

Introduction

This volume is a revised version of my PhD thesis (Volpato 2010b) and discusses important aspects of the acquisition of complex structures by populations with hearing impairment compared to populations with normal hearing. It presents data on Italian children with hearing impairment fitted with cochlear implants, whose language competence has been investigated only very recently. The research conducted during my PhD was the first study on their syntactic competence.

After that, some research has been devoted to investigating different linguistic aspects, using standardized tests (Caselli et al. 2012; Chilosi et al. 2013) and experimental tests on clitic pronouns (Guasti et al., 2014). Much research is still needed to understand the difficulties that children with cochlear implants encounter with language and with syntax in particular.

The research carried out during my PhD (2006-2009) and in the following years has attempted to fill in the gap focusing on the comprehension and production of complex syntactic structures, specifically restrictive right-branching relative clauses, by deaf children with cochlear implants. The choice of this research topic depended, on the one hand, on the fact that no data were available at the time on the syntactic abilities of Italian-speaking children with cochlear implants (and more generally, individuals with hearing impairment). On the other hand, the wide body of literature on the syntactic description of relative clauses and their acquisition made it possible to understand the difficulties with these complex structures in case of hearing impairment.

A long-lasting debate exists on how relative clauses are processed, comprehended, and produced across a variety of languages and populations: children (for English, Sheldon 1974; Hamburger, Crain 1982; Crain, McKee, Emiliani 1990; Kidd, Bavin 2002; Contemori, Marinis

2012; for Italian, Guasti, Cardinaletti 2003, Arosio, Adani, Guasti et al. 2005, 2009; Utzeri 2006, 2007; Adani 2008; Adani et al. 2010; Volpato 2010b; for French, Labelle 1990; Pérez-Leroux 1995; Guasti, Cardinaletti 2003; for Hebrew, Arnon 2005; for Greek, Varlokosta, Armon-Lotem 1998), adults (for English, Contemori, Marinis 2012; for Italian, Utzeri 2006, 2007; Belletti, Contemori 2010; Contemori, Belletti 2013), children with specific language impairment (for English, Adani et al. 2014; for Italian, Adani 2008; for Greek, Stavrakaki 2001; for Hebrew, Friedmann, Novogrodsky 2004; for Swedish, Håkansson, Hansson 2000), and agrammatic patients (for Italian, Garraffa, Grillo 2008; for Hebrew, Friedmann 2008).

Cross-linguistic research on the acquisition of relative clauses by individuals with hearing impairment exists: for English (Quigley, Smith, Wilbur 1974; Engen, Engen 1983; Quigley, Paul 1984; De Villiers 1988; De Villiers, De Villiers, Hoban 1994), Hebrew (Friedmann, Szterman 2006; Friedmann et al. 2008; Szterman, Friedmann 2014; 2015), Palestinian Arabic (Friedmann, Haddad-Hanna 2014), French (Delage 2008), and German (Ruigendijk, Friedmann 2017). The first data on Italian-speaking children with hearing impairment fitted with cochlear implants were presented in Volpato and Adani (2009) and Volpato (2010b).

The aim of the study is to obtain a picture as detailed as possible of the underlying linguistic knowledge of individuals with normal hearing and individuals with hearing impairment, as far as the acquisition and development of relative clauses are concerned.

The investigation on relative clauses was also enriched with data collected on other populations, including adolescents with hearing impairment using Italian Sign Language (LIS, henceforth), and hearing children, adolescents, and adults. This is the first study which presents data from Italian hearing adolescents.

The comprehension task and the production task used to investigate the syntactic representation of relative clauses in these populations have been developed following previous experimental research by Friedmann and Novogrodsky (2004), Arnon (2005), Utzeri (2006, 2007), and Adani (2008).

What makes my tools different from all previous experimental research is the manipulation of number features on both the head and the embedded DP in right-branching relative clauses. Several conditions were presented with all possible combinations: both conditions in which the two DPs are similar (*match* condition) and conditions in which the DPs are dissimilar (*mismatch* condition) in terms of number features. I focused on number features because cross-linguistic studies on the representation of number (and gender) features in clause structure (e.g. Ferrari 2005) and cross-psycholinguistic research on the role of phi features in sentence processing (e.g. Nicol 1998; De Vincenzi, Di Domenico 1999) show that the salience of Number ex-

erts an important influence on linguistic performance.

In the tasks developed during my PhD, the use of singular and plural DPs made it possible to investigate how marked features modulate the comprehension of relative clauses in the various populations, and especially in individuals with hearing impairment. Due to the delayed access to the linguistic input, plural markers on verbs are underspecified in these individuals (Chesi 2006), and consequently, their linguistic competence may be compromised.

The performance on the comprehension and production of relative clauses, and in particular the asymmetry found between subject (*the rabbit that hits the mice*) and object relative clauses (*the rabbit that the mice hit*), has been addressed by combining theories on phi features and approaches based on Relativized Minimality (Rizzi 1990; 1997; 2004a; Friedmann, Belletti, Rizzi 2009). Relativized Minimality is a principle of locality postulating that a relation between two positions (the first merge position and the landing site of movement) cannot be established if an intervening element represents a potential candidate for the local relation.

Proposals based on Relativized Minimality and on evidence coming from (young) typically developing children (Friedmann, Belletti, Rizzi 2009) suggested that intervention effects arise in object relatives when the intervener is lexically restricted, namely when a full NP moves across another full NP. Further refinements of this hypothesis suggested that other DP-features such as Number may be crucial for the correct interpretation of (object) relative clauses by participants with typical language development (for centre-embedded relatives, see Adani et al. 2010; for right-branching relatives, see Volpato 2010b; 2012). Although Relativized Minimality effects may also be at play in children with hearing impairment, other linguistic phenomena must be assumed to explain their different performance on object relatives with preverbal subjects in the different match and mismatch conditions tested. These phenomena include attraction phenomena along the lines of Kayne (1989) and the failed or damaged processing of number features on plural verbal morphology.

