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ANALYSIS AND TREATMENT OF MOVEMENT-DERIVED STRUCTURES IN ITALIAN-SPEAKING COCHLEAR IMPLANTED CHILDREN

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To Gabriella, Paris, and Serena

Quello che conta è la nostra vita, le nostre idee
che dobbiamo sparpagliare come i seminatori nei campi

N. Lilin

ANALYSIS AND TREATMENT OF MOVEMENT-DERIVED STRUCTURES IN ITALIAN-SPEAKING COCHLEAR IMPLANTED CHILDREN

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INTRODUCTION

The aim of this research is to analyse syntactically complex structures derived from *wh*-movement in Italian-speaking children with hearing impairment and fitted with a cochlear implant. On the one hand, the data collection concerns structures (i.e. subject and object restrictive relative clauses) which are well-investigated in several populations and different languages (healthy adults: De Vincenzi 1991; Cooke et al. 2002; Wingfield et al. 2003; adults with an acquired language disorder: agrammatic patients: Thompson & Shapiro 1995; Grillo 2008; Garraffa & Grillo 2008); typically developing children (Labelle 1990; Pérez-Leroux 1995; Varlokosta & Armon-Lotem 1998; Guasti & Cardinaletti 2003; Utzeri 2007; Arosio et al. 2009; Brandt et al. 2009; Belletti & Contemori 2010; Volpato 2010; Adani 2011); children with Specific Language Impairment (SLI) (Dick et al. 2004; Friedmann & Novogrodsky 2007; Levy & Friedmann 2009; Contemori & Garraffa 2010); children with developmental dyslexia (Guasti et al. 2015; Pivi et al. 2016; Delage & Durrleman 2018; Piccoli 2018); children and adolescents with hearing impairment fitted with hearing aids (HA) or cochlear implants (CI) (Quigley & Paul 1984; De Villiers 1988; Friedmann & Szterman 2006; Delage 2008; Friedmann et al. 2008; Volpato & Adani 2009; Volpato 2010, 2012; Friedmann & Haddad-Hanna 2014; Volpato & Vernice 2014).

On the other hand, this research suggests a first analysis of complex structures that were less or never analysed in children with hearing impairment and fitted with HAs or CIs: simple and long-distance *wh*-questions, genitive and oblique restrictive relative clauses, left dislocated sentences with resumptive clitic pronouns, cleft sentences.

In addition to this, the research also aims at improving the treatment protocols of movement-derived sentences based on the explicit teaching of syntactic rules. The experiments described in this thesis origin from a first treatment of relative clauses administered to a child fitted with a CI which was described by D'Ortenzio (2015). The development of syntactic interventions administered to several populations has its genesis more than thirty years ago with an interesting study carried out by Roth (1984) who aimed at improving and accelerating the acquisition of relative clauses by very young children. This study influenced clinical-oriented studies involving the treatment of movement-derived structures in patients with agrammatic aphasia (Shapiro et al. 1993; Shapiro & Thompson 1994; Thompson & Shapiro 1994, 1995, 2005, 2007; Thompson et al. 1993, 1995, 1997, 1998, 2003; Thompson 2015) and children with SLI (Ebbels & van der Lely 2001; Ebbels et al. 2007; Ebbels 2007, 2014, 2017; Levy & Friedmann 2009).

Before going more in the details of our research, a brief introduction to hearing impairment and CIs is needed. Sensorineural hearing impairment is caused by a malfunctioning of the cochlea (Govaerts

et al. 2002) which prevents the transformation of the acoustic stimuli into neurological signals, causing a misprocessing of the auditory information by the brain (Aimar et al. 2009; Kral & O'Donoghue 2010). Therefore, the quantity and the quality of the linguistic input is reduced (Chesi 2006; Friedmann & Szterman 2006; Hammer 2010; Volpato 2010; Franceschini 2013; Szterman & Friedmann 2015). In order to prevent this loss of information and to provide the individual an easy access to sounds and to language, a CI is often prescribed when the hearing loss is higher than 70 dB and in the absence of ear malformations (Martini et al. 2013). Previous studies have however demonstrated that children fitted with CIs still have troubles with syntactically complex structures derived by *wh*-movement (Friedmann & Szterman 2006; Volpato 2010, 2012; Volpato & Vernice 2014; Szterman & Friedmann 2015; Ruigendijk & Friedmann 2017; Volpato & D'Ortenzio 2017; Penke & Wimmer 2018).

Since much of the linguistic research carried out on Italian-speaking children fitted with CIs was focused on subject and object restrictive relative clauses, this research aimed to increase the knowledge about the problematic structures for children fitted with a CI by also analysing left-dislocated sentences with resumptive clitic pronouns, cleft sentences, simple and long-distance *wh*-questions, genitive and oblique restrictive relative clauses. In order to analyse this large number of structures, several tests were used: a sentence repetition task (Del Puppo et al. 2016), a preference task (Volpato 2010), a character selection task (Volpato 2010), and a task for the elicited production of *wh*-questions (Guasti et al. 2012, 2015).

The sentence repetition task has demonstrated to be a valid methodology for data collection by previous studies conducted on different populations (agrammatic aphasic patients: Friedmann & Grodzinsky 1997; Friedmann 2007; children with hearing impairment: Friedmann & Szterman 2011; Szterman & Friedmann 2015; children with SLI: Del Puppo et al. 2016). It enables a deep analysis of the individual's ability to recall acquired knowledge. Indeed, the repetition of a sentence is not an automated task since it involves both comprehension and production of the heard utterances controlling the used words (Devescovi et al. 2007) and syntax (Friedmann & Szterman 2011; Szterman & Friedman 2015; Del Puppo et al. 2016). Therefore, the participant repeats sentence whose syntactic structure has already been acquired. A further advantage of this task is that it allows the analysis of several syntactic structures using one and the same task. The task developed by Del Puppo et al. (2016) investigates one's abilities in left-dislocated sentences with resumptive clitic pronouns, cleft sentences, long-distance *wh*-questions, and genitive and oblique restrictive relative clauses. Only few of these structures have been analysed in individuals with hearing impairment fitted with HAs or CIs. For example, Guasti et al. (2014) analysed the production of direct-object clitic pronouns in Italian children fitted with CIs and what they have found is a delay in the processing of these

