to obtain a homogeneous group for normal language competence and socio-cultural aspects. Consequently, statistical analysis was adjusted using the Bonferroni correction, to limit bias linked to the small population.

The results obtained showed how unilaterally CI children with good listening abilities and language skills performed as well as NH subjects in most of these finer linguistic tasks, but not in all of them.

Unilaterally CI children with normal language levels showed responses similar to NH children in inferring during conversation, but not in figurative language comprehension.

Regarding the first aspect, in a colloquial circumstance, within a dialog, they were able to infer implicit information, to achieve full understanding of the discourse and to grasp the meaning that some expressions recruit in a particular social interaction, adapting it to the context. This is an important aspect that demonstrates how unilaterally implanted children who had the opportunity to access hearing early enough to develop adequate listening and linguistic competencies, can develop adequate inferencing skills. Using Kintsch's construction–integrating model of discourse processing [49], it is possible to affirm that they demonstrate to be able to process and use linguistic indicators and context to trigger the inferencing process; to recall their general knowledge, to form different concepts and, using working memory, to elaborate and compare the different concepts until the final inference is produced as the most coherent.

Metaphors still remained a challenge for unilaterally implant users and above all when they had not any reference points, as demonstrated by the significant difference in verbal rather than figured metaphor comprehension.

For VM, children had to (freely) explain with their own words, the meaning of each metaphor after listening it, so if they did not know the response they had a high probability of error. For FM, children had to choose between four alternatives, so there was a chance level of 25% for giving a casually correct answer, percentage that grew to 33% if they learnt, by the practice condition, that the correct answer could not be the literal meaning, as shown by Iran-Nejadet al. [44]. An important aspect to consider is the kind of response given in VM, when wrong: there was no significant difference between the two groups in number of literal responses ($p = 0.23$), but unilaterally CI children tended to give more frequently incomplete answers ($p < 0.001$). Their answers confirm that they did not have specific disorders or were not literal and rigid in their language use. This finding was in line with those reported in studies on figurative language in deaf children with hearing aids [43,44,50].

Unilaterally CI children in the present study were aware of the figurative meaning of expressions used in the test as well as of the need to find analogies, therefore when they did not know the correct answer they were able to proffer a partial explanation.

The differences between unilaterally CI and NH children could be explained in the difficulties that children with cochlear implant still experience due to the deafness, or say, in the limits given by a hearing device.

First of all, they could effectively experience a limitation in accessing acoustic cues during interaction [51,52], due to increase in number of communicative partners [53], background noise [54,55] and distance from the sound source [56]. NH children develop a mature comprehension of metaphors only after a long experience of repeated occasions during which they are exposed to them in significant and well contextualized interactions with their parents, with their peers and at school. Hence, the first metaphors that they master are the more frequent and transparent ones [21,36]. Also in our study group children with cochlear implant had no difficulties in explaining the meaning when describing metaphors of frequent use, such as "John is a snail" or "Mark is a lion", and their responses were similar to those of their NH peers.

Unilaterally CI children could lack a significant part of these experiences in not favorable listening conditions and profit less from indirect and informal mediation [57]: this may explain their overall differences. New important insight could come in future studies by assessing deaf children using bilateral cochlear implant or bimodal stimulation that allow them binaural listening.

From a linguistic point of view, another two important aspects should be taken into consideration: the ability to use context information [24] and conversational perspective-taking hypotheses [25]. Failure to understand figurative language has been linked to the inability to use context to derive meaning [58]. Context is important in the processing of metaphors, in that it provides a clue for the interpreter as to whether the sentence has to be understood literally or non-literally [59]. In addition, context aids the selection of the correct target and vehicle features in order to establish the common ground between them and these two factors can differ from situation to situation. For example, depending on the context, in the expression "John is a lion", John could be referred to as a lion because he is as strong as a lion or alternatively because his hair looks like a heavy mane. The similarity between target and vehicle is therefore greatly enhanced by the context in which both are presented [60]. Our unilaterally CI children have no difficulties in using context to infer meaning, as we observed in IMC and S tasks.