For all participants, the lower performance with object relatives with postverbal subjects, as opposed to object relatives with preverbal subjects, is explained in terms of fragility of agreement between the sentence constituents, following Guasti and Rizzi (2002) and Franck et al. (2006).

Interesting findings are also observed in the production task. Although children do not seem to be able to comprehend object relatives because of minimality effects arising in immature grammars, they do produce object relatives in elicited production tasks (Utzeri 2006; 2007; Volpato 2010b; 2011; Volpato, Vernice 2014). As children grow older, they opt for structures containing the passive voice. In adolescents and adults, the use of passive relatives is indeed the prevailing

strategy, while object relatives are almost never produced. Although these results have been replicated by much research on Italian typically developing children and adults, they are nonetheless surprising, since a structure that is comprehended at ceiling by adults, is never produced by them, and a structure that is problematic for children is among the most used strategies by these young participants. The explanation for such a behaviour, proposed by Volpato (2010b) and Volpato and Vernice (2014), combines recent linguistic proposals on locality (*Smuggling* mechanism, Collins 2005) and agreement phenomena (Guasti, Rizzi 2002; Franck et al. 2006). The analysis of the different strategies used by typically developing populations also help accounting for the inter-subject variability found in the performance of children with cochlear implants.

Another important issue that is addressed in the last chapter of this book concerns the assessment of memory skills and the relationship between comprehension of relative clauses and memory resources in children with cochlear implants and normal hearing children. Different memory measures are used to assess memory skills and investigate possible relationships with relative clause comprehension: nonword repetition, forward and backward digit span recall, sentence and word repetition.

The volume is organised as follows.

Chapter 1 offers a general overview on hearing impairment, its implications for the acquisition of an oral language, and the variables that characterize the populations with hearing impairment and may influence their language acquisition. This impairment is of sensory nature. It drastically reduces the quantity and quality of linguistic input available, hindering children from acquiring an oral language naturally. The level of linguistic competence they achieve may depend on the interaction of a variety of clinical and personal factors, namely degree of hearing loss, hearing device used, age of intervention, parents' linguistic background, etc. A section is devoted to show the difficulties that Italian-speaking children encounter when acquiring their oral language.

Chapter 2 presents the relevant syntactic properties of the structures assessed in the production and comprehension tasks. Restrictive subject and object relative clauses are complex structures derived through long-distance (A') movement from the embedded subject and object positions, respectively. Stemming from much linguistic and psycholinguistic research on phi features, I discuss the use of different combinations of number features in the creation of the experimental trials, in order to test how these morphosyntactic cues modulate the comprehension of relative clauses.

Chapter 3 provides an overview of the research on the comprehension of relative clauses in Italian-speaking populations as well as on the comprehension of these complex structures by Italian individu-

als with hearing impairment. The new data collected during my PhD concern the comparison between a group of children, a group of adolescents, and a group of adults. For the first time in the research investigating the comprehension of relative clauses by typically developing individuals, adolescents' performance is distinguished from that of adults. Interestingly, some differences between the two populations indeed emerge from data analysis. In addition, the studies carried out on the comprehension of relative clauses by children with cochlear implants compared to normal hearing children are presented (Volpato, Adani 2009; Volpato 2012). I also present data on the performance of a small group of adolescent LIS signers.

In all groups (except adults), an asymmetry between subject and object relatives is detected. All participants with hearing impairment (both children with cochlear implants and LIS signers) significantly differ from younger hearing children in the comprehension of relative clauses. In particular, their responses differ from those of hearing children in the different number conditions in which object relatives have been tested. We suggest that the source of difficulty for the group of participants with hearing impairment is different from that of normal hearing participants. While a refinement of the proposal by Friedmann, Belletti, and Rizzi (2009) is used to account for the performance of hearing children, for children with hearing impairment attraction phenomena (in the sense of Kayne 1989) and computational difficulties with plural verbal morphemes are also at play. For all populations, the difficulties with object relatives with postverbal subjects are explained in terms of fragility of agreement (Franck et al. 2006).

Chapter 4 focuses on the production of relative clauses. A literature review is offered at the beginning of the chapter in order to present the main strategies adopted by Italian-speaking individuals in relative clause production. The production task and the results observed on the populations of children, adolescents, and adults are presented and discussed. The discussion focuses on two main strategies used when object relatives are elicited, namely the production of target object relatives and passive relatives. The use of these two strategies is explained in terms of developmental processes involved in language acquisition (*smuggling* and agreement phenomena). In the second part of the chapter, I turn my attention to the production of relative clauses in populations with hearing impairment. The performance of children with cochlear implants is compared with that of different groups of normal hearing children. The results of this comparison have appeared in Volpato (2011) and Volpato and Vernice (2014); some strategies (namely the use of resumptive elements and passive relatives) have been discussed in Volpato and Cardinaletti (2015).

Chapter 5 discusses the possibility that the scores obtained in the

comprehension task are due to low memory resources in both hearing children and children with cochlear implants. The first part of the chapter presents an overview of the studies focusing on memory skills of typically developing children and children with cochlear implants. It also shows the results of these populations in the different memory measures. The second part of the chapter discusses the relationship between memory skills and scores on language measures in both hearing populations and participants with hearing impairment. Different results are found in the different populations. Most interestingly, the difficulties experienced by hearing children in the comprehension of relative clauses may also be attributed to limited memory resources, resulting from correlation analyses between the performance in each sentence condition and repetition tasks. As we will see, this hypothesis cannot be extended to the other populations.