structures. Furthermore, less investigated structures are long-distance and simple *wh*-questions. The former structure was investigated by de Villiers, de Villiers and Hoban (1994) in a study on the interpretation of long-distance *wh*-questions in a group of English-speaking adolescents with hearing impairment. The latter structure was analysed in children with hearing loss and fitted with conventional HAs or CIs in several languages (German: Ruigendijk & Friedmann 2017; Penke & Wimmer 2018; Hebrew: Friedmann & Szterman 2011; Palestinian-Arabic: Friedmann & Haddad-Hanna 2014). The study of this structure in Italian has been started by De Vincenzi (1991) and De Vincenzi et al. (1999) (see also Penolazzi et al. 1999) who analysed the production of subject and object *who* and *which+NP*. These structures were also investigated in other Italian-speaking individuals with a language impairment (children with developmental dyslexia: Guasti et al. 2015; children with CIs: Volpato & D'Ortenzio 2017). As for direct object clitic pronouns, also in the processing of long-distance and simple *wh*-questions, children with a language impairment had a worse performance than the control group made of children with a younger or same chronological age. However, children with both a typical language development and with hearing impairment showed the same tendencies. Indeed, in all the studies were found two asymmetries: The first between subject and object *wh*-questions, namely the former structure is easier to compute than the latter. The second asymmetry is between *who* and *which+NP* questions, the former structure is easier to perform than the latter.

As aforementioned, the aim of this research was also to increase the existing data on the production and the comprehension of subject and object restrictive relative clauses, for this reason were used two tests developed by Volpato (2010). The preference task allowed data collection on the production of subject and object relative clauses, while the character selection task enabled data collection on the comprehension of subject relatives, object relatives with preverbal embedded subject, and object relatives with postverbal embedded subject. Differently from Volpato's previous study, it will be showed that most of the children with CIs showed a good performance, often comparable with the performance of their normal hearing typical developing age peers.

The processing of movement-derived structures has been found problematic also in other populations with a language impairment with a different nature, namely patients with agrammatic aphasia (Thompson & Shapiro 1995; Grillo 2008; Garraffa & Grillo 2008) and children with SLI (Friedmann & Novogrodsky 2007; Levy & Friedmann 2009; Contemori & Garraffa 2010; Adani et al. 2014). In these populations the difficulties related to the deficient processing of movement-derived structures have been treated through a syntactic intervention based on the explicit teaching of syntactic rules (Thompson & Shapiro 1995; Ebbels & van der Lely 2001; Levy & Friedmann 2009). D'Ortenzio (2015) applied the same methodology to a child fitted with a CI who showed an impaired production

of object relative clauses. Because of the encouraging results found at the end of the treatment, it was decided to administer an improved version of the same treatment to two children with hearing impairment and fitted with CIs, in order to improve children's production and comprehension of moved-derived sentences and narrative skills. The treatments described in this thesis are based on the explicit teaching of three linguistic rules, namely the verb argument structure (Chomsky 1981), the Theta criterion (Chomsky 1981), and syntactic movement (*wh*-movement: Chomsky 1971). Differently from previous studies (e.g. Thompson and her research group, Levy and Friedmann), the treatments described in this thesis are short-term treatments that can be more easily adapted to the time limits of speech therapy.

The thesis is organised as follows.

Chapter one offers an overview on hearing impairment starting from its causes and implications. Afterwards, rehabilitation devices and methods will be introduced. A large part of the discussion will be devoted to the CI which is a surgically implanted electronic device considered as 'gold-standard' in the recovery of hearing impairment (Vincenti et al. 2014) as it allows a better hearing experience to individuals with hearing impairment. By the way, the CI itself does not provide a complete restore of hearing, but its use must be supported by a specific speech therapy which starts before the individual receives a CI. Then, the chapter provides some information about language development in children with hearing impairment fitted with CIs and how an atypical language acquisition may or may not influence their writing skills (Dominutti 2017).

Chapter two acts as a state of the art of previous studies carried out in children with hearing impairment fitted with HAs or CIs on some of the structures that have been analysed for this research. First, two studies will be presented on the production and the comprehension of subject and object relative clauses in Italian-speaking children fitted with CIs (Volpato 2010, 2012; Volpato & Vernice 2014). Afterwards, several studies on the competence of children and adolescents with a hearing impairment in simply *wh*-questions (German: Ruigendijk & Friedmann 2017; Penke & Wimmer 2018; Hebrew: Friedmann & Szterman 2011; Italian: Volpato & D'Ortenzio 2017; Palestinian-Arabic: Friedmann & Haddad-Hanna 2014), and long-distance *wh*-questions (de Villiers et al. 1994) will be presented. Finally, will be briefly presented a study by Guasti et al. (2014) conducted on Italian-speaking children fitted with CIs in the production of direct object clitic pronouns.

Chapter three is entirely dedicated to the first aim of this research. Indeed, all tasks used, and the data collected will be analysed and discussed in this chapter. Data were collected from March 2017 to September 2017 in the Ear Nose Throat Clinic, Department of Neurosciences, University of Padua. The chapter is structured in several sections, each focused on one or, as the case of the preference and character selection tasks, two tests used during the data collection. Each section starts with a brief

syntactic explanation of the investigated structures, then the task will be explained. Afterwards will be described the experimental and the control groups, which differ from task to task since the main groups had different chronological ages and, moreover, not all the children fitted with a CI finished all the tasks administered. The data collected are analysed and discussed. Chapter three ends with a general discussion of the data, which also aims at comparing some interesting results concerning the comparison between simple and long-distance *wh*-questions and the comparison between subject and object relative clauses and genitive and oblique relative clauses.

Chapter four offers the state of the art on the numerous studies carried out on the treatment of movement-derived structures in several populations.

Chapter five is dedicated to the detailed description of the two treatments carried out for this thesis. The participants in these experiments were selected at the Ear Nose Throat Clinic, Department of Neurosciences, University of Padua. The treatment carried out with ES was conducted together with a student of the bachelor's degree in speech therapy of the University of Padua (Vanzin 2016). This collaboration helped to make treatment shorter, which made it more compatible with conventional speech therapy. The treatment given to MM was conducted by the author of this thesis alone. Even though MM showed good proficiency with all the tested structures, she was administered the syntactic intervention since her parents showed high interest in the research.

Chapter six offers a general discussion of the results and questions for future research.

