The production of relative clauses by Italian cochlear-implanted and hearing children

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Abstract

This study investigates the elicited production of subject (SRs) and object relatives (ORs) in Italian by 13 cochlear-implanted (CI) children (age:7;9-10;8) to determine whether and to what extent they differ from three groups of 13 normal hearing (NH) children matched on morphosyntactic abilities (age:5;0-7;9), chronological age (age:7;5-10;3), and auditory age (e.g. duration of CI use (age:4;11-9;4)) respectively.

Results showed that for CI children, SRs are more accurate than ORs. The same asymmetry is observed in all NH groups, although NH children's percentages of target responses are higher for both sentence typologies.

The syntactic difficulty with ORs led CI and NH groups to adopt a considerable number of answering strategies: among them, production of passive relatives, causative constructions, and *wh-* elements replacing the complementizer *che* ('that').

Individual performance variability within the CI group is observed. Some CI children showed good competence in Italian and age-peer performance by producing passive relatives, which are largely attested in older children's production. For other CI children, however, the tendency to produce sentences attested in young children's production is evidence of the linguistic delay associated to hearing impairment. In this case, the performance of these CI children was comparable to that of younger NH children.

1. Introduction

Children suffering from hearing loss have difficulty in developing an oral language due to the limited exposure to the linguistic input during the critical period, a span of time in which our brain is predisposed to build mental grammars, and to set the correct parameters for the target language, beginning at birth and ending with puberty (Lenneberg, 1967). After the end of the critical period, it is more difficult to develop the grammar of a language naturally.[1] The critical period view is crucial in predicting the linguistic outcomes of hearing-impaired individuals. The delayed access to the linguistic input, as is the case of people suffering from hearing loss, has strong consequences on the development of linguistic abilities. Indeed, cross-linguistically, individuals with hearing loss experience difficulties in different linguistic domains including vocabulary, phonology and morphosyntax. They avoid the production of complex sentences and instead prefer the use of short sentences, by omitting functional elements which are crucial for the correct interpretation of a sentence (for Dutch, Hammer, 2010; Verbist, 2010; for English, De Villiers, 1988; De Villiers et al., 1994; Quigley and Paul, 1984; for French, Delage, 2008; Delage and Tuller, 2007; Tuller, 2000; for Italian, Ajello et al., 2001; Caselli et al., 1994; Caselli et al., 2012; Chesi, 2006; Rinaldi and Caselli, 2009; Volpato, 2010; Volterra and Bates, 1989).

Despite the fact that, overall, in hearing impaired children using a cochlear implant (CI children, henceforth), language proved to develop faster than in children using conventional hearing aids (Blamey et al., 2001; Miyamoto et al., 1999; Tomblin et al., 1999), studies focusing specifically on CI children found that, whereas lexical skills are in most cases within

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[1] Recently, some researchers have proposed the existence of a 'sensitive period' (rather than a critical period) for which the onset is gradual and the offset is incomplete (Tomblin et al., 2007). Actually, there seems to exist more than one sensitive period, depending on the linguistic component considered (morphology, phonology or syntax) (Guasti, 2007).

the normal range (Caselli et al., 2012; Young and Killen, 2002), receptive and expressive morphology and syntax still represent problematic domains for this population (Caselli et al., 2012; Geers et al., 2009; Hammer, 2010; Spencer et al., 2003; Volpato, 2010; Young and Killen, 2002), some morphosyntactic abilities being not fully age-appropriate. Hammer (2010) found that 5 to 7-year-old Dutch CI children proved to be delayed in their acquisition of regular and irregular past tense forms, as well as to make subject-verb agreement errors, consisting in the omission of the third person singular morpheme and the plural morpheme. Spencer et al. (2003) found that English-speaking children using a cochlear implant experience difficulties with complex sentences, and tend to use short sentences, also making a considerable number of errors, including incorrect verb forms and agreement errors between subjects and verbs, and between modifiers and nouns.

Caselli et al. (2012), who assessed the linguistic abilities by 17 preschool Italian-speaking CI children, found that in both lexical and morpho-syntactic comprehension, CI children perform lower than hearing age-peers, but similarly to younger children, namely those matched for time from cochlear implant activation.

Overall, a delay in the acquisition of language definitely persists in CI children if compared to normal hearing age peers. It is true though that substantial individual difference within the population of CI individuals is observed, and some individual children were reported to show age-appropriate performance comparable to normal hearing age peers (Geers, 2004; Geers et al., 2003; Geers et al., 2009; Hay-McCuchoin et al., 2008; Szagun, 2001). Geers et al. (2009) reported the results of a group of 39 CI children on different language measures, including receptive and expressive vocabulary, and receptive and expressive language, providing evidence in favour of the positive effect that the use of a cochlear implant, especially since early ages, has for some of them on the possibility of catching up with hearing peers in

spoken language abilities. Geers (2004) and Geers et al. (2003) investigated the level of linguistic competence of 8- and 9-year-old English CI children with prelingual hearing impairment by testing different language abilities (language comprehension, verbal reasoning, narrative skills, and spontaneous language production). They found that most children showed a level of performance comparable to that of age peers as far as measures of verbal reasoning, narrative skills, length of utterance, and lexical abilities are concerned. A low percentage of CI children also managed to achieve age-appropriate language development on the use of bound morphemes and overall language comprehension. However, difficulties in receptive and expressive morphology were experienced by some CI children. In Szagun (2001), ten German CI children out of 22 were reported to show a performance comparable to hearing ones matched on MLU, especially in the development of grammatical morphology. Wide inter-individual variability in language outcomes is also reported in Hay-McCuchoin et al. (2008), who carried out a longitudinal study on 30 CI children till the age of 18. They found that some CI children perform at or near the average of the typically-developing (TD) children, while others perform lower than TD children.

Language development is not uniform across linguistic domains, since some linguistic areas are mastered with more difficulty than others. In particular, complex constructions represent a vulnerable area for CI children. For this reason, also complex syntax is also strongly required to be assessed (Geers et al., 2009), above all in the years following implantation (Tomblin et al., 2007). Recent first attempts to investigate complex structures in Italian CI children are represented by Volpato (2010), (2012) and Volpato and Adani (2009), focusing on the syntactic comprehension of relative clauses. Relative clauses are subordinate structures that children are habitually exposed to, occurring frequently in common speech and, even more, in texts and school materials, and constitute a very interesting and debated morphosyntactic

domain. Volpato (2012) found that one of the aspects which has proven to be particularly compromised in the use of relative clauses was number agreement between subjects and verbs. If we consider that agreement phenomena are crucial to keep the correct formal relations between elements within the noun phrase, between noun phrases and other sentence constituents, and between noun phrases within a text discourse, thus contributing to the textual cohesion, it is immediately clear that the failed or inadequate development of these systems at the nominal and sentence level may lead to the incorrect comprehension and production of sentences and texts.[2]

Results on relative clause comprehension showed that CI children performed not only lower than age-matched hearing peers, but also lower than younger language-matched hearing children, i.e. children selected on the basis of comparable vocabulary skills and general morphosyntactic abilities assessed by using standardized tests (Volpato and Adani, 2009). Whereas some studies on relative clause comprehension have been carried out on Italian CI children, to our knowledge, there are no studies that systematically investigate the elicited production of subject and object relative clauses by Italian hearing-impaired children with cochlear implants.

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[2] The study of complex syntax within a well-defined linguistic framework (in the case in point, generative grammar) may be useful for linguists and speech therapists in order for them to develop some strategies to possibly help cochlear-implanted children to treat the compromised language properties. Some studies show that by training individuals with language disorders and deficits on complex sentences, it is possible to rehabilitate even untrained simple structures. Treatment experiments have been carried out on agrammatic patients (Chinellato, 2003; Thomson and Shapiro, 1994) and SLI children (Levy and Friedmann, 2009). Similar experiments do not exist for hearing-impaired subjects; however, this study could be useful for future research to develop some linguistic strategies to recover compromised linguistic properties in these individuals.

Indeed, mastering a language implies the ability not only to comprehend the structures of that language, but also to produce those structures. The analysis of both comprehension and production is crucial to provide a more complete account of children's language competence and acquisition of relativization. Some studies investigating different linguistic properties reported the existence of an asymmetry between production and comprehension. According to Clark (1993), the general tendency occurring in language acquisition is that comprehension precedes production. This is also confirmed by a study on children displaying atypical language development (SLI) (Contemori and Garraffa, 2010). However, some studies found a different pattern of development by investigating the acquisition of object pronouns and SVO word order (Hendriks and Koster, 2010), and of relative clauses (Håkansson and Hansson, 2000), production being found to be ahead of comprehension. In the course of language acquisition, relative clauses are produced very early, around age 3;0 (Crain, et al., 1990; De Villiers et al., 1994; Varlokosta and Armon-Loten, 1998). Conversely, children's comprehension of relative clauses appears to be problematic until the age of five or six (De Villiers et al., 1994; Håkansson and Hansson, 2000; Sheldon, 1974). Hence, even though comprehension and production are closely related in language development, some qualitative differences between the two modalities cannot be excluded. An adequate way for exploring the development of relative clauses in CI children is to investigate the level of difficulty that these individuals experience with the same linguistic structure not only in comprehension but also in production.

Previous studies, such as Chesi (2006), investigated the presence of complex structures, also including relative clauses, by analysing data collected from spontaneous speech production in a heterogeneous group of Italian hearing-impaired children, and found that these constructions are in most cases avoided and replaced by easier structures (i.e. coordinated

sentences), making the expressions redundant, full of unnecessary word repetitions. These studies were however not exhaustive enough to illustrate thoroughly the development of Italian relative clauses in hearing-impaired children and did not analyse the production by CI children.

In our study, we aim to investigate the use of complex syntax, namely the production of relative clauses in CI children, in order to determine whether and to what extent their performance is comparable to that of NH age peers or to that of younger children. For the group of CI children, in addition to group results, the level of individual variability will also be taken into consideration. Indeed, we expect that although the group's performance is not comparable to age peers, some children may nonetheless show quite good language competence.

In addition, it has been observed that age of intervention and age of implantation are crucial factors that contribute to explain CI children's linguistic performance (Friedmann and Sztermann, 2006; Guasti et al., 2012; Oller and Eilers, 1988; Schauwers et al., 2005). Also length of device use appears to be a predictor of language outcomes (Fryauf et al., 1997). Hence, we also want to investigate which clinical variables (age at hearing aid fitting, age at implantation, and length of use of cochlear implants) correlate with the ability of CI children to produce subject and object relatives.

2. The production of relative clauses in normal hearing and hearing-impaired individuals

Relative clauses are at the core of a great deal of cross-linguistic studies both from a linguistic and psycholinguistic point of view. The types of relative clauses at issue in this study are restrictive relatives. Subject and object restrictive relative clauses are subordinate

clauses which modify a nominal element (the head), restricting the number of possible referents for it. Syntactically, they are CPs (Cinque, 1982; Rizzi, 1997; Vergnaud, 1985) and are embedded in a complex nominal expression (DP). In Italian, they are introduced by the complementizer *che* (the equivalent of English *that*)[3], they are characterised by long-distance (A-bar) dependencies between the sentence constituents (namely between the position internal to the subordinate clause and the (external) position in the main clause), and contain a gap in the embedded clause marking the merge position of the element that has been relativized. Examples of relatives in which the nominal element (head) is extracted from subject and object positions are provided in (1) and (2), respectively[4]:

(1)   Il cane che   <il cane> insegue i gatti

       The dog   that   <the dog> chases the cats
              |_____|

(2)   La giraffa   che   il topo colpisce <la giraffa>

       The giraffe that   the mouse hits <the giraffe>
              |_____|

Furthermore**,** the head of the relative enters a thematic relation with the verb of the matrix clause. It can be either the subject or the object of the main verb, as shown in (3) and (4), giving rise to either center-embedded or right-branching relatives, respectively:

(3)   a. il cane   che   <il cane> insegue i gatti è nero

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[3] As in English, in Italian, there is no agreement between the complementizer and the head of the relative.