In contrast, conversational perspective-taking hypothesis proposes that speakers use figurative expressions because they allow the speaker to convey a certain intended meaning, which would have been difficult to express using any other kind of expression [61]. It has been argued that comprehension of metaphor relies upon understanding of the communicative intent of the speaker [62]. This means that the recipient needs to attribute mental states to the speaker in order to arrive at the correct meaning of the expression [63]. So there is a direct link between comprehension of non-literal language and Theory of Mind (ToM), the ability to attribute mental states (such as beliefs and intentions) to others [64]. Research has highlighted how the development of ToM in the deaf could be significantly delayed [65–68] probably due to the limited access to the mental state discourse of their hearing parents and siblings [65]. A shared communicative code, through which parents could shared mental state concepts with their children from the first infancy, is crucial for the development of an adequate ToM, as shown both by studies on normal development in hearing children [69,70] and in deaf children of Sign language families [67,71]. The difficulties to share a communicative code could impact on early interaction [72]. If in the first two years of life, deaf children are no different in responsive communication, topic initiation [73] and in the range of communicative intention –[74], they do however show a more uneven and delayed pattern of development across chronological age when compared with normal hearing peers [75]. Differences, no detectable below two years of age, increase significantly over time, along with an increase of the age/linguistic gap [73]. This in turn could imply that they communicate less, spending more time in silence [51] and they converse about a topic for shorter time [73], thus having less opportunities to be exposed to a varied and rich figurative language or else they are exposed later on in their life to more metaphorical language which refers to peoples' mental state [76].

Since the Universal Neonatal Hearing Screening protocol is not universally adopted in all Italian regions, in our sample only 2 children were implanted under 12 months (9–10 months) of age, while the remaining between 16 and 24 months of age (15 subjects) or later (14 subjects). Although at the moment of the study, all children had filled the gap in language skills, the delayed language acquisition in most of them could have affected their competence in figurative skills. As a matter of fact, a significant correlation between age at implantation and performance, both for metaphors and IMC was found. There were not enough patients implanted around the first year of age to compare their skills with older children, but it could be speculated that a further reduction of language delay and of all consequent communicative alteration could give the opportunities to hearing impaired children to catch up on these aspects.

Recent studies [10,9] are emphasizing the increasing number of children who gain a language competence within normal limits within the first 3–4 years of age, so intervention programs have now new challenges: helping these children to follow a normal path of development in such fine linguistic domains, to adequately absorb experience needed for inference skills and for ToM development, so that they could mature adequate abilities at school entry by the age of six.

Parent training programs [12,77,78] show that it is possible to help families to learn how to support oral language development through various natural communication exchanges and incidental listening activities on a daily basis, in true meaningful contexts [77,78]. Clinicians can guide parents both to take advantage from "incidental interaction" and to "embellish" interaction [12] using daily routines and experiences [77].

Instructing parents to involve their child in conversation about what happens in the present and in the past and what they experience using rich mental state expressions [79,80], – reasoning about what people do, think, feel, desire, belief, highlighting analogies, similities, idioms, metaphors – can enrich the variety and the quantity of perspective-take opportunities to reason about one's own and others' mental state and about the different ways to represent reality.

Finally figurative language is rich in written stories, books and fables [81]: preschool daily home-shared book reading and storybook telling can help children to have more frequent access to figurative language, thus sustaining their development [82]. Clinicians can encourage families to promote frequent exposure to books at home [83,84] and guide them through the use of facilitative strategies during shared reading [85,86].

5. Conclusion

CI device is helping deaf children to catch up on NH peers, although differences in finer linguistic domains still remain. Unilaterally CI children with normal language level showed responses similar to NH children in discourse inferences, but not in figurative language comprehension. Metaphors still remains a challenge for implant users and above all when they have not any reference, as demonstrated by the significant difference in verbal rather than figurative metaphors comprehension. An early age at intervention positively correlates with performance. These aspects, until now poorly investigated, are so important that should be specifically addressed in future prospective studies to deeply understand possible effects of intervention within the first year of life and the benefits of bilateral/bimodal CI. Also, specific mechanisms and possible effects of different levels of figurative language complexity (presence or absence of contextual input, degree of transparency and syntactic frozenness) should receive more attention in order to orient programs in early intervention settings and to respond in adequate manner to all complex communicative needs of deaf children.

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Conflict of interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ijporl.2014.02.022.

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