1. LANGUAGE ACQUISITION IN CHILDREN WITH HEARING IMPAIRMENT: FROM DIAGNOSIS TO INTERVENTION

1.1. INTRODUCTION

Gases, liquids and solids are the possible mediums through which the sounds propagate in the space. Usually people can perceive a sound because it travels through the air as air-pressure fluctuation. However, it is also possible for sounds to propagate through liquids (e.g. one can hear the noise of the boats underwater), or solids (e.g. it is possible to hear sounds by leaning the ear against a door).

The most natural way for a human being to perceive sounds is when they are carried by the air as air-pressure fluctuations. Therefore, pressure compresses the air molecules, which start to move, under the form of air vibrations. The human ear can perceive fluctuations varying from 20 to 20.000 fluctuation per second, which are measured in Hertz (Hz). While the sound density is measured in decibel (dB) (Campolongo 2014).

A normal hearing allows the perception and detection of sounds by the ears, thus allowing the acquisition of an oral language. Moreover, hearing grants one's awareness of the external world and the establishment of interpersonal relationships (Maragna et al. 2000). A decrease in hearing causes a linguistic delay, which involves language at several levels: phonology, semantics, morphology, syntax, and pragmatics (Hammer 2010).

The aim of the present chapter is to illustrate how sounds waves are detected and discriminated in healthy and unhealthy ear, what are the causes and implications of hearing loss, and how oral and written language are acquired by children with typical language development or hearing impairment.

The chapter is organised as follows. Section 1.2. provides some information about the anatomy and functioning of the healthy ear. An introduction on hearing loss is provided in section 1.3. In this section will be explained the causes and effects of hearing loss. Some indications for the rehabilitation through the combination of the use of prosthetic devices, i.e. HAs and CIs, and speech therapy will be given in section 1.4. The acquisition of spoken language in children with hearing loss will be briefly discussed in section 1.5. Section 1.6. provides a comparison between children with typical language development and children with hearing impairment in the acquisition of written language.

1.2. ANATOMY AND FUNCTIONING OF THE EAR

The ear is considered the most complex sensory organ of the body (Møller 2014). Sounds are transmitted to the sensory receptors through two phases. During the first phase, involving the middle

ear, the sound is optimised in order to stimulate the cochlear fluids, while the second phase involves the transformation of the sound waves in movements of the basilar membrane.
The ear is commonly divided in three sections, which include the outer, the middle, and the inner ear.

- The *outer ear* is made up by the *pinna* (auricle) and the *ear canal* (external auditory meatus). The *pinna* collects and boosts the sound (Wiener & Ross 1946), then funnels it into the *ear canal*, which conveys the sounds into the middle ear;

Fig. 1: the sections of the ear: (1) the outer ear; (2) the middle ear; (3) the inner ear; (4) the auditory nerve. www.cochlear.com/it/home/understand/hearing-and-hl/how-hearing-works, 27th September 2018.

- The *middle ear* is located between the outer and the inner ear and consists of three different areas connected with each other: the *tympanic cavity*, the *Eustachian tube*, and the *round* and *oval windows*. The tympanic cavity is an air-filled cavity in which the *eardrum* (tympanic membrane) and the three *ossicles* are located, namely *hammer* (malleus), *anvil* (incus), and *stirrup* (stapes), which function together to receive, amplify and transmit the sound from the eardrum to the inner ear. In a nutshell, the sound waves hit the eardrum starting a chain reaction with the ossicles, and when vibrations finally arrive to the stirrup, they are transmitted to the cochlea through the oval window on which the last ossicle rests. Vibrations cause the movement of the fluid contained in the cochlea. Furthermore, the middle ear connects to the upper throat and the nasopharynx via the pharyngeal opening of the Eustachian tube.

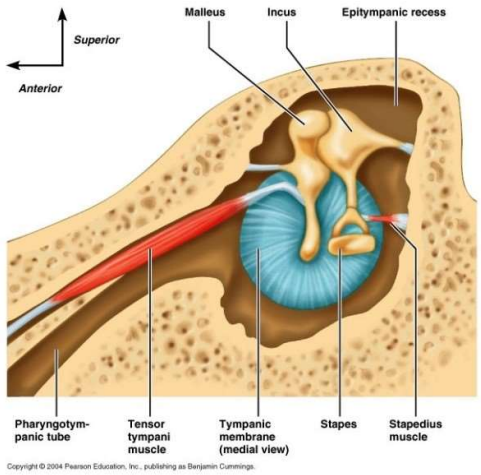


Fig. 2: section of the middle ear. Medial view of the tympanic membrane, and the three ossicles. www.apsubiology.org/anatomy/2010/2010_Exam_Reviews/Exam_4_Review/CH_15_Middle_Ear.htm, 27th, September 2018.

- The *inner ear* or *cochlea* is divided in three parts: the *scala tympani*, the *scala vestibuli*, and the *scala media* (cochlear duct). Each part contains a liquid which allow the transmission of sound waves. The three parts of the cochlea and their fluids are separated by two membranes: the *Reissner's membrane* and the *basilar membrane*. This latter membrane hosts the *stereocilia* ('hair' cells), which move when stimulated by sound vibrations. The cells are contained in the vestibular system that also controls balance. When stimulated, the 'hair' cells transfer the sound signals to the brain through the *auditory nerve*.

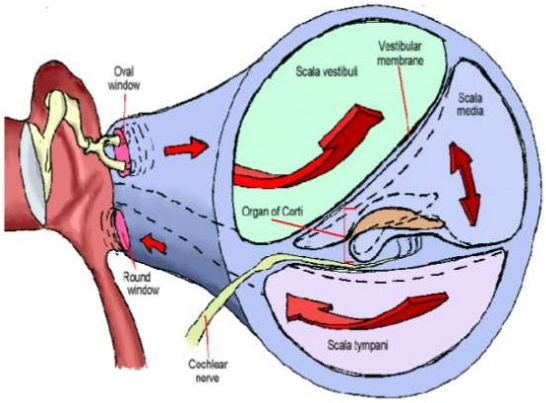


Fig. 3: sections of the cochlea. The Scala vestibuli is coloured in green, the scala media iis coloured in light blue, the scala tympani is coloured in pink. www.slideshare.net/rameshparajuli14/anatomy-of-inner-ear-50355289, 27th September 2018.

1.3. HEARING LOSS

The word '*deaf*' refers to a person who has little to no hearing, with a residual hearing equal to or greater than 30 dB in the better hearing ear. A decrease in hearing prevents the comprehension of language during a typical conversation (Nota et al. 2002), which usually happens in a sound spectrum included between 20 and 60 dB, as the banana speech graphic below shows.