[4] The '< >' marked constituents identify the original position from which the nominal element (head) is extracted.

'the dog   that   <the dog> chases the cats is black'

b. tocca   il cane che   <il cane> insegue i gatti

'touch   the dog that   <the dog> chases the cats'

(4)   a. la giraffa   che   il topo colpisce <la giraffa> è molto alta

'the giraffe that   the mouse hits <the giraffe> is very tall'

b. tocca la giraffa   che   il topo colpisce <la giraffa>

'touch the giraffe that   the mouse hits'

In this paper, we focus on right-branching relatives.

Because of their complex structure and the complex relations involved, the acquisition of

relative clauses has been at the heart of a lively cross-linguistic debate regarding typical and

atypical populations. It is well-acknowledged that – irrespective of the language – it is easier

for all individuals to acquire subject relatives (cf. (1)) because of the presence of a short

relation between the sentence constituents and because of a preserved (canonical) word order

of arguments (SVO), as opposed to object relatives (cf. (2)), in which the relation is longer,

and in which arguments display a non-canonical word order (OSV).

The elicited production of subject and object relative clauses has been widely researched in

populations with typical development in many languages (for Italian, Belletti and Contemori,

2010; Guasti and Cardinaletti, 2003; Utzeri, 2007; Volpato, 2010; for French, Guasti and

Cardinaletti, 2003; Labelle, 1990; for Hebrew, Friedmann et al., 2009; Novogrodsky and

Friedmann, 2006). Subject and object relative clauses have also been investigated in hearing-

impaired populations in individuals fitted with conventional hearing aids (for English, De

Villiers, 1988; Quigley and Paul, 1984; for French, Delage, 2008), in Italian children fitted

with a cochlear implant (Volpato, 2010), and in heterogeneous groups of Hebrew children including both subjects with hearing aids and subjects with a cochlear implant (Friedmann and Szterman, 2006). Common to all these studies is the well-known asymmetry between subject and object relatives. This asymmetry and the complexity involved in these structures have been discussed in various studies (Contemori and Garraffa, 2010; De Vincenzi, 1991; Gibson, 2000; Jakubowicz, 2011; Jakubowicz and Tuller, 2008).

Focusing on Italian typical language development, subject relatives are correctly produced at 61% between the age of 3;0-3;11, and are around 90% at the age of 4 (Belletti and Contemori, 2010). Accuracy increases with age, reaching ceiling levels at adolescence and adulthood (Utzeri, 2007; Volpato, 2010). While subject relatives are easily produced by all populations, the relativization of the object is in most cases avoided through a number of strategies turning object relatives into subject relatives.

By testing 41 children (age range: 6-11 years) and 30 adults (age range 15-73 years), Utzeri (2007) found that children produced 22% of object relatives, while the percentage of object relatives produced by adults is less than 1%. She detected four main strategies in both children and adults when object relatives are targeted: use of passive sentences (5), use of causative sentences (6), use of complex forms consisting of *receive*+DP (7), and use of verbs different from those proposed by the experimenter (8):

(5)   Target: Il bambino che la mamma copre

                          'The child that the mother wraps up'

       Production: Il bambino che è coperto dalla mamma

                          'The child that is wrapped up by the mother'

(6)   Target: Il bambino che il re pettina

                                'The child that the king combs'

        Production: Il bambino   che si   fa pettinare dal re

                                the child   that himself   makes comb by the king

                                'The child that makes himself comb by the king'

(7)   Target   Il bambino che la mamma bacia

                                'The child that the mother kisses'

        Production   Il bambino che riceve un bacio dalla mamma

                                'The child that receives a kiss by the mother'

(8)   Target   Il bambino che il nonno ascolta

                                'The child that the granddad listens-to'

        Production   Il bambino che legge al nonno

                                'The child that read to the granddad'

Interestingly, Utzeri (2007) found that Italian children produced a considerable number of object relatives, whereas in adults object relatives are nearly absent and passivization is the prevailing strategy. Similar results were achieved by Volpato (2010), who used some more homogeneous groups of participants, namely children (age range: 5;3-7;5), adolescents (age range: 15;1-17;5), and adults (age range: 20-34), in order to analyse the use and distribution of the different response strategies in the course of language development. While object relatives are attested in child production, they gradually disappear as children grow older – at adolescence, for instance, they are no longer attested. Adolescents and adults largely adopt

passive relatives (82% and 97%, respectively). By further investigating the use of these two strategies in developmental language in very young children, Belletti and Contemori (2010) found that object relatives are produced at the rate of 37% at the age of 3, 52% at the age of 4, and 45% at the age of 5 and 6. A considerable increase in the use of target object relatives takes place between the age of 6 and 7, a period in which the strategy of producing object relatives begins to be avoided through the consistent use of passive relatives and causative constructions (Re, 2010). Passive relatives in contexts in which object relatives are elicited are produced at the rate of 1,5% before the age of 5, 9% between 5;11 and 6;9, and 19% between 6;10 and 7;7. At the age of 8, the percentage of passive relatives considerably increases (55%). By the age of 7, causative constructions are massively produced as well (30%), at the age of 10, they gradually reduce to 20%, and completely disappear at the age of 11 (Carpenedo, 2011; Re, 2010). Very young children who are not able to master these structures properly adopt a large number of strategies (Re, 2010; Utzeri, 2007). The shift from object relatives to passive relatives will be brought up again in the discussion session, in section 7.3.

Among the strategies adopted when object relatives are targeted, the use of resumptive relatives is worth mentioning in which either a clitic pronoun or a full DP resume the head of the relative clause. The use of clitic pronouns is limited to children's productions in languages like French, Spanish, English and Italian; this phenomenon is also largely found in spoken colloquial language by people of different socio-economic backgrounds (for Italian, Guasti and Cardinaletti, 2003; Utzeri, 2007; for French, Guasti et al., 1996; Guasti and Cardinaletti, 2003; Labelle, 1990; for English, De Villiers, 1988; McDaniel et al., 1998; Pérez-Leroux, 1995; for Spanish, Ferreiro et al., 1976; Pérez-Leroux, 1995). While object relatives with resumptive pronouns are largely attested in informal speech, object relatives

with resumptive DPs are frequently found in young children's language (Utzeri, 2007; Volpato, 2010), but are never attested in adults' productions.

Similar studies facing this highly-debated issue of relative clause production also exist for hearing-impaired populations of various languages, like English (De Villiers, 1988), Hebrew (Friedmann and Szterman, 2006), and French (Delage, 2008). The individuals considered in these studies are to a large extent hearing aid users. The investigation by Friedmann and Szterman (2006) was the only study which also included, in the heterogeneous experimental sample, children fitted with a cochlear implant, although most participants used conventional hearing aids. The authors observed a less accurate performance on subject relatives by hearing-impaired individuals as opposed to hearing ones, in addition to the typical asymmetry between subject and object relatives. Interestingly, what distinguished the production of hearing-impaired individuals from that of normal hearing subjects in both Hebrew and French was mainly the use of ungrammatical sentences, which were not found in the hearing controls. A peculiarity of French-speaking hearing-impaired individuals is that they sometimes avoided the use of the complementizer *que* 'that', by replacing it with a different *wh*-filler, namely *où* 'where'. The use of this locative pronoun is a typical phenomenon occurring in different kinds of French relative clauses, also including object relatives, and is usually found in typically-developing child language (Guasti and Cardinaletti, 2003). The difficulties that Hebrew hearing-impaired children experience with relative clauses (and more generally with long-distance dependencies), in comparison to normal hearing controls, are attributed to a difficulty in the use of movement-derived constructions (Friedmann and Szterman, 2006).

With this study, we aim at contributing to the debate on the production of relative clauses by investigating whether an asymmetry between subject and object relatives is also found for

13

Italian CI children, and by analysing the type of answering strategies adopted when subject and object relatives are targeted, comparing the experimental group with three groups of normal hearing children. The analysis of the strategies adopted by the CI children will also make it possible to investigate individual performance and to detect the level of language competence attained by the children.

3. Linguistic background

In this section, we present some linguistic background concerning the discussion on the answering strategies adopted as appropriate alternatives to the relativization of the object, namely the use of causative and passive relatives. We will briefly mention causative relatives and focus on passive relatives.

3.1 The use of causative relatives

At the age of six, typically-developing children were found to use a considerable number of reflexive causative relatives (Re, 2010), such as (9), in which an additional thematic role is assigned by the causative verb *fare* 'make':

(9)   I bambini che si fanno   lavare dal papà

          The children   that themselves make wash by the father

          'The children that have themselves washed by the father'

In (9), the extra argument due to the presence of *fare* is *i bambini*. The example in (10a) is the counterpart of (9) with the full reflexive form *se stessi* instead of the clitic *si*, parallel to the non reflexive example in (10b):

(10) a. I bambini   fanno lavare   se stessi dal papà

          the children   make wash   themselves by the father

          'The children have themselves washed by their father'

     b.   I bambini   fanno lavare   la macchinina dal papà

          the children   make wash   the toy car by the father

   'The children have the toy washed by their father'

3.2. Object relatives and passive relatives: Relativized Minimality and *Smuggling*

Belletti (2009) and Friedmann et al. (2009) claimed that the difficulties that typically-

developing children experience with both comprehension and production of object relatives

are explained in terms of locality principles and intervention phenomena due to the presence

of an interfering lexically restricted noun phrase in the embedded subject position, which

blocks the relation between the head in the main clause and its copy in the embedded object

position. These proposals can be traced back to the original formulation of the Relativized

Minimality (RM, henceforth) principle as put forward by Rizzi (1990, 2004). In

configurations like the following,


(11)   X ... Z ... Y

The RM principle states that a local relation between the moved element (X) and the

extraction site (Y) is interrupted by the presence of an intervening element (Z), a potential

candidate sharing the same structural set of features of the extracted element. The sentence in

(12) is an illustration:

(12)   *How do you wonder <u>who</u> behaved \<how\>?

      X   Z   Y
      |_____no_____|
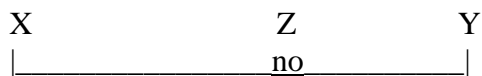
The presence of the same *wh-* feature on the moved element (*how*) and the intervener (*who*) makes the sentence in (12) ungrammatical in both child and adult grammars. In contrast, a sentence like (13) is grammatical, since the moved element (*how*) and the intervener (*John*) do not share any feature:

(13)   How do you think <u>John</u> behaved \<how\>?

      X   Z   Y
      |_____ok_____|
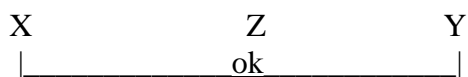
This principle has been applied to language development by Friedmann et al. (2009). They ran a series of experiments with Hebrew-speaking typically developing children on different types of (A-bar) constructions, and found that some types of sentences involving object extraction were quite problematic for them. A sentence like (14), in which the embedded subject is a lexically restricted noun phrase, is difficult for children to comprehend, while adults do not have any problem interpreting it:[5]

(14)   *Tare li   et ha-pil   she-ha-arie   martiv.

      show to-me   ACC the-elephant that-the-lion wets

      'Show me the elephant that the lion is wetting \<the elephant\>'

                   +R+DP   +DP   +R+DP

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[5] +R identifies the presence of relative features.