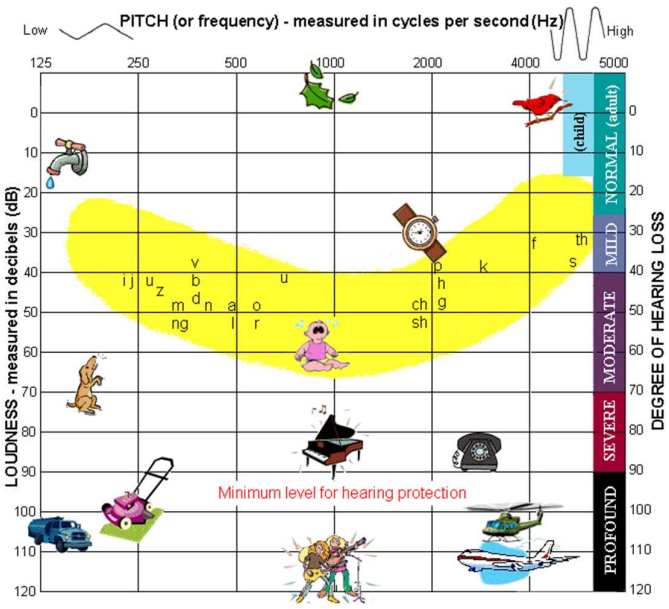


Fig. 4: Banana speech graphic. www.pinterest.com/pin/322993223036236O4/, 27th September 2018.

Hearing impairment is one of the most common disabilities of human beings. In the annual global estimate on the incidence of hearing loss issued by the World Health Organization (WHO) it has been pointed out that 466 million people in the world (6,1% of the world's population) suffer from hearing loss. 34 million (7%) of individuals suffering from disabling hearing loss are children aged between 0 and 14 years. Deafness mostly strikes people living in the less developed areas of the world (WHO 2018). Studies carried out in the USA have shown that only 20% of the population with hearing loss is composed of young people (5% are children within the third year of life; 15% are individuals between 3 and 18 years). The highest rate (80%) of people suffering from hearing loss concern adults suffering from presbycusis or disease from environmental noise (Paludetti & Fetoni 2014).

Martini et al. (2013) reported that in Italy 8 million individuals suffer from hearing loss. Moreover, in Italy from one to three out of thousand new-borns are affected by severe to profound sensorineural hearing loss (see also Niparko 2000). The rate increases if children at risk[1] are included in the statistics.

[1] Usually, children in neonatal intensive care are considered as children at risk.

Hearing loss can be classified considering four main factors: (i) the site where the lesion or the damage is localised; (ii) the aetiology, namely the causes of the hearing loss; (iii) the age at onset of deafness; (iv) the degree of hearing loss.
Considering the site of the damage, it is possible to distinguish four types of hearing loss:

- *conductive hearing loss* consists in a damage of the outer or the middle ear;
- *sensorineural hearing loss* presents a damage of the nerve fibres or the stereocilia;
- *combined hearing loss* occurs in both the outer or middle ear and the inner ear;
- *central hearing loss*, the rarest, is caused by a damage along the pathways to the brain or in the brain itself.

Within the four types of hearing loss described above, conductive and sensorineural hearing loss are the most common.
Conductive hearing loss may be caused by the obstruction of the ear canal; an injury of the eardrum blocking transmission of the vibration to the inner ear; or a problem to the ossicles. Usually, the grade of hearing loss is lower than 60 dB, and can be treated trough medical or surgical therapies, in order to partially or totally recover the auditory functions of the ear.
Sensorineural hearing loss can be caused by genetic or non-genetic factors. The grade of hearing loss is usually higher than 70 dB, thus it heavily conditions language acquisition. In most of the cases, sensorineural hearing loss may occur in association with other neurological deficits (Nota et al. 2002).
Hearing loss can occur at different ages. Prelingual deafness arises between the birth and the third year of life. It is usually caused by congenital causes that may have a genetic origin (Connexin 26 deafness or syndrome), or non-genetic origin (disease passed from mother to foetus or disease of the child). Congenital severe-to-profound hearing loss occurs in 0,5 to 3 per 1000 births (Niparko 2000). In 30% of the cases, congenital hearing losses present a comorbidity with visual or cognitive impairment. Even though congenital hearing loss is frequently bilateral, 3,4 children per 1000 show a monolateral hearing loss mostly caused by a middle ear malformation (Paludetti & Fetoni 2014). Prelingual hearing loss is strictly related to language acquisition. Postlingual hearing loss occurs after the end of the critical period for language acquisition. Acquired hearing loss can be caused by trauma, disease or ototoxic antibiotics.
The following tables present a more detailed overview of the causes of conductive (Tab. 1) and sensorineural hearing loss in children (Tab. 2).

Tab. 1: Aetiology of conductive hearing losses in children. Table adapted from 'La valutazione delle disabilità' (Nota, Rondal, & Soresi 2002: 113).

AETIOLOGY OF CONDUCTIVE HEARING LOSS IN CHILDREN	
CONGENITAL MALFORMATION	atresia of the ear canal; malformation of the ossicles
OTITIS EXERNA	cutaneous modification of the ear canal with an obstruction caused by swelling
OTITIS MEDIA	serious or suppurative, acute or chronical
CHOLESTEATOMA OF THE EAR	cyst development that may cause a destruction of the bones structure and/or a damage of the labyrinth
OTOSCLEROSIS	hereditary disease that damages the osteo coating of the tympanic cavity and the ossicles

Tab. 2: Aetiology of sensorineural hearing losses in children. Table adapted from from 'La valutazione delle disabilità' (Nota, Rondal, & Soresi 2002:113-114).

AETIOLOGY OF SENSORINEURAL HEARING LOSS IN CHILDREN	
GENETIC	
PRENATAL	Waardenburg Syndrome, Pendred Syndrome, Usher Syndrome, Lobstein's disease, Endemic Cretinism[2], CHARGE Syndrome
POST-NATAL	Heredodegenerative family hearing loss, Alport Syndrome (nephropathy)
NON-GENETIC[3]	
PRENATAL	embryopathy, rhesus incompatibility
NEONATAL	haemolytic disease, kernicterus (new-born's icterus), birth trauma, anoxia
POST-NATAL	infectious disease (parotitis, encephalitis, meningitis), ototoxic antibiotic, injury
UNKNOWN	± 30%

The degree of hearing loss can be ranked from mild to profound. This is measured by the degree of loudness a sound must attain before being detected by an individual. Individuals have different degrees of hearing loss depending on the frequency of the sound (Hammer 2010). The degree of hearing loss is measured with a pure tone audiometric air conduction testing also known as *audiometry* (Albera 2014). This medical exam is performed by presenting a pure tone to the ear through an earphone and measuring the lowest intensity in decibels (dB) at which this tone is perceived 50% of the time. This measurement is called *threshold.* The testing procedure is repeated at specific frequencies from 250 to 8000 hertz (Hz, or cycles per second) for each ear, and the thresholds are recorded on a graph called *audiogram* (Saunders et al. 1990; Albera 2014). The

[2] Endemic Cretinism is a form occurring in regions of severe endemic goitre, marked deaf-mutism, spasticity, and minor disfunction in addition to, or instead of, the usual manifestations of cretinism.
[3] Children's sensorineural hearing losses are mostly caused by non-genetic aetiological factors, and especially by embryopathies.

following table resumes the different degrees of hearing loss following the regulation for hearing impaired children approved by the Ministry for social affairs of Québec[4] (Nota et al. 2002).

Tab. 3: classification of the degrees of hearing losses ((Nota, Rondal, & Soresi 2002: 115).

DEGREE OF HEARING LOSS	IMPLICATIONS
MILD HEARING LOSS 26-40 dB I.S.O.	difficulties in hearing low intensity words, mild language impairment, some sounds are difficult to perceive, the attention of other people is required
MODERATE HEARING LOSS 41-55 dB I.S.O.	difficulties in hearing normal intensity words, significant social disability, amplification of sounds is needed for language development
MODERATE-TO-SEVERE HEARING LOSS 56-70 dB I.S.O.	difficulties in hearing loud sounds, amplification of sounds is needed otherwise the child can show impairments in language developments and psychological and social behaviours
SEVERE HEARING LOSS 71-90 dB I.S.O.	difficulties in hearing shouts, significant language impairment, amplification of sounds and specific interventions are needed
PROFOUND HEARING LOSS >90 dB I.S.O.	difficulties in hearing amplified voice, language and learning impairments, psycho-social problems, special interventions are needed
TOTAL HEARING LOSS	greatest language impairment, significant psychological, social and learning problems, specific interventions are indispensable

Indeed, most of the patients with hearing impairment present a mild hearing loss, 127 million patients suffer from a moderate hearing loss, while the number of people suffering from a severe-to-profound hearing loss is lower, about 37 million (WHO 2016).

1.4. REHABILITATION

Synapse is the process through which new connections establish in the brain. This process starts from the 28th week of gestation and finds its higher proliferation at 2 years of life (Berardino 2014). After this period of high proliferation, neural connections are reduced through the *neural pruning*, namely the brain trims away unemployed neural connections under the law of 'use or loose it' (Hebb 1949). Following Hebb (1949), when neurons interact, they activate and strengthen their connections through the production of neurotransmitters, a higher post-synaptic sensibility and a higher synaptic enrolment. On the contrary, if neurons do not interact, they lose their connections (Di Berardino 2014). Therefore, only a high and continuous stimulation of neural connections helps to preserve them and avoid their pruning. Visual and hearing neural connections are the first to undergo neural pruning. Taking into consideration only the development of hearing neural connections, the maturation of these particular connections is particularly active during the first two years of life.

[4] Even though this regulation for hearing losses is old-fashioned, it presents also a more detailed distinction of hearing losses than WHO one.

Indeed, from the 21st week of gestation to the first year of life, the length of the auditory pathway triplicates (Lecours 1975; Moore et al. 1995). As pointed out by Manrique et al. (1999), the growth of the central auditory system lasts until 10-12 years of life. However, during this period, there is a more relevant period comprised between the birth and the 5 year of life, during which if there is not a proper auditory stimulation, it may occur irreversible neuroanatomic alterations.

Neuroplasticity is the characteristic of the brain to modify its functions by adapting them to necessities and is essential for the central nervous system including the auditory one (Møller 2014). Brain modifies on the basis of the individual's experiences. Therefore, genes and environment (biology and experiences) work together to establish one's intelligence, emotions, and outlook on life. Therefore, neuroplasticity is essential during the first years of life, when the child is exposed to sounds and his/her brain start developing the necessary neural connections to comprehend them. This specific period is called *sensitive period*, during which auditory experience must occur to establish and develop the central auditory pathways of the neocortex (Lenneberg et al. 1967; Locke 1997; Sharma et al. 2002; Kuhl et al. 2005; Hammer 2010; Møller 2014).

Several studies have also found out a *critical period*, lasting within the seventh year of life, during which the fitting of HAs or CIs is recommended in individuals with hearing impairment (Sharma et al. 2002; Sharma & Campbell 2011; Kral & Sharma 2012, Di Berardino 2014). When the critical period is completed, the brain makes more effort to re-organise its neural connections in the neocortex. During this critical period, neuroplasticity is crucial for the efficacy of the use of HAs or CIs, since it helps the establishment of new neural connections (Sharma et al. 2007; Peterson et al. 2010; Møller 2014). Studies on evoked potentials carried out with individuals fitted with a CI who received the CI at different ages support these hypotheses. People who received a CI during the critical period showed more age-appropriate performance than individuals who received a CI after this period (Sharma et al. 2007, 2015; Kral & Sharma 2012).

Taking these results into consideration, it is important that deaf children receive a HA or a CI as soon as possible so as not to extend the period of deprivation of the hearing input and preserve the quantity and the quality of the child's spontaneous vocalisations, which are indispensable to establish a good coordination between respiratory and vocal mechanisms (Nota et al. 2002). Moreover, there are no restrictions in the precocity of the surgery for a CI, since the cochlea is completely well-formed at birth (Møller 2014).

In the following sections, some information on the devices used for the treatment of hearing loss will be provided, namely the conventional HA and the CI, so as some strategies used by speech therapists during the (re)habilitation of language in CI children (Archbold & Tait 2003).