Friedmann et al. (2009) propose that in children, a stricter, non-adult version of RM is at play. Adults correctly comprehend sentences like (14) because their grammar allows object extraction over the intervening DP, since the moved element (*the elephant*) has a distinct (richer) feature specification set than the intervener (*the lion*). Children cannot establish a correct relation between the moved constituent and the position from which it has been extracted because the intervener shares a subset of feature (+DP) with the moved head. Children are not able to disjoin the features of the head from those of the intervener. Conversely, the manipulation of the referential properties of either the relative head or the intervening subject, by using for instance a lexically unrestricted *wh*-pronoun, as in (15), helps to improve children's performance accuracy:

(15) Tare li   et   mi   she-ha-yeled   menadned.

       show to-me ACC   who   that-the-boy   swings

       'Show me who the boy is swinging <who>'

            +R   +DP   +R

In this case, the moved head (*who*) and the intervener (*the boy*) do not share any feature specification. This operation is definitely less costly for children.

Summing up this proposal, children experience difficulties in comprehending object relatives because their immature grammatical system leads them to adopt a stricter version of RM, while adults, who possess a mature system, do not experience any problem with object relatives.

This account was extended to relative clause production by Belletti (2009).

According to her, the principle of RM leads children to the avoidance of object relative production and to the replacement of this structure with subject relatives through passivization. The preference for passive relatives is explained by adopting the derivation of passive sentences through *smuggling*, as recently proposed by Collins (2005). Since the movement of the object past the vP internal subject is not possible due to locality (16), *smuggling* is the operation which moves the VP chunk containing the verb and the direct object to a position above the subject (17):

(16)   [CP .. DP(O) [TP [vP **DP(S)** [vP V DP(O)]]]]
                 |_____no_____|

(17)   [CP <u>il bambino</u> che [IP è [vP pettinato <il bambino>] *da* [vP papà [<pettinato il bambino>]]]]
                        |_____|_____|

            the child   that   is combed <the child>   by   the father <combed the child>

In Collins' (2005) proposal, more than one local derivational step is found in the derivation of passive relatives. After the smuggling step, a second step is necessary for the object to reach the head position in the left periphery of the sentence (Belletti, 2009). Hence, in passive relatives, the presence of two chains is involved.

Unlike passive relatives, object relatives are derived in a single step:

(18)   [CP <u>Il bambino</u>   che   [IP il papà   [vP pettina <<u>il bambino</u>>]
                        |_____|

           'the child   that   the father   combs <the child>'

Belletti (2009) argues that the use of passive relatives represents the most economic and least complex solution to realize the structure, since any intervention effects are eliminated. However, while Belletti (2009) and Friedmann et al.'s (2009) proposals may explain some aspects of the comprehension and production of relative clauses, they also raise a number of questions. If their assumptions are correct, and a restrictive version of RM is said to be at play in immature grammars, it is not easy to explain why young children do produce object relatives. Why do they produce object relatives before producing passive relatives, which are non-RM violating subject relatives and should thus be easier than object relatives? Another open issue concerns adults. If RM is the source of difficulty in immature grammars (hence in children, but not in adults), why are object relatives, which are definitely grammatical, never or very rarely found in adult production? And why are passive relatives produced instead? Children's and adults' data are problematic for the RM analysis. RM can neither explain Italian-speaking children's production of object relatives, nor can it account for the adults' preference for passive relatives.

For this reason, we suggest that other linguistic properties of relative clauses should be taken into consideration, which involve agreement relations between sentence constituents.

3.3 Agreement phenomena in the derivation of object relatives and passive relatives

The difference between object relatives and passive relatives may be interpreted in terms of the different agreement relations involved between the sentence constituents, following proposals by Franck et al. (2006) and Guasti and Rizzi (2002). They adopt the minimalist theory of agreement (Chomsky, 1995, 2000, 2001), but supplement it with a local agreement operation also used in other places of grammar (e.g. in DPs between adjectives and nouns), which is called Concord in studies that distinguish Agreement and Concord (cf. Giusti, 2008).

The agreement relation in clause structure is established through two feature checking

operations, as (19) shows:

(19)
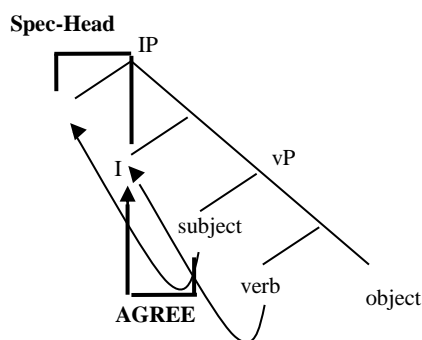
AGREE is the agreement relation established between the subject and the verb when the

subject is still in its position inside the vP projection. The second feature checking operation

occurs when the subject moves to the specifier of IP, thus entering a local relation with the verb

in the Spec-Head configuration.

In this respect, Franck et al.'s (2006) proposal slightly differs from current minimalist

theories, according to which the agreement relation is established only through a single

feature checking operation, either in a Spec-Head configuration as in Chomsky (1995), or

under AGREE, as in Chomsky (2000, 2001). Franck et al. (2006:181) postulate that 'the

proper sharing of featural values, already established by AGREE, is further checked in the

local Spec-head configuration'. When the subject occurs in specIP, the subject-verb

agreement configuration recalls Concord patterns found e.g. in DPs between adjectives and

nouns (Giusti, 2008). The proposal of a double checking operation accounts for cross-

linguistic data in English (Frank et al., 2006), and some Italian varieties (Guasti and Rizzi,

2002), in which the presence of a subject-verb word order obligatorily implies morphological

agreement ((20a), (21a)), while agreement is optional or non present when a verb-subject configuration occurs ((20b), (21b)):

(20)   a. Many books are/*is on the table

        b. There are/'s many books on the table

(21)   a. Le ragazze vengono / *viene

            the girls come / comes

        b. Viene le ragazze

            comes the girls

In all cases of failed agreement in VS configurations, a singular verb precedes a plural subject yielding a more fragile realization of agreement. Fragility is thus expressed in terms of use of the default (singular) feature on the verb with a marked (plural) subject.

Guasti and Rizzi (2002) suggest that the robustness of agreement, namely the presence of morphologically realized agreement between the subject and the verb in SV structures, is to be attributed to the fact that features are checked twice, occurring through AGREE and in the strictly local Spec-head configuration. Conversely, in structures displaying VS word order, in which subject-verb agreement is not morphologically realized, features are checked only once, through AGREE, with no local Spec-head check, since the subject has not moved to the specifier of IP. Franck et al. (2006) adopted the hypothesis of a double checking procedure in order to explain errors in the interpretation of French cleft sentences with subject-verb (SV) order (22a) and verb-subject (VS) order (22b):

(22)   a. C'est les négociations que le ministre suspend

'it is the negotiations that the minister stops'

b. C'est les négociations que suspend le ministre

'it is the negotiations that stops the minister'

The greater number of errors found in (22b) than in (22a) is predicted by the fragility of agreement in VS constructions, which is only established through AGREE. In SV constructions, in which both AGREE and local Spec-Head checking are established, agreement is more stable.

Summing up, Frank et al. (2006) and Guasti and Rizzi (2002) claim that in subject/verb configurations, the morphological manifestation of agreement is more stable, because two types of agreement relations are involved. When only one relation occurs, the manifestation of agreement is more fragile because speakers have less evidence for it.

Along the lines of Frank et al. (2006) and Guasti and Rizzi (2002), we assume that in object relatives, in which a SV word order is displayed in the embedded clause, the agreement relation is established both under AGREE and in the local Spec-Head configuration, as shown in the following representation:

(23)   a. [DP I bambini [CP che [IP il papà [I pettina]   [vP il papà [VP pettina <i bambini>]]]]]

|Spec-Head| |___AGREE___|

In passive relatives, displaying verb-subject configurations (VS word order), *Smuggling* is the operation necessary to establish the correct agreement relation between the inflected verb and the internal argument, the patient, which occurs only under AGREE:

(24)   a. [DP Il bambino [CP che [IP è [pettinato <u>‹il bambino›</u>] *dal* [vP papà [VP ~~pettinato ‹il bambino›~~]]]]]

|_____AGREE_____|

Notice that object relative clauses with postverbal subjects combine the properties of object relatives and passive relatives: the object moves long-distance from the merge position to the matrix clause, and agreement inside the relative clause is established only in the AGREE configuration:

(25)   a. [DP I bambini [CP che [IP   [I <u>pettina</u>]   [vP <u>il papà</u> [v ~~pettina ‹i bambini›~~]]]]]

|___AGREE___|

Based on the linguistic theory concerning the derivation of object relatives and passive relatives, and on the development of these properties in typically-developing populations (young children prefer using the former structure and older children – and consequently adults – frequently produce the latter), we will discuss the use of these two answering strategies by three groups of normal hearing children and a group of CI children.
We will show how syntactic phenomena and developmental factors may influence the production of either object relatives or passive relatives.

4. Research aims

In this section, we are summing up the research aims of this study, which analyses linguistic abilities in Italian children with a cochlear implant in the production of relative clauses.

Relative clauses are complex syntactic structures developing at a late stage in typically-developing (hearing) children.

On the one hand, this study gives us the possibility to investigate the well-known asymmetry between subject and object relatives, seeking further support for the cross-linguistic analysis of relative clause production by testing a population with atypical (delayed) language development, namely hearing-impaired children using a cochlear implant.

On the other hand, the comparison between CI children and three groups of NH children (one matched on morphosyntactic abilities, i.e. linguistic age (LA group), one matched on auditory age, i.e comparable exposure time to the linguistic input (AA group), and one matched on chronological age (CA group)) gives us the opportunity to investigate (i) whether and to what extent a difference exists between the experimental group and the control groups, (ii) whether cochlear implants are able to make up for the lack of input in early stages of language acquisition, and (iii) whether the delayed exposure to linguistic input during the sensitive period makes it possible for children with hearing loss to produce complex sentences, such as relative clauses. These are structures containing long-distance dependencies and representing the easiest way to link sentences together, frequent in speech and written texts, and have never been tested in CI children before.

The comparison of the CI group with that of CA children makes it possible to investigate whether despite a delayed exposure to the input, CI children are able to behave like age-peers in the production of relative clauses. It is however well-known from the literature that in most cases, CI children show linguistic abilities comparable to younger children. In this case, a way to measure the level of linguistic competence attained is to consider general morphosyntactic abilities. This is the reason why CI children have been compared to younger hearing children matched on morphosyntax (LA children). In addition to the comparison with

CA and LA children, this particular atypical acquisition led us to further compare the experimental population with children matched on duration of formal experience to language (AA group) in order to verify whether CI and AA children show comparable performance on the basis of this aspect.

We will consider CI children's performance both at the group and the individual level. As a group, CI children are expected to perform lower than CA children, but comparable to younger children. However, we want to investigate whether some CI children will show a performance comparable to their age peers when considered individually.

The analysis of the different answering strategies used by Italian CI children when subject and object relative clauses are targeted, and the comparison with different groups of NH children will give us the opportunity to detect the level of linguistic competence attained by the experimental group.

The group of CI children includes children ranging from 8 to 10 years of age. Should these children be able to make up for the linguistic delay and behave like children of comparable chronological age, we expect that they produce a considerable number of passive relative clauses. Should their language be influenced by the late exposure to the linguistic input, CI children should adopt strategies more largely found in younger hearing children, or produce sentences found in other hearing impaired populations. Hence, they should either produce a higher number of object relatives, or produce a higher number of sentences that are usually found in young typically developing children.

We also want to verify whether clinical data of CI children (age at hearing aid fitting, age at implantation, duration of cochlear implant use) are significant predictors of performance in the production of subject and object relatives.

In addition to the analysis of CI children's language competence, this paper aims at contributing to the linguistic debate on the production of passive relatives and object relatives, starting from the assumptions of Belletti (2009) and Friedmann et al. (2009), and proposing an alternative account to their proposal, showing how syntactic phenomena and developmental factors may influence the production of either structure.

5. Method

5.1 Participants

The experimental group included 13 hearing-impaired children with bilateral, sensorineural hearing loss fitted with a cochlear implant (CI group). All of them had profound hearing loss (>=90 dB), classified according to the B.I.A.P (Bureau International d'Audiophonologie).[6] All children were hearing-impaired since birth. They were born to hearing parents and ranged in age from 7;9 to10;8 (mean age: 9;2). They were fitted with hearing aids between the age of 0;5 and 1;8 years. They received a cochlear implant between the age of 1;9 and 3;4. The duration of use of the cochlear implant varied from 4;5 and 8;6.[7] CI children had normal IQ. They had been exposed exclusively to the oral language. They did not know or use any sign language. All children had been trained orally and all of them received speech-language therapy from two to three times per week. They did not show any other associated mental or linguistic disabilities.

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[6] Hearing thresholds refer to audiological measurement in the better unaided hearing ear. According to the B.I.A.P., normal hearing and degree of hearing loss fall into the following categories: 0 dB – 21 dB (normal hearing), 21 dB – 40 dB (mild hearing loss), 40dB – 70 dB (moderate hearing loss), 70 dB – 90 dB (severe hearing loss), >90 dB (profound hearing loss).

[7] This window made it possible to test relative clauses, which are very difficult structures and are acquired quite late by hearing children (see section 2).

Table 1 shows the CI children's clinical data:

Table 1.

Identification number and data of the cochlear-implanted children (HL: Hearing loss; HA: Hearing aids; CI: cochlear implantation).

ID	Age (Y;M)	Age of HA (Y;M)	Age of CI (Y;M)	CI Use (Y;M)	HL (dB)	HL with HA (dB)	HL with CI (dB)
1	10;8	0;9	2;2	8;6	90	85	30
2	7;11	1;2	1;11	6;0	>90	75	25
3	7;9	1;0	3;4	4;5	>90	85	30
4	9;6	1;6	2;4	7;2	>90	85	30
5	9;6	1;6	2;3	7;3	>90	55	30
6	9;6	1;6	2;4	7;2	>90	85	30
7	8;10	1;0	2;11	5;11	90	65	30
8	9;5	1;8	2;3	7;2	>90	85	30
9	9;9	0;9	2;8	7;1	>90	85	30
10	9;10	0;5	1;9	8;1	>90	85	30
11	9;3	0;10	1;9	7;6	>90	85	30
12	8;1	1;0	1;10	6;3	>90	85	25
13	8;2	1;4	2;3	5;11	>90	75	25

Each CI child was individually matched to a normal hearing child selected on the basis of comparable linguistic, auditory, and chronological age.

The group matched on morpho-syntactic abilities is composed of 13 normal hearing children of comparable linguistic age (LA group). They ranged in age from 5;7 to 7;9 (mean age 6;7). They were matched to the hearing-impaired group on the basis of the scores obtained on a standardized test assessing morpho-syntactic abilities (TCGB test – Test di Comprensione Grammaticale per Bambini, Chilosi and Cipriani, 2006). A between-group analysis showed that no significant difference was found between the scores obtained by the two groups on the TCGB test (Mann Whitney U=74.5 p=.606).

The group matched on auditory age (based on the difference between chronological age and age at cochlear implantation – AA group) is composed of 13 normal hearing children ranging

in age from 4;11 to 9;4 (mean age 6;10). They were matched to the CI children on the basis of the length (in months) of exposure to the Italian language.

The age of each NH child was either three months higher or lower than the length of exposure of a CI child. In two cases, the CI children had less months of exposure (six and ten) than the matched AA children. No significant difference was however found between the months of exposure to the spoken language of the CI and AA children (Mann Whitney U= 83.5 p=.960).

The group matched on chronological age (CA group) is composed of 13 normal hearing children ranging in age from 7;5 to 10;3 (mean age 9;1). The age of each CA child was either three months higher or lower than the age of a CI child (in two cases, the CI children were four and five months older than the matched CA child). In any case, no significant difference was found between the age (in months) of the CI and CA children (Mann Whitney U=78.5 p=.762).

Normal hearing children were recruited in a kindergarten and two primary schools near Venice. They did not have any language impairment or any hearing or mental disabilities. In their families, some of them were also exposed to dialect.

5.2 Materials

The elicited production of subject and object restrictive relative clauses was investigated by using a preference task. The preference task was elaborated by following the paradigm adopted by Friedmann and Sztermann (2006) to test the production of relative clauses in Hebrew-speaking hearing-impaired children, later adapted to Italian by Utzeri (2007) to test production in Italian-speaking normal hearing children and adults. The choice to use a preference task relies on the fact that the child's interest in the task is stimulated by the

possibility of opting for the picture that he/she likes and in which he/she can identify himself/herself.

Two pictures were shown to the child and then he/she was asked to express a preference between the two options, thus being forced to produce a relative clause.

The task was composed of 24 experimental trials (12 questions eliciting a subject relative, 12 questions eliciting an object relative).

All experimental sentences were semantically reversible, namely they contained verbs in which thematic roles could be compatible with both DPs. This means that the meaning of the sentence could not be derived by relying on semantic or pragmatic cues. Verbs and animate nouns were mainly selected among the high-frequency lexicon of children (Marconi et al. 1993). All verbs were transitive, taking a direct object as a complement, and were used in the present tense, in order to avoid difficulties deriving from the presence of more complex tenses including auxiliaries and past participle morphology, which are often problematic for hearing-impaired children (Chesi 2006), and may increase the difficulty of the task.

The verbs used for the experimental trials are: *lavare* (to wash), *colpire* (to hit), *inseguire* (to chase), *portare* (to bring), *tirare* (to pull), *pettinare* (to comb), *fermare* (to stop), *baciare* (to kiss), *guardare* (to look at), *mordere* (to bite), *seguire* (to follow), *salutare* (to greet), *rincorrere* (to run after), *visitare* (to visit), *accarezzare* (to stroke), *alzare* (to lift), *abbracciare* (to hug), punire (*to punish*), premiare (*to praise*), *seguire* (to follow).

The experimental trials contained both singular and plural features on the head DPs. Number features were manipulated in order to determine whether the number feature on the noun could influence performance and increase accuracy. In fact, a study conducted on the comprehension of relative clauses by CI children showed that higher percentages of accuracy were attested when the head was singular as opposed to cases in which it displayed plural

features (Volpato, 2010). Hence, in twelve sentences, the head was singular, and in twelve, the head was plural. Although in some pictures the characters were performing unusual actions, the child was asked to express nevertheless a preference for one of the two options. A trial eliciting a subject relative is given in the following example:

(26)   *Ci sono due disegni. Nel primo disegno, i bambini accarezzano il gatto. Nel secondo, i bambini colpiscono il gatto. Quali bambini ti piacciono (di più)? Inizia con 'Mi piacciono i bambini…' oppure 'I bambini...' Target: '(Mi piacciono) i bambini che accarezzano/ colpiscono il gatto'.*

'There are two pictures. In the former, the children are stroking the cat. In the latter, the children are hitting the cat. Which children do you like? Start with 'I like the children…' or 'The children…' Target answer: '(I like) the children that are stroking/hitting the cat'.

Fig. 1. A picture used to elicit a subject relative.

A trial eliciting an object relative is provided by the following example:

(27)   *Ci sono 2 disegni. Nel primo, la maestra sgrida i bambini Nel secondo,la maestra premia i bambini. Quali bambini ti piacciono? Inizia con 'Mi piacciono i bambini…'*

oppure 'I bambini...' Target: '(Mi piacciono) i bambini che la maestra

sgrida/premia'.

'There are two pictures. In the former, the teacher is punishing the children. In the

latter, the teacher is praising the children. Which children do you like? Start with 'I

like the children…' or 'The children…' Target answer: '(I like) the children that the

teacher is punishing/praising.'
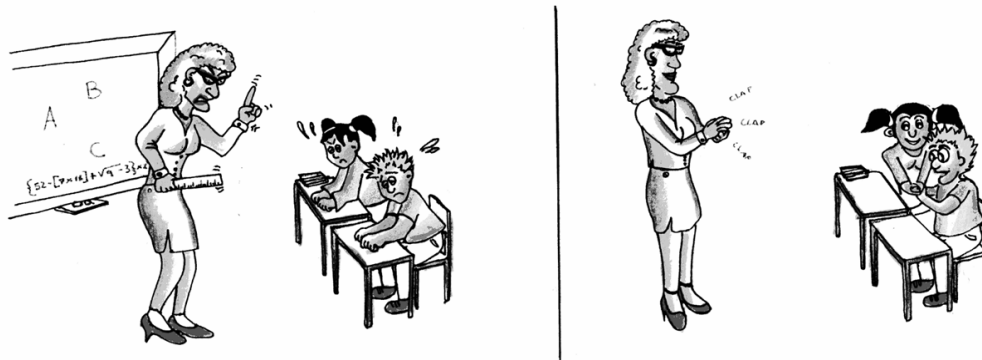
Fig. 2. A picture used to elicit an object relative.

Experimental trials were interspersed with filler sentences, i.e., non-reversible sentences

containing either intransitive verbs or transitive verbs with inanimate objects. Fillers are easy

items (Goodluck and Tavakolian, 1982), included in the battery with the function of diverting

the attention of the tested participant from the real aim of the investigation, to keep children's

attention high, and to renew the child's confidence and interest in the task. The presentation

of filler items required the production of simple SV or SVO word order sentences.

A trial eliciting a filler sentence is illustrated in Figure 3:

(28)   Cosa fa l'orso? Target: L'orso legge (un libro).

'What is the bear doing? The bear is reading (a book).'

Fig. 3. A picture used to elicit a filler sentence.

The drawings were all coloured.

5.3 Procedure

Written consent was collected from all the children's parents before beginning the experiment. In addition, in order to avoid the inclusion of children speaking foreign languages, parents were asked to inform us about the language(s) mainly spoken in their family, by selecting one of the following options:

- Italian

- Italian and dialect

- Italian and a foreign language

- Mainly a foreign language

Only children speaking either Italian, or Italian and dialect in their family were included in this analysis.

All tasks were presented orally. Trials were randomized and presented on separate A4-sized pages in the same order to all participants.

Since the aim of the study was to assess language competence and not auditory skills, the tasks were administered to CI children without the experimenter's mouth hidden by her hands, to give the children the opportunity rely on lip-reading. When the stimuli were not perfectly heard by the participants, they were read again.

Each participant was assessed individually in a quiet room, in three sessions, each lasting about 30 minutes.

The experimental part was preceded by a training session aiming at familiarizing children with nouns, verbs, items and experimental setting, and to make sure that they had correctly understood the instructions.

The production of relative clauses was audio-recorded and then transcribed by the first author and another experimenter. The sentences produced by the participants were coded by two people. For hearing children, the sentences were coded by the first author and another experimenter contributing to data collection. For CI children, another judge was asked to code the sentences.

5.4 Coding

In this section, we present how the different answering strategies have been coded. First of all we coded the target sentences for each sentence typology (subject or object relatives). Then we coded all the different answering strategies adopted by children when subject relatives and object relatives were targeted. We coded the strategies and factors that are identical for subject and object relatives, and then the factors and strategies that are particular and unique to each structure.