1.4.1. The conventional hearing aid

HAs can help to partially restore hearing in people with mild-to-moderate sensorineural hearing loss. They are electronic devices which transmit a voiced message to the ear limiting a possible audio distortion (De Filippis Cippone 1998). Therefore, their main task is to amplify sounds. HAs can be analogue or digital (Tognola 2014). Both the analogue and the digital hearing aids are composed of several elements: the *microphone*, the *telecoil*, the *amplifier*, the *adjusting commands*, the *battery*, and the *receiver*. Following the main parts of HAs will be briefly illustrate. The microphone converts sound waves into an electric signal, which is conveyed to the amplifier (known also as processor) in order to be elaborated. The telecoil has the same role of the microphone, namely converts sound waves in electric signals, but it is used during telephone calls. Indeed, the use of the telecoil helps to reduce the distortion of sounds during the phase of acquisition of signal coming from the telephone. The amplifier is the computer or motherboard of the HA and converts the electric signals in order to be manipulated later by the receiver. The amplifier enhances the amplitude of the signal in order to counterbalance the loss of sounds. The receiver is the last component of the HA and transforms the electric signal into a sound signal so as to be heard by the user (Tognola 2014).

A conventional HA functions as follows. The sound is captured by the microphone, which converts the sound waves into an electrical signal. The amplifier increases the strength of the electrical signal, which is converted back into an acoustic signal in the receiver. The amplified sound is channelled into the ear canal via an earmold or a tube. The battery gives the HA the electrical energy. The telephone coil helps the hearing during a phone call, it picks up the electromagnetic signals, amplifies them and converts them to acoustic energy.

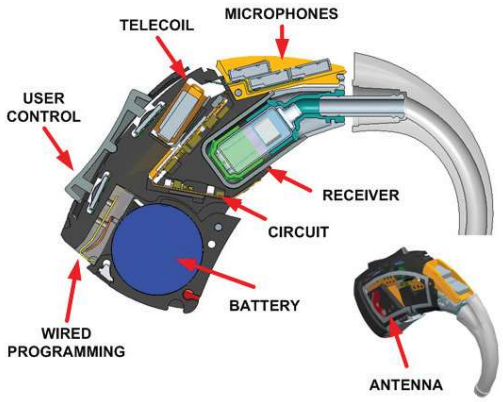


Fig. 5: Components of a classical HA. https://www.ansys.com/About-ANSYS/advantage-magazine/Volume-IX-Issue-1-2015/i-hear-you, 7th December 2018

1.4.2. The cochlear implant

Even though HAs become even more sophisticated, they cannot provide enough acoustic gain to people suffering from severe-to-profound hearing loss. In these cases, when the grade of hearing loss is equal to or higher than 70 dB, a CI is prescribed.

The CI is an electronic artificial sensory organ which directly stimulates the residual fibres of the acoustic nerve, which transfers auditory perceptions to the cortical areas in the central nervous system. The CI transforms the acoustic signals in electric impulses, which directly stimulate the acoustic nerve bypassing the damaged structures of the inner ear (Guida et al. 2014).

The Food and Drug Administration as reported by Martini et al. (2013), claimed that approximately 188,000 people worldwide have received implants. In Italy it is estimated that there are about 6-7000 implanted patients, with an average of 700 CI surgeries per year. Cochlear implantation, followed by intensive post implantation speech therapy, can help young children to acquire speech, language, and social

1.4.2.1. History

In 1790, Alessandro Volta electrically stimulated the ear for the first time. The scientist described his experience as like the noise of a dense boiling fluid. For the sake of clarity, Volta's remarks are reported below in an extract of a letter sent to Sir Joseph Bank, President of the Royal Society, so as to describe his feelings after he activated two electrodes placed in his inner ear canal (Volta, 1800).

> *Nel momento in cui il circuito è stato chiuso ho ricevuto uno shock nella testa, e qualche momento dopo ho cominciato a udire un suono, o piuttosto un rumore nelle orecchie, che non posso ben definire; è stato una specie di crepitio con scosse, come se della pasta o del materiale liquido denso stesse bollendo. Questo rumore è continuato incessantemente, e senza incrementi, per tutto il tempo in cui il circuito è rimasto chiuso. La sensazione spiacevole di una scossa nel cervello, che ho avvertito potesse essere pericolosissima, mi ha suggerito di non ripetere l'esperimento*[5].

Volta's experiment was replicated by many other scientists worldwide. But without any success since 1961, when William F. House proved that a line of electrodes could be inserted in the cochlea, without provoking irreversible damages. Together with a team of researchers of the Massachusetts Institute

[5] When I closed the circuit, I received a shock in my head, and after some time, I started to hear a sound, or rather a noise in the ears, which I cannot describe; it was like crackling with shakes, like some dense fluid was boiling. This noise lasted, without any increase, the time the circuit was closed. The unpleasant sensation of a shake in the head, that I thought was extremely dangerous, suggested me not to repeat the experiment. (Translation by the author of this thesis).

of Technology (MIT), House developed a 5-active-electrodes-system connected to a coil, which has been put under the skin behind the ear. The prototype of the CI was activated from the outside through an electromagnetic induction and allowing the perception of ambient sounds, timbre, intonation, and rhythm of the language. However, this system was rejected by the body within 3 weeks (Guida et al. 2014). In 1968, House developed a mono-electrode intracochlear CI. The electrode was linked to a receiving internal coil implanted under the skin, which received the messages via magnetic induction from an external coil linked to a processor. Ten years later, in 1978, Graeme Clark and his collaborators at the University of Melbourne developed the first multi-electrodes CI. Nowadays, some CIs have 22 electrodes and are developed following the instructions by House and his collaborators. The U.S. Food and Drug Administration approved the use of CIs for adults in 1984 for the first time, while the consent for the use of CIs in children came later, in 1990. In 2000, the same association lowered the age at implantation to 1 year (Martini et al. 2013).

1.4.2.2. Structure and functioning of the cochlear implant

CIs are composed by an external part and an internal part, which is surgically implanted in the temporal bone of the skull. The following picture shows the parts of a CI.