5.4.1 Target sentences

The first step consisted in counting the number of target subject relatives and target object relatives. Subject relatives and object relatives were considered as correct when they had the structure as shown in (29) and (30), respectively:

(29)   I bambini che lavano la tigre

        'The children that wash the tiger'

(30)   I bambini che (la maestra) premia (la maestra)[8]

        'The children that (the teacher) praises (the teacher)'

All other answering strategies were coded separately and are presented in the following sections. Thus we do not have in our dataset any "Other" response, as all non-target responses were coded as follows.

5.4.2 Subject relatives: general strategies

The only strategy which was grammatical and appropriate for the context when a subject relative was targeted was as in (29).

We coded sentences that were grammatically correct, namely built according to the rules of Italian, but not licit in the context in which they were produced, as for instance simple SVO word order sentences without relativization, as in (31):

---

[8] In the case in which the two DPs in object relatives displayed a number mismatch, namely the first DP was singular and the second was plural, or the other way round, the embedded subject was considered as correct when it was placed either in pre-verbal or post-verbal position. When both DPs were either singular or plural, the object relative was considered as correct when the embedded subject was placed in pre-verbal position.

(31)   Target: Il bambino che rincorre l'orso

               'The child that runs after the bear'

     Production: Il bambino rincorre l'orso

               'The child runs after the bear'

A non-target answer coded when a subject relative was elicited consisted in the production of a relative clause in which the complementizer *che* was replaced by a different *wh*-filler (such as *dove* 'where')[9].

(32)   Target: Il bambino che alza l'elefante

               'The child that lifts the elephant'

     Production: Mi piace il bambino quello dove alza l'elefante

               'I like the child where (he) lifts the elephant'

Relative clauses with theta-role inversion were also produced. In this case, an object relative was produced instead of a subject relative, as in the following example[10]:

(33)   Target: I bambini che baciano la bambina

---

[9] The use of the *wh-* filler *dove* instead of the complementizer is an option frequently attested in child language in French and Italian (Guasti and Cardinaletti, 2003; Labelle 1990). This phenomenon is also attested in hearing-impaired populations, as reported, for instance, for French (Delage, 2008).

[10] The sentence in (33) is the only case in which an object relative is produced instead of a targeted subject relative. This unexpected production could receive a different perhaps more plausible analysis, namely it is a subject relative with an unpronounced plural verb inflection. Whatever the correct interpretation of this case, it does have an impact on the linguistic discussion in the following sections.

'The children that kiss the child.FEM'

Production: I bambini   che   bacia la bambina

the children that   kisses the child.FEM

'The children that the child.FEM kisses'

Sentences with a missing relative pronoun which did not represent a grammatical structure of Italian were coded as '*che* omission' (34), or 'ungrammatical' (35). The latter group included sentences of various error types:

(34)   Target: Mi piace il bambino che guarda la tigre

'The child that looks at the tiger'

Production: Mi piace il bambino … guarda la tigre

'I like the child ... looks at the tiger'

(35)   Target: Il bambino che rincorre l'orso

'The child that run after the bear'

Production: Il bambino rincorrere l'orso

'The child to-run-after the bear'

Subject relatives for which only a portion of the sentence was uttered were classified as incomplete sentences, as in (36):

(36)   Target: Mi piace il bambino che pettina il cane

'I like the child that the combs the dog'

Production: Mi piace il cane

'I like the dog'

Answering strategies not falling within any previous coding category were classified as 'other strategies'.

5.4.3 Object relatives: general strategies

This section presents the answering strategies to targeted object relatives which fit in the categories found for subject relatives.

We coded sentences with theta-role inversion when a subject relative was produced instead of an object relative, as in the following example:

(37)   Target: I bambini che i cani baciano

'The children that the dogs kiss'

Production: I bambini che baciano il cane

the children that   kiss the dog

We coded non-target sentences consisting in the production of an object relative in which the complementizer *che* was replaced by a different *wh*-filler (such as *dove* 'where') (see note 9):

(38)   Target: Il bambino che il papà lava

'The child that the father washes'

Production: Mi piace il bambino quello dove il papà lava

'I like the child the one where the father washes'

Sentences as in (39) and (40) were coded as '*che* omission' and 'ungrammatical', respectively, the latter including incorrect sentences with various errors:

(39)   Target: Mi piace il bambino che il dottore guarda

                       'The child that the doctor looks at'

        Production: Mi piace il bambino … il dottore guarda

                       'I like the child ... the doctor looks at'

(40)   Target: Il bambino che il cane segue

                       The child that the dog follows

        Production: Mi piace il bambino così cammina e così il cane insegua

                       I like the child so walks and so the dog follow.SUBJ.MOOD

Object relatives were classified as 'incomplete' when only a portion of the sentence was uttered as in (41):

(41)   Target: I bambini che la maestra premia

                       'The children that the teacher praises'

        Production: Premia i bambini

                       '(She) praises the children'

Answering strategies not falling within any previous coding category were classified as 'other strategies', as in the following example:

(42) Target: Il bambino che il cane segue

'The child that the dog follows'

Production: Il bambino che porta a spasso il suo cane

'The child that takes his dog for a walk'

5.4.4 Object relatives: particular strategies

A further analysis classifying all the answering strategies found when object relatives were targeted consisted in coding sentences containing resumptive elements, either a pronoun, as in (43), or a full DP, as in (44):

(43) Il bambino che l'orso *lo* accarezza

the child that the bear *him* caresses

'The child that the bear caresses him'

(44) Il bambino che l'orso accarezza *il bambino*

'The child that the bear caresses *the child*'

Notice that resumptive clitic pronouns and DPs were not found when subject relatives were elicited.

Other strategies which are specific to object relatives were the production of passive relatives (45) and causative constructions, built with *farsi + verb* 'to make oneself + verb', as in (46).

They were both considered as grammatical and appropriate for the context. In both cases, a

subject relative is produced instead of the target object relative:

(45)   Il bambino che è pettinato dal papà

        'The child that is combed by the father'

(46)   Il bambino che si fa pettinare dal papà

        the child   that   himself makes comb by the father

        'The child that has himself combede by the father'

A strategy coded for object relatives consisted in the use of ambiguous sentences:

(47)   Target: Il bambino che il papà lava

                      'The child that the father washes'

        Production: Il bambino che lava il papà

                      'The child that washes the father'

In Italian, this production is ambiguous between a subject and an object reading, because

either of the DP (*il bambino* 'the child' or *il papà* 'the father') could be interpreted as the

subject of the embedded verb. In the case of an object reading, the embedded subject is

placed in postverbal position, which is licit in Italian. Since these sentences are ambiguous,

we are not sure that children are assigning thematic roles correctly. For this reason, we keep

this sentence type separate from unambiguous object relatives.

Incorrect answers which were grammatically correct but not licit in the context in which they were produced (classified as 'head inversion') consisted in turning object relatives into subject relatives, making the target embedded subject become the relative head of the matrix clause, as in (48):

(48)   Target: I bambini che il papà pettina

                       'The children that the father combs'

       Production: Il papà che pettina i bambini

                       'The father that combs the children'

Notice that the difference between head inversion, as in (48), and theta-role inversion, as in (37), is that in the former, thematic roles are correctly assigned, while in the latter, thematic roles are reversed.

5.4.5 Reliability

Sentences were coded by two naïve coders. The percentage of exact agreement was 93% for subject relatives in the CI group; for object relatives, the percentage of agreement was 88% in the CI group, 94% in the LA group and 95% in the AA group. An inter-rater reliability analysis using the Cohen's kappa statistic was performed to determine reliability among raters. The inter-rater reliability was found to be kappa = .87 for subject relatives in the CI group. As for object relatives, the kappa values were .78 in the CI group, .89 in the LA group, and .90 in the AA group.

6 Results

6.1 Target subject and object relatives

Table 2 reports the number and percentage of accuracy of target subject and object relatives, such as those coded in examples (29) and (30), respectively. Since the number of stimuli for each sentence type is 12, we expected 156 sentences in all for each group. The first step consisted in calculating the number of target sentences produced when subject and object relatives were elicited.

Table 2

Number (No.), Mean (M), and Standard Deviation (SD) of the target responses in each type of sentence (SR: subject relative; OR: object relative) in each group (CI: cochlear-implanted children; LA: language matched hearing children; AA: children matched on auditory age; CA: age matched hearing children).

	SR			OR			TOT		
	No.	M	SD	No.	M	SD	No.	M	SD
CI (7;9-10;8)	138/156	88%	6%	10/156	6%	8%	148/312	47%	5%
LA (5;7-7;9)	154/156	99%	0,1%	22/156	14%	29%	176/312	56%	2%
AA (4;11-9;4)	150/156	96%	5%	29/156	19%	30%	179/312	57%	3%
CA (7;5-10;3)	156/156	100%	0%	21/156	13%	27%	177/312	57%	2%

Results of Table 2 are graphically represented by means of box plots for subject relatives (Figure 4) and object relatives (Figure 5). Crucially Figure 4 showed the large group-internal variation that was found in the CI group as compared to the control groups.

Fig. 4. Box plots showing the distribution of correct responses on a total of 12 in subject relative clauses in the CI (i.e., cochlear-implanted) group and in all the other control groups (i.e., LA: language matched hearing children; AA: children matched on auditory age; CA: age matched hearing children). The box plot displays 25th, 50th (median) and 75th percentiles in the box and 5th and 95th percentiles as horizontal lines outside the box. All values below or above these percentiles are plotted as dots. Dots display outliers (i.e., below 1.5 standard deviation from the mean).
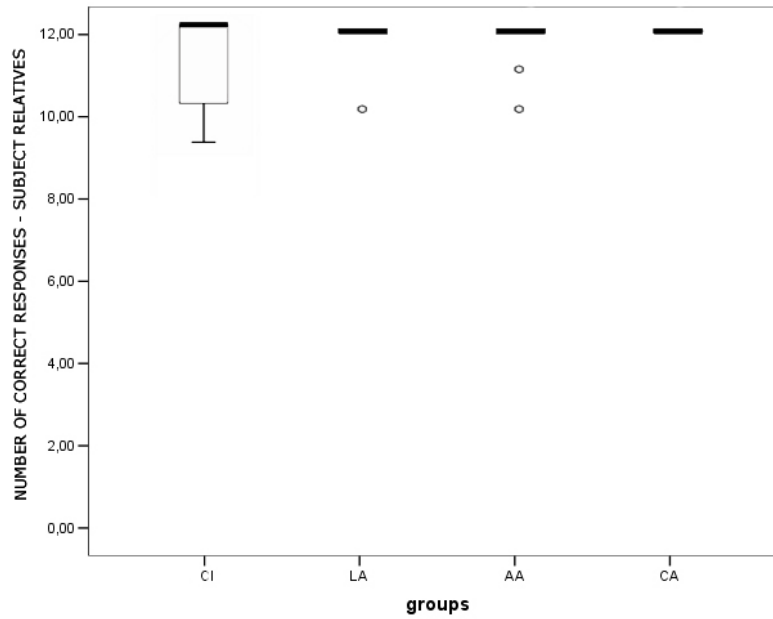
Interestingly Figure 5 revealed a large variability in the CI group as well as in the control groups.

Fig. 5. Box plots showing the distribution of correct responses on a total of 12 in object relative clauses in the CI (cochlear-implanted) group and in all the other control groups (i.e., LA: language matched hearing children; AA: children matched on auditory age; CA: age matched hearing children). Dots display outliers (i.e., above 1.5 standard deviation from the mean).
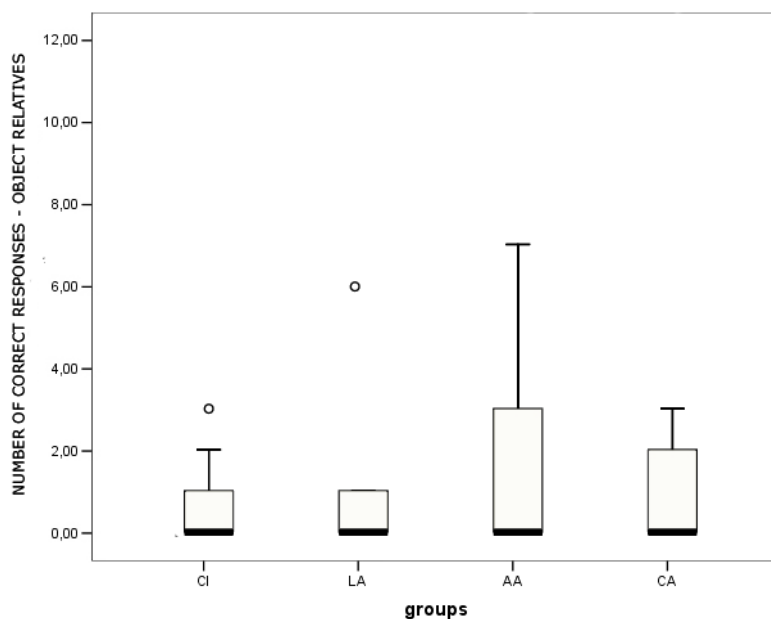
Overall, results showed that in both CI children and all groups of hearing control subjects, the percentage of accuracy is higher in subject relatives than in target object relatives. The groups of hearing control subjects have a higher percentage of accuracy than CI children, for both sentence types.

Following Dixon (2008) and Jaeger (2008), a repeated-measure logistic regression analysis was carried out in order to analyse accuracy data, using the statistical software R (R Development Core Team, 2008).[11]

Our independent variables are group (CI vs. LA, CA, AA), sentence type (subject relatives (SR) vs. object relatives (OR)), and nominal number effect (singular vs. plural). Random effects were subjects and items. Our dependent variable is the proportion of accurate responses. We considered which factors provide a better fit to the data. In mixed logit models, in order to decide whether a predictor contributes significant information to the

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[11] Dixon (2008) and Jaeger (2008) demonstrated that, when data are categorical (binomially distributed), mixed logit model analyses are more reliable than analyses carried out with ANOVA.

model, a model including the predictor is contrasted against a model without it using a χ^2-test (Jaeger, 2008).

We present results separately for each comparison between the CI group and each normal hearing group.

The first comparison is between the CI and LA groups. By contrasting a model with predictors with a model including the other factors, we found that the model fitting our data is the one including sentence type (subject vs. object relatives): $\chi^2(1) = 73.12$, p < .001. We only found a significant main effect of sentence type, namely subject relatives are easier to produce than object relatives (Wald Z=13.02, p < .001). Neither within the SR sentence type, nor within the OR sentence type did we find any significant difference between the two groups. Both the CI group and the LA group performed significantly better in subject relatives than in object relatives (Wald Z=10.04, p < .001, and Wald Z=6.50, p < .001, respectively).

The second comparison is between the CI and CA groups. By contrasting a model with predictors with a model including the other factors, we found that the model fitting our data includes yet again only sentence type (subject vs. object relatives): $\chi^2(1) = 69.88$, p < .001. We found a significant main effect of sentence type, namely subject relatives are easier to produce than object relatives (Wald Z=11.14 p < .001). The variable "group" was not included in the model ($\chi^2(1)$ <1). However by comparing the two groups on overall performance we found a significant effect of group (Wald Z= 1.93, p < .05), namely the CA group performed slightly better than the CI group.

The third comparison is between the CI and AA group. By contrasting a model with predictors with a model including the other factors, we found that the model fitting our data only includes, once more, sentence type (subject vs. object relatives): $\chi^2(1) = 69.60$, p < .001.

We found a significant main effect of sentence type, namely subject relatives are easier to produce than object relatives (Wald Z= 13.64, p<.001). The variable "group" was not included in the model ($\chi^2(1)$ <1). However by comparing the two groups on overall performance also in this case, we found a significant group effect (Wald Z= 1.92, p<.05), namely the AA group performed slightly better than the CI group.

To assess homogeneity of variance across groups we performed a Levene test. Interestingly, the CI group significantly differed from all other control groups both in subject and object relatives. With subject relatives, CI significantly differed from LA [t(11.00) = 6.51, p<.001], CA [t(11.00) = 6.51, p<.001] and AA [t(21.40) = 3.31, p<.003] groups. Similarly, in object relatives, CI children differed from LA [t(16.61) = 5.59, p<.001], CA [t(15.34) = 5.56, p<.001] and AA [t(17.62) = 5.65, p<.001] groups.

In addition, we performed a z-test of proportions, on the proportions of correct subject and object relatives produced in the CI group vs. all control groups. A Bonferroni adjustment was made to avoid a Type I error (.05/3 = .016). In subject relatives, CI significantly differed from LA (z = -13.83, p <.001), CA (z = -13.83, p <.001) and AA (z = -7.06, p <.001). In object relatives, CI significantly differed from LA (z = -5.77, p <.001) CA (z = -5.29, p <.001), and AA (z = -7.38, p <.001).

We also verified whether clinical data of CI children (age at hearing aid fitting, age at implantation, duration of cochlear implant use) were significant predictors of performance. As Table 3 shows, we found significant correlations in the production scores only for subject relatives. Namely, length of cochlear implant use (in months) significantly predicted accuracy in the production of subject relatives, with children using CI for a longer time being more accurate than those with a shorter length of CI use. In object relative data, none of the clinical variables appeared to predict the performance.

Table 3

Pearson Correlation Parameters between the clinical variables and the accuracy in the production of subject

(SRs) and object relative (ORs) clauses (HA: Hearing aids; CI: cochlear implantation).

	SRs	ORs
CI use	r = .23 p < .004	r = -.04 p = .60
Age of HA	r = -.03 p = .71	r = .03 p = .70
Age of CI	r = .01 p = .88	r = .05 p = .56

6.2 Results: all answering strategies

In this section, the different relativization strategies adopted by children when subject and

object relatives were targeted are discussed.

6.2.1 Strategies of response in targeted subject relatives

The following table shows the number and percentages of responses provided for the

different strategies when a subject relative was targeted:

Table 4

Number (No.), Mean (M), and Standard Deviation (SD) of answering strategies for target subject relatives in the

four groups.

	CI			LA			AA			CA		
	No.	M	SD	No.	M	SD	No.	M	SD	No.	M	SD
Target SRs I bambini che accarezzano il gatto	138/156	88%	23%	154/156	99%	5%	150/156	96%	8%	156/156	100%	0%
SVO sentence Il bambino rincorre l'orso	8/156	5%	16%	1/156	1%	2%	3/156	2%	4%	0/156	0%	0%
***Wh*-fillers** Il bambino quello dove alza l'elefante	3/156	2%	5%	0/156	0%	0%	0/156	0%	0%	0/156	0%	0%
Ungrammatical sentences/various errors Il bambino rincorrere l'orso	2/156	1%	3%	0/156	0%	0%	0/156	0%	0%	0/156	0%	0%
Omission of *che* Mi piace il bambino guarda la	1/156	1%	2%	0/156	0%	0%	0/156	0%	0%	0/156	0%	0%

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Theta-roles inversion I bambini che bacia la bambina	1/156	1%	2%	0/156	0%	0%	0/156	0%	0%	0/156	0%	0%
Incomplete sentences Mi piace il cane	0/156	0%	0%	0/156	0%	0%	1/156	1%	2%	0/156	0%	0%
Other strategies	3/156	2%	4%	1/156	1%	2%	2/156	1%	3%	0/156	0%	0%

By analysing the performance on subject relatives, an asymmetry between the group of CI children and the three normal hearing groups is easily detected as far as the response strategies are concerned. While for almost all trials, hearing children produced subject relatives correctly, CI children produced some incorrect sentences.

When subject relatives were not correctly produced by CI children, the strategy with the highest occurrence percentage is the use of simple SVO sentences. This strategy was rarely used by the younger groups, and completely absent in the group of older normal hearing children. In contrast to hearing children, the CI group used *wh*-fillers replacing the complementizer *che* (*dove* 'where', *quando* 'when'), and produced ungrammatical sentences, but these strategies were not attested in any of the hearing groups,

We submitted the occurrences of participants producing non-target responses to a chi square analysis. We did not find any significant difference for any of the non-target sentences.

6.2.2 Strategies of response in targeted object relatives

In this section, we focus on the strategies adopted by the four groups when an object relative was targeted.

In Table 2, we showed the number and percentage of target object relatives (with gap) correctly produced. As shown in section 5.4.4, besides target object relatives with gaps, two additional types of object relatives were coded in the analysis (ORs with resumptive clitic pronouns – see (43) and ORs with resumptive DPs – see (44)). The following table shows the

number and percentage of the three types of object relatives (target object relatives, object relatives with resumptive pronouns, and object relatives with resumptive DPs) out of the total number of sentences (156).

Table 5

Number (No.), Mean (M), and Standard Deviation (SD) of resumptive relatives in the four groups.

	CI			LA			AA			CA		
	No.	M	SD	No.	M	SD	No.	M	SD	No.	M	SD
Target ORs (with gap) Il bambino che il papà lava	10/156	6%	8%	22/156	14%	29%	29/156	19%	30%	21/156	13%	27%
ORs with resumptive clitic Il bambino che il papa lo lava	15/156	10%	23%	24/156	15%	22%	13/156	8%	14%	2/156	1%	5%
ORs with resumptive DP Il bambino che il papà lava il bambino	11/156	7%	13%	6/156	4%	9%	5/156	3%	7%	0/156	0%	0%
Total ORs	**36/156**	**23%**		**52/156**	**33%**		**47/156**	**30%**		**23/156**	**15%**	

As for object relative sentences, the chi square analysis revealed a significant difference in the use of the object relatives with resumptive clitics across groups [$\chi^2(3)= 9.35$ p<.01]. In this case, mostly the LA group (SR =1.81) contributed to the result. For object relatives with resumptive DPs, no significant difference across groups is attested.

In addition to object relatives with a gap, resumptive pronouns and resumptive DPs, both hearing and CI children adopted a considerable number of strategies when object relatives were targeted. We list all the strategies adopted by each group in Table 6. In the category OR ('Object relatives'), target object relatives with a gap, object relatives with resumptive clitic pronouns, and object relatives with resumptive DPs are all grouped together ('Total ORs' in Table 5):

Table 6

Number (No.), Mean (M), and Standard Deviation (SD) of the different answering strategies for targeted object relatives.