- The **external part** of the CI is composed of several elements. The *microphone* (1) receives the acoustic signals, which are transformed in electrical current fluctuation and sent to the internal receiver by *low frequencies circuits*. The *speech processor* (2) analyses, filters, digitally encodes, and adapts the signal to the cochlea standards. The signal is then transferred to the *external transmitter coil* hold on the sculp by a *magnet*, which transfers the message through radiofrequency waves.
- The **internal part** is composed of a *receiving internal coil* (3), an *electrical circuit* containing a *microchip* which controls the *electrodes* and the information received by the external processor. Information are then transmitted to the *array* (4), which holds a variable number of electrodes depending on the type and the brand of the CI, as table 4 shows. The internal part is arranged under the skin and the array is introduced in the cochlea. The internal receiver coil has compact dimension; therefore, it can be implanted also in very young children (Møller 2014). The electrodes stimulate the acoustic nerve fibres and transfer the information in the form of electrical impulses organised as codified signals. Moreover, each electrode provides different acoustic sensations for each frequency (low/middle/loud). The array is inserted in the scala tympani of the cochlea within 22-30 millimetres in depth. Picture 6 shows how the array is placed in the cochlea

in order to define the frequency information, while the amount of current defines the amplitude of the sound.

Fig. 6: parts of a CI. 1=microphone, 2=speech processor, 3=receveing internal coil, 4=auditory nerve. www.cochlear.com/it/home/understand/hearing-and-hl/trattamenti-ipoacusia/cochlear-implant, 27th September 2018.

Tab. 4: comparison between three CIs produced by different companies. The table has been taken from https://www.cochlear.com/us/home/treatment-options-for-hearing-loss/cochlear-implants/comparison-hearing-devices, 20th July 2018).

Considerations When Choosing an Implant

IMPLANT

COMPANY	COCHLEAR	ADVANCED BIONICS	MED-EL	WHY IT MATTERS
Implant	CI24RE	HiRes 90K	Synchrony	
Reliability Record	99.1% at 11 years[7]	98.3% at 7 years[8]	99% at 5 years[9]	Provides peace-of-mind and confidence. Independent data confirms that Cochlear™ Nucleus® Implants are designed to work over a lifetime without the need for additional surgeries.
MRI Compatible	Yes: 1.5 Tesla*	Yes: 1.5 Tesla*	Yes: 3.0 Tesla	MRIs are an important medical tool, and you want reassurance you can get an MRI without concern.
Removable Magnet for MRI	Yes	Yes	Yes	Removing the magnet can help provide a clearer image if MRI is needed for the head.
Number of Channels	22 Channels *(22 electrodes)*	16 Channels *(16 electrodes)*	12 Channels *(19–24 electrodes - Up to 12 pairs)*	A higher number of channels could be beneficial with programming problem areas of the cochlea giving you a better hearing performance.
Choice of Electrodes	5 Electrodes	3 Electrodes	5 Electrodes	The cochlea comes in all different shapes and sizes so providing a selection can ensure that your surgeon can choose the best one based on your specific needs.
Hybrid Implant	Yes	No	No	Provides your surgeon with the only FDA-approved implant choice that is designed to use your low-frequency hearing while providing you access to the high-frequency sounds you may be missing.
Stimulation Rate *(pulses per second)*	32,000 pps	83,000 pps	50,704 pps	Just as some cars are built to go fast but must adhere to a speed limit, the auditory nerve can handle only so much information at once. Cochlear designs our implants with the goal to exceed the auditory nerve's speed limit, but not so much that stimulation is wasted so you get the most efficient and effective stimulation as possible to the hearing nerve.
Longest Implant Insertion Depth	450[910]	420[911]	720[912]	Optimal hearing performance is reached when there is electrical stimulation in the Hearing Zone, which is located approximately 400 to 450 degrees into the cochlea.[13,14] Deeper insertion beyond the Hearing Zone could result in trauma to the cochlea and possibly pitch confusion.[15]

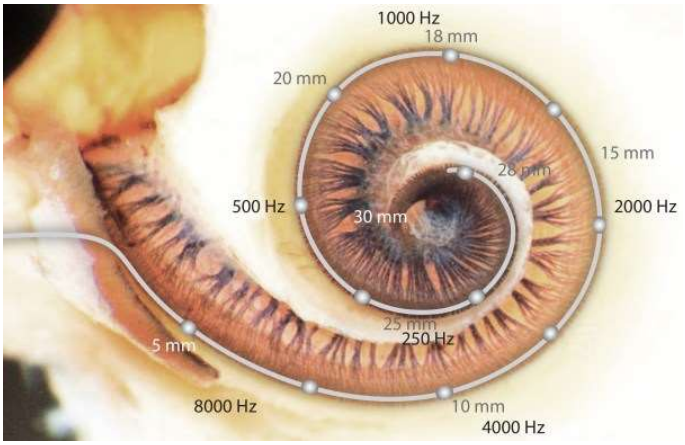


Fig. 7: Placement of the array in the cochlea. www.medel.com/uk/show2/index/id/1361/title/Complete-Cochlear-Coverage/, 27th September 2018.

1.4.2.3. Indications for the cochlear implant

Depending on the age of onset of the hearing loss, CIs are prescribed following specific criteria.

Postverbal deaf adults can receive a CI if the diagnosis of severe-to-profound hearing loss is recent and they not benefit from the use of HAs (Guida et al. 2014).

Preverbal deaf children can receive a CI only if several conditions are observed. Primarily, to obtain better results the child must receive the CI within the second year of life (Hammes et al. 2002; Anderson et al. 2004; Nicholas & Geers 2007; Niparko et al. 2010; Schramm et al. 2012; Sharma & Campbell 2011; Coletti et al., 2012; May-Medereake 2012; Leigh et al. 2013, Vincenti et al. 2014). The essential conditions in order to receive an early CI are: the confirmed diagnosis of hearing loss between 3 and 6 months of life; the fitting with HAs within the sixth month of life; a poor or absent benefit of HAs; the attendance of an oral speech therapy. Preverbal deaf children are not valid candidates for a CI when they present a malformation of the cochlea, an obliteration on the cochlear canal, and if they benefit of the HA.

If prescribing a CI to a prelingual deaf child is easy, the same cannot be said when the addressee are preverbal deaf adolescents, because it is difficult to take advantage of their neural plasticity (Sharma et al. 2002; Sharma & Campbell 2011; Kral & Sharma 2012) and/or their auditory memory. However, if the prosthetic gain is insufficient, a CI is given also if there are not the optimal conditions to prescribe it, since there are undeniable advantages in using a CI instead of a HA (Guida et al. 2014).

1.4.2.4. Selection of the candidate

Since CIs are electric devices which are surgically implanted in the patient, the selection of the candidate is very strict and involves a great number of professionals (Aimar et al. 2009). The

specialized medical staff involves: an otorhinolaryngolist, a speech therapist, an acoustic-aid technician, a paediatrician, a psychologist, a child neuropsychiatry, and a neurologist (Martini et al. 2013; Bubbico et al. 2015).