	CI			LA			AA			CA		
	No.	M	SD	No.	M	SD	No.	M	SD	No.	M	SD
Object relatives (see table 5)	36/156	23%	30%	52/156	33%	34%	47/156	30%	30%	23/156	15%	27%
Ambiguous sentences Il bambino che bacia la mamma	26/156	17%	16%	17/156	11%	7%	24/156	15%	15%	21/156	13%	20%
Passive relatives Il bambino che è lavato dal papà	41/156	26%	41%	22/156	14%	28%	24/156	15%	26%	65/156	42%	39%
Causative sentences Il bambino che si fa lavare dal papà	5/156	3%	12%	32/156	21%	32%	32/156	21%	33%	42/156	27%	35%
Wh-**fillers** Il bambino quello dove il papa lava	9/156	6%	14%	0/156	0%	0%	0/156	0%	0%	0/156	0%	0%
Simple SVO sentence Il papà pettina i bambini	10/156	6%	12%	3/156	2%	5%	1/156	1%	2%	0/156	0%	0%
Theta-roles inversion I bambini che baciano il cane	6/156	4%	6%	1/156	1%	2%	1/156	1%	2%	2/156	1%	5%
Head inversion Il papà che pettina i bambini	4/156	3%	6%	15/156	10%	16%	10/156	6%	14%	0/156	0%	0%
Omission of *che* Mi piace il bambino…guarda il dottore	2/156	1%	3%	0/156	0%	0%	0/156	0%	0%	0/156	0%	0%
Incomplete sentences Premia i bambini	0/156	0%	0%	2/156	1%	5%	2/156	1%	5%	0/156	0%	0%
Ungramm. sentences/other errors Il bambino così cammina e così il cane insegua	5/156	3%	5%	0/156	0%	0%	0/156	0%	0%	0/156	0%	0%
Other strategies	12/156	8%	9%	12/156	8%	12%	15/156	10%	12%	3/156	2%	5%

In object relatives, there are several response strategies, and there are some interesting
asymmetries between the CI group and the three hearing groups (LA, CA, and AA).
We ran a series of chi square tests on the number of subjects that used a different structure or
a strategy instead of producing a target relative sentence in the CI group in comparison with
LA, CA and AA groups.
CI children produced 23% of object relatives (including in the response object relatives with
gaps, resumptive clitics, and resumptive DPs).
Although no significant difference is attested between the experimental and control groups,
by comparing CI children's performance with that of normal hearing groups, it is evident that

the CI group produced less object relatives than the LA and AA groups (which are the groups with the lowest mean age), but more than the CA group (which has the highest mean age). In the use of passive relatives (45), the performance pattern is the opposite of that shown for object relatives, that is, the CI group produced more passive relatives than the LA and AA groups, but less than the CA group, which displays the highest percentage of this answering strategy. By comparing the CI group with the three hearing groups, we found a significant difference in the use of passive relatives [$\chi^2(3)= 9.27$, p<.01]; the CA group provided the strongest contribution to such result (SR = 2.19).

As far as the use of these two strategies is concerned (object relatives vs. passive relatives), the CI group appears to be at an intermediate position between the groups of younger hearing children (LA and AA) and the group of older ones (CA group).

Another strategy largely occurring in hearing children's production consists in the use of causative constructions (*farsi + verb* 'to make oneself + verb') (46). The use of causative constructions represents a strategy largely used by normal hearing children. Causative constructions are rarely produced by the CI group, with a very low percentage of occurrences (3%). However no significant differences were found between groups in the use of this strategy.

A strategy which is only used by CI children is the production of *wh*-fillers replacing the complementizer (such as *dove* 'where', *quando* 'when'). As for the use of this strategy, the difference across groups [$\chi^2(3)= 9.55$, p<.05] was mostly due to the CI group (SR = 2.59). This strategy is also found in subject relatives produced by the CI group, but it is not found in any of the normal hearing groups.

In some cases, children in the CI group produced simple SVO sentences, avoiding the production of a relative clause altogether. Also in this case, there was a difference across

groups in the tendency to produce simple SVO sentences [$\chi^2(3)$= 8.27, p<.05] and again, the CI group mostly contributed to such result (SR = 2.12).

In the CI group, the inversion of theta-roles is also attested in some sentences, namely the production of a targeted object relative is replaced by the production of a subject relative in which the head becomes the embedded subject. This strategy is rare in the hearing groups. However there was no significant difference in the tendency to produce sentences with thematic role inversion [$\chi^2(3)$= 7.09, p>.05].

On the other hand, in the two younger normal hearing groups (LA and AA), we find the transformation of object relatives into subject relatives by turning the embedded subject into the relative head. This strategy is less frequent in the productions of the CI and CA groups, even though no significant difference is attested between the different groups. Although such a response does not correspond to the target one, it shows that thematic roles are correctly assigned, contrasting with what happens in sentences in which theta-roles are reversed.

Other strategies that are more frequent in the CI group's productions than in those of hearing children's ones include the use of sentences in which the complementizer is omitted, the use of incomplete sentences, and the production of ungrammatical sentences.

While no significant differences are attested in sentences with complementizer omission and in incomplete sentences, groups differed in the tendency to produce ungrammatical sentences [$\chi^2(3)$= 13.00, p<.01], with the CI group mainly contributing to the result (SR = 3.00).

A strategy occurring to the same extent in all populations and showing no performance difference across groups consists in the use of ambiguous sentences. Since we do not know the exact nature of these structures (either subject or object relatives), we counted them separately.

Table 6 showed that the strategies adopted by the CI children are more numerous, if compared to the group of normal hearing children.

Focusing on the CI group and looking at individual performance, it is evident that within the group much individual variability is found. Table 7 shows the individual performance of the CI group in the use of the different answering strategies when an object relative is targeted.

Table 7

Distribution of individual responses by CI children in the production of targeted object relatives (OR=object relatives, PR=passive relatives, CS= causative sentences, AMB=ambiguous sentences).

Subj.	OR	PR	CS	AMB	Simple SVO	Wh-fillers	SRs instead of ORs		Ungrammatical sentences		Other strategies
							Theta roles inv.	Head inv.	'che' omission	Other errors	
1	5			4	1		1		1		
2		10		1	1						
3	2	1		7			2				
4			5	1	1		1			1	3
5	9			2							1
6		12									
7		11		1							
8	6			3			1				2
9	10			1						1	
10	1	7		1				2			1
11	1			3		6	1				1
12				2	2	1		2	1	2	2
13	2				5	2				1	2
Total	36	41	5	26	10	9	6	4	2	5	12
Mean	23%	26%	3%	17%	6%	6%	4%	3%	1%	3%	8%
SD	30%	41%	12%	16%	12%	14%	6%	6%	3%	5%	9%

As is evident from the table, some children produced a considerable number of passive relatives and some others correctly produced object relatives. Most interestingly, children producing passive relatives never or rarely used other answering strategies. Only one child produced few causative constructions, opting instead for a considerable number of incorrect strategies.

Children who were not able to use context appropriate answering strategies preferred producing a number of incorrect sentences which were either grammatical but did not match the question uttered by the experimenter (SVO sentences, relative clauses with theta-role inversion, and head inversion), or contained *wh*-fillers replacing the complementizer *che*, or were ungrammatical (incomplete sentences and sentences in which the complementizer *che* is omitted).

7. Discussion

This study investigates the effect of hearing impairment on the elicited production of subject and object relative clauses by a group of CI children in comparison to three groups of normal hearing children. The discussion will focus on the asymmetry between subject and object relatives in the group of cochlear implanted children in comparison with normal hearing children, on the analysis of the differences in performance between the experimental group and the control groups, and on how syntactic phenomena and developmental factors may influence the production and the use of passive relatives and object relatives.

7.1 The asymmetry between subject and object relatives

One goal of this study is to investigate whether the asymmetry between subject and object relatives is also found in Italian CI children. Indeed, this study found that both in the group of

CI children and in the three groups of normal hearing children, subject relatives as in (49) are produced to a significantly larger extent than object relatives as in (50). Most importantly, this finding shows that CI children follow the same performance pattern as normal hearing children. Therefore, in line with previous studies on other populations and on other languages, this study confirms the asymmetry between the two types of structures.

(49)   Mi piacciono [i bambini   [che <i bambini>   accarezzano il gatto]]

       I like   [the children [that <the children   stroke the cat]]
                                    |_____|

(50)   Mi piacciono [i bambini   [che il papà pettina   <i bambini>]]

       I like   [the children [that the father combs <the children>]]
                                  |_____|

Subject relatives are well preserved in all groups of participants, while object relatives occur in a low percentage of responses.

As pointed out by all previous studies reported in section 2 above, subject relatives are easier because the relation between the relative head and the position from which it has moved is short (49). Moreover, the canonical SVO order is preserved. In object relatives, on the other hand, a longer movement is involved and a long-distance relation is established between the position of the object in the main clause and its original position (50). Movement produces a marked OSV word order. As previous studies pointed out, syntactic complexity and long-distance relations are particularly taxing for performance systems (Contemori and Garraffa, 2010; De Vincenzi, 1991; Gibson, 2000; Jakubowicz, 2011; Jakubowicz and Tuller, 2008; Tuller et al., 2011).

7.2 Answering strategies: comparison between cochlear-implanted and normal hearing children

The second issue we address concerns the existence of a difference between the performance of CI children and that of the three groups of normal hearing children, in order to detect whether the delayed access to the linguistic input may hinder them. Although from the analysis conducted so far it is possible to determine that the four groups follow the same performance pattern, namely object relatives are more problematic than subject relatives, our study also shows that in the production of both subject and object relatives, CI children significantly differ from each of the three groups of normal hearing children.

Subject relatives, although maintaining a subject-verb-object word order, involve an A'-dependency between the DP head position and the position from which it has moved. Subject relatives, in the same way as object relatives, are characterized by the presence of two thematic relations, since the subject of the relative clause is the object of the main clause. The difficulty is probably to be attributed to the presence of a chain between the position internal to the subordinate sentence and the external position (main sentence), namely the computation of an element with respect to two verbs. In sentence (49), for instance, the DP *i bambini* 'the children' is the object of the verb *piacere* 'to like', but it is also the subject of the verb *accarezzare* 'to stroke'. The difficulty that CI children experienced with subject relatives is also reflected in the number of (incorrect) strategies they adopted, and in particular in the number of SVO sentences (in which no relativization occurs) they produced. This phenomenon is rarely attested in the group of normal hearing children, even in the younger ones, who produced, in most cases, a correct subject relative clause. The presence of a considerable number of simple SVO sentences in productions by hearing-impaired individuals is a phenomenon found in other studies investigating the elicited production of

relative clauses, for instance in Hebrew (Friedmann and Szterman, 2006) and French (Delage, 2008), and it can thus be considered a marker for linguistic delay in acquisition. Also in the production of targeted object relatives, CI children significantly differed from all hearing groups. Indeed, the strategies adopted by CI and normal hearing children are different, their distribution varying according to the type of hearing group considered and the age of the children included in the groups.

For the use of some sentence types, namely object relatives and passive relatives, the tendency of CI children is to occupy an intermediate place between the groups of younger hearing children and the group of older hearing children.

Studies conducted on normal hearing children show that young individuals produce object relatives to a certain extent till the age of 6-7 years, as reported by Belletti and Contemori (2010), Utzeri (2007), Volpato (2010). Conversely, as children grow older, object relatives tend to decrease and the number of passive relatives begins to consistently increase, till they become the prevailing strategy at adolescence and adulthood. Our data showed that the group of older hearing children (CA group) significantly produced more passive relatives than the other groups. The experimental group, which consists of children ranging in age from 7;9 to 10;8, produced 23% of object relatives and 26% of passive relatives. For both strategies, looking at Table 6, we can see that the tendency of CI children is to hold an intermediate position between the younger groups of children (for whom the production of object relatives is higher than that of passive relatives) and the older one (who instead produced a higher percentage of passive relatives than object relatives).

The fact that older typically-developing children are more likely to produce passive relatives than younger ones, and the fact that in the CI group also a considerable number of passive

relatives is also observed is a sign that to a certain extent, CI children have attained a good competence of Italian.

The group of CI children also produced a number of object relatives, most of which contain resumptive elements, especially resumptive clitic pronouns. The use of resumptive pronouns, namely the partial repetition of a copy of the moved head (Belletti, 2009), largely occurred in the group of younger normal hearing children, but it is rarely used by the group of older children. Although resumption is a strategy not largely adopted by the CA group, it is frequent in child language as well as in informal adult speech (see section 2).

Hearing individuals also produced a considerable number of causative constructions, which are rarely used by CI children (only in 3% of responses). In causative sentences, the presence of the functional verb *fare* 'to make', which assigns an additional thematic role, may be problematic for hearing-impaired children.

The need to assign this extra thematic role probably constitutes a non-trivial problem for CI children, resulting in the rather frequent absence of this structure from their productions. In these constructions a number of functional elements come into play, but, unfortunately, the lack of data on the acquisition of these properties by typically-developing children does not allow us to examine this issue more deeply. For this reason, we do not go further on this point and leave it open for further research.

Among the answers produced by CI children which do not represent context adequate strategies and which distinguish the performance of the experimental group from that of the control groups, we mention sentences containing *wh*-fillers, simple sentences with SVO word order, sentences with theta-role inversion, and ungrammatical sentences. These response types are found in the production of CI children, but are rarely or never attested in normal hearing children's productions. Ungrammatical sentences significantly distinguish the CI

group from control groups, especially as far as object relatives are concerned, replicating previous findings that hearing-impaired participants are more likely to produce ungrammatical sentences than hearing children (Chesi, 2006; Delage, 2008; Friedmann and Szterman, 2006).

That the use of ungrammatical sentences, simple SVO sentences, sentences with *wh*-fillers replacing the complementizer, and sentences with theta-role inversion are typically found in hearing-impaired individuals and younger children and especially in the CI group can be considered a consequence of linguistic delay for CI children.

An incorrect strategy occurring to a greater extent in the younger hearing children is the use of a subject relative containing head inversion, instead of a target object relative. Although this answer does not represent an adequate strategy, it is evident that children are able to correctly assign the thematic roles of agent and patient to the arguments of the relative clause, but the production of an object relative is still problematic for them.

Focusing on the group of CI children and looking at the individual performance within this group, it is interesting to observe that much individual variability is found.

Table 7 showed that four children (subjects 2, 6, 7, 10) largely adopt the passive relative strategy, whereas three other children (subjects 5, 8, 9) produced a considerable number of object relatives. Interestingly, the CI children who produced passive relatives never or very rarely produced object relatives, and only for few stimuli did they adopted other strategies. The fact that older typically-developing children are more likely to produce passive relatives than younger ones, and the fact that some CI children also produced a considerable number of passive relatives is a sign that these CI children have attained a very good competence of Italian. This also means that in spite of the delayed exposure to the linguistic input during the sensitive period, it was possible for these children to attain a language competence

comparable to like-age peers. In cases in which the strategy of passive relatives does not yet represent an available option, some children produced object relatives.

More frequently, however, CI children used strategies which are never or rarely found in the group matched for chronological age, but that are attested in the productions of the groups of younger normal hearing children. Indeed, these CI children produce simple sentences displaying SVO word order without relativization, object relatives turned into subject relatives either through head inversion or through thematic-role inversion, and sentences in which the complementizer was either omitted or replaced by different *wh*-fillers.

The CI children mainly producing ungrammatical sentences (subjects 4, 12) are, to some extent, performance deviant compared to the normal hearing children.

The fact that these children produced a number of sentences not found in the groups of normal hearing children of the present study, but found for instance in the productions of other very young participants tested by other authors, or often found in the productions of hearing-impaired individuals is a sign of linguistic delay for these CI children. This means that these CI children were not able to make up for the lack of exposure to the linguistic input in the early stages of language acquisition.

7.3 The use of object relatives and passive relatives

A further goal of our study was to contribute to the linguistic debate on the use of object and passive relatives, trying to give an account for the production of the former by young children and the latter at a later stage of language acquisition.

Belletti (2009) and Friedmann et al. (2009) explain the low percentages of object relatives comprehended by children by claiming that this phenomenon depends on a developmental constraint, namely the use of a stricter (non-adult) version of RM, as discussed in section 3.2.

This proposal however raises a number of issues. The first issue concerns the reason why young children produce object relatives – which are not expected if RM is at play in immature grammars –, before producing passive relatives, which are subject relatives and should be preferred over object relatives because they do not violate RM. The second issue arises when considering adult performance and concerns the reason why adults do not produce object relatives, preferring passive relatives instead, even though RM is not a problem for this population.

As mentioned in section 3.2, RM can neither account for Italian-speaking children's production of object relatives, nor can it explain the adults' preference for passive relatives. Section 3.2 showed that passive relatives are formed through a linguistic device, known as *Smuggling* (Collins, 2005), in a derivation consisting of more than one step. As Belletti (2009) pointed out, passive relatives, which are subject relatives, are more economic than object relatives because more local steps are involved.[12] It seems, however, that *Smuggling* is not available from the earliest stages of language acquisition. Hence, young children use different answering strategies, among which a considerable number of object relatives. The availability of *Smuggling* makes it possible for children to shift from object relatives to passive relatives when they grow older.

Notice however that it is not possible to argue that maturation is at stake here. If *Smuggling* were not available at all in early grammars, passive sentences should never be comprehended or produced by very young children. Evidence to the contrary is however accumulating in

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[12] A comparison is possible with other types of movement. Cyclic wh-movement, which implies more local steps, is less marked than long *wh*-movement, which undergoes a number of restrictions and is not available with all *wh*-elements (cf. Cinque, 1990; Rizzi, 1990).

recent years (for English, Bencini and Valian, 2008; Messenger et al., 2009; O'Brien et al., 2006; for Sesotho, Demuth et al., 2010; for Italian, Volpato et al., in press).

The larger use of object relatives rather than passive relatives in early grammars (hence in young children) can be explained in terms of the agreement relations involved in the two constructions, as discussed in section 3.3 above.

Following the proposals by Franck et al. (2006) and Guasti and Rizzi (2002), in sentences which display the subject-verb word order, as in object relatives (in the case in point, in the embedded sentence – *i bambini che il papà pettina* 'the children that the father combs'), the agreement relation occurs both under AGREE (when the embedded subject is still in its original position within the VP projection), and in the local Spec-head configuration (after the subject has moved to the preverbal embedded position). On the other hand, in passive relatives (*i bambini che sono pettinati dal papà* 'the children that are combed by the father'), the agreement relation takes place only through AGREE, and no local checking in a Spec-head configuration occurs. We suggest that object relatives are preferred over passive relatives in the earliest stages of language acquisition because of the robustness of agreement between the embedded subject and the verb, occurring both under AGREE and in the Spec-Head configuration. The evidence for the need of robust agreement in early grammars is confirmed by the low number and percentage of object relatives with a post-verbal embedded subject (*I bambini che pettina il papà* the children that combs the father – meaning 'the children that the father combs') which are correctly comprehended and produced by young children (Volpato, 2010; Volpato and Adani, 2009).

The delayed access to passive relatives, in which more local steps are involved due to the *Smuggling* operation, depends on the fragility of agreement (based on AGREE only). When this possibility is acquired and *Smuggling* becomes an option fully available to children, local

steps constitute the most economic solution, and passive relatives are therefore preferred over object relatives. Both structures however remain are available to both older children and adults.

8. Conclusion

This study showed that CI children display the same asymmetry between subject and object relatives found cross-linguistically in studies investigating these properties in typical and atypical language acquisition, thus confirming that, overall, this population's performance pattern follows that of normal hearing individuals. Object relatives are significantly more difficult to produce than subject relatives for both CI children and the three groups of normal hearing participants.

However, although subject relatives are easily produced by all children, a difference in performance is attested between the experimental group and the three control groups. While hearing children produce the target sentence in most cases, CI children sometimes provided incorrect responses, by producing simple sentences with SVO word order (without relativization), sentences containing *wh*-fillers (*dove* – 'where') replacing the complementizer, ungrammatical sentences, and sentences in which the complementizer is omitted. The use of such a variety of incorrect responses by the group of CI children, as opposed to normal hearing children, represents a sign of the linguistic delay associated to hearing impairment. Object relatives are more problematic than subject relatives for all groups, and are characterized by low percentages of occurrence. A number of different strategies are adopted when object relatives are targeted, also differentiating the performance of the CI group from the three normal hearing groups.

Children have a wide range of possible strategies available in their grammar to convey meaning, as shown by previous studies on typically-developing Italian children. The groups of young hearing children (LA and AA groups) produced a higher percentage of object relatives than the group of older children (CA group), replicating the tendency observed in previous studies that children at early stages of relative clause acquisition do produce object relatives, which decrease as they grow older, at adolescence and adulthood (Belletti and Contemori, 2010; Carpenedo, 2011; Re, 2010; Utzeri, 2007; Volpato, 2010). In the normal hearing groups, the tendency to produce more passive relatives than object relatives is higher in the group of older children (CA group). Previous studies report that passive relatives are more frequent in adolescents and adults than in children (Utzeri 2007; Volpato, 2010).

In addition, all hearing groups produced a considerable number of causative constructions, which are not found in the group of CI children. The groups of younger children also produced a considerable number of sentences containing head inversion which, although not felicitous in the context, show nonetheless that they are able to correctly assign thematic roles to arguments.

A qualitative analysis of the responses and the comparison between the experimental group and the hearing control groups in the answering strategies provided when an object relative was targeted shows that there is high individual variability of performance within the CI group, confirming results from previous studies for English and German (Geers, 2004; Geers et al., 2003; Szagun, 2001). Children with hearing loss produced object relatives and passive relatives, which are grammatical and pragmatically felicitous. They however also produced some sentences which are not felicitous (namely (i) relative clauses in which the complementizer *che* 'that' was either omitted or replaced by other *wh*-fillers such as *dove* 'where', and (ii) simple sentences with simple SVO word order), and some ungrammatical

sentences, among the other strategies. As far as the type of responses and the percentage of their occurrences, the group of CI children seems to hold at an intermediate position between the group of age-matched (older) hearing children (CA group) and the younger hearing groups (LA and AA groups).

On the one hand, the tendency of some CI children to produce more passive relatives than object relatives is presumably linked to their chronological age and to the good cognitive and linguistic development somehow related to it, showing that these children were able to make up for the lack of linguistic input in the early stages of language acquisition. Indeed, in this respect, they pattern with the group of older hearing controls (CA group), who largely produced passive sentences. On the other hand, the tendency of other CI children to produce sentences containing theta-role inversion, rarely found in hearing children, or head inversion, found especially in the groups of young children (LA and AA), and sentences in which different *wh*-fillers replaced the complementizer (for example *dove* 'where'), sentences in which the complementizer was omitted, or ungrammatical sentences, which are rarely or never found in the normal hearing children's corpus, is to be related to the linguistic delay associated to hearing loss. Although in this study, *wh*-fillers are only found in cochlear-implanted children's production, their use is not specifically limited to this population. Indeed, these productions are attested in very young normal hearing children (Guasti and Cardinaletti 2003). The use of ungrammatical sentences is frequent in hearing-impaired individuals' productions (for Italian, Chesi, 2006; for French, Delage, 2008; for Hebrew, Friedmann and Sztermann, 2006). The lack of causative constructions, probably due to the peculiar structure of these constructions and to the difficulty for cochlear-implanted children to compute the further thematic role assigned by the causative verb, may also be a sign that the acquisition of some properties by this population deviates from that of typically-

developing hearing individuals. Interestingly, the length of cochlear implant use was found to positively correlate with the production of relative clauses, although only when considering subject relatives. Children using a cochlear implant for longer time appear to have better linguistic outcomes than children using it for a shorter period of time.

Focusing on the use of the strategies with the highest percentage of occurrence, namely object relatives and passive relatives, by both cochlear-implanted and normal hearing children, this study contributes to the recent debate on the acquisition of these properties by claiming that the rather frequent production of object relatives at early stages of language acquisition is explained by the robustness of agreement between the embedded subject and the verb, occurring both under AGREE and in the Spec-Head configuration. Passive relatives, in which the agreement relation is based on AGREE only develop later. The delayed access to *Smuggling* depends on the presence of a fragile agreement relation. When *Smuggling* becomes fully available, local movement steps constitute the most economic solution (Belletti, 2009; Collins, 2005), and passive relatives are highly preferred over object relatives, in which one unique long-distance relationship is found.

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