The patient's examinations concern the quantity of the auditory residual, the appropriate functioning of the auditory nerve, the causes and the type of hearing loss, which must be higher than 70 dB (Vincenti et al. 2014). To collect this information, several clinical tests are required, such as Computer Tomography (CT), Nuclear Magnetic Resonance (NMR), which allow the detection of malformation or anomalies of the middle and inner ear, and of the facial nerve (Vincenti et al. 2014). The speech therapy examination evaluates hearing, verbal expressiveness, lip reading, perceptual categories, and interaction (Guida et al. 2014).

Moreover, the patient's evaluation also involves his/her psychological, cognitive, socio-relational, and environmental characteristics, his/her motivation and the family support, especially for the post-surgery treatment (Martini et al. 2013).

1.4.2.5. Binaural stimulation

'Natural' hearing takes place when both ears are involved and allow *dichotic* listening, that is, the message arrives to the ears in different moments, with different phase and intensity. Conversely, *diotic* listening takes place when the message comes to the ears with the same time, phase, and intensity characteristics.

It is possible to recreate a kind of 'natural' hearing resorting to a bilateral CI, which is *simultaneous* when both CIs are implanted during the same surgery, or *sequential* when the second CI is implanted within 50 months from the first CI, to avoid that a too long *critical period* could prevent the activation of brain plasticity. This period can be bypassed in adult patients who resort to a bimodal stimulation, namely they combine the use of a CI with a contralateral HA.

Binaural stimulation is indispensable to give the child the opportunity of a more natural language acquisition. Indeed, binaural stimulation enables a better sounds localization, improves speech perception in both quiet and noisy listening conditions, improves sound localization abilities, and reduces listening effort (Martini et al. 2013; Kalluri 2011; Guida et al. 2014; Sarant et al. 2014). In addition to this, some studies investigated the benefits of a binaural stimulation in language development. Nittrouer and Chapman (2009) analysed language development in a group of forty-two children with hearing-impairment, who were mono- or binaurally stimulated. Results showed that children with a binaural stimulation (bilateral CIs, or a CI and a HA) showed better language abilities than children with only a CI. However, Sarant et al.'s (2014) study on a group of ninety-one children

fitted with CIs does not show any significant correlation between the performance of children stimulated by a monaural CI and that of children with binaural stimulation.

1.4.3. Speech therapy in cochlear implanted children

The role of the speech therapist is essential in the life of a child diagnosed with hearing impairment. After the diagnosis, the child must receive a proper stimulation as soon as possible, in order to begin a therapy during which s/he is not only exposed to sounds but also to visual and kinesthetics stimulations. The use of several types of stimulations helps speech therapists to facilitate the comprehension of sounds (Nota et al., 2003).

When the deaf child is selected for a CI, the speech therapist plays a key role both in the pre- and in the post-surgery period. Before the intervention, the speech therapist, who is a member of the specialized medical staff involved in the assessment of the candidate for a CI, evaluates the perceptual and attentional capacities of the candidate, both in language comprehension (discrimination, comprehension, categorisation, generalisation, abstraction) and language production (phonetics, phonology, semantics, lexicon, morphosyntax, pragmatics).

After the child has received the CI, the speech therapist takes part during the activation[6] of the CI and observes the child's reaction to the new stimulation. This information will be useful during speech therapy. During the intervention, the speech therapist helps the child to develop his/her hearing and cognitive abilities through several exercises (De Filippis Cippone 1998). Some of the abilities that the deaf child must develop are presented below.

Hearing abilities that must be trained are:

- *Detection*, namely the distinction between the presence/absence of sounds;
- *Discrimination*, namely the identification of similarities/differences between sounds;
- *Identification of auditory stimuli in a close set*;
- *Identification with a clue*, namely the identification of auditory stimuli in a semi-close set;
- *Identification without a clue*, namely the identification of auditory stimuli in an open set;
- *Comprehension of an oral text*;
- *Speech tracking*, namely the repetition of sounds without semantic cues.

[6] A month after the CI surgery, if there are not swelling or scabs on the scar, the CI is activated. As long as the CI settings are not stable, the patient has follow-up medical examinations during which the map of his/her CI is improved and regularised.

Cognitive abilities that must be practiced:

- Perception, memory, attention, metacognition;
- Lexical development;
- Similarities, differences and contrasts;
- Classification, categorisation, generalisation and abstraction;
- Morphosyntactic development;
- Reading development.

However, speech therapy is different for each child based on their chronological age. Very young children and infants at the pre-verbal stage are trained with their parents and clinicians to facilitate listening abilities in the development of communication. They are trained on pre-verbal skills of eye contacting, turn taking, auditory processing, and meaningful vocalizations. During this phase, the parents have a central role because they facilitate early language development and help the child to use the CI at the best of its capacities. After the child has developed his/her pre-verbal skills, the therapist starts training the five Ling's sounds (oo, ah, ee, sh, ss) by using some toy objects (Ling 1989; Archbold & Tait 2003).

When the child receives a CI at an older age, when s/he already shows a functional spoken language, the speech therapy is focused mostly on listening activities to help the CI child to get used to the new signal and integrate their new hearing into a previously established communication system. However, communication and interaction at this stage become a great deal easier, and some activities found useful in developing listening to environmental sounds, musical instruments and spoken language are described (Archbold & Tait 2003).

1.5. LANGUAGE ACQUISITION

Children acquire the language (or the languages) to which they are exposed spontaneously and effortlessly, since they are equipped with innate language-specific abilities (Chomsky 1975, 1981, 1986; Pinker 1994). During their first years of life, children acquire a language in identical ways across different languages, spontaneously by exposure to linguistic input and without any explicit teaching (Chomsky 1975, Pinker 1994).

In hearing impaired children, language acquisition is deeply influenced by their parents. In fact, parents choose the modality through which their children's language acquisition must develop:

children can be exposed to an oral language, a sign language, and/or some form of manually-coded language.

Most children with hearing impairment have hearing parents. As a consequence, deaf children born in normal hearing families are exposed to an oral language by resorting to HAs and CIs. However, even though deaf children receive a HA or a CI at an early age, they still show a language delay in several aspects of language, such as vocabulary, pragmatics, morphosyntax (Chesi 2006; Hammer 2010).

Language acquisition in children with hearing impairment follows the same stages as children with normal hearing, but it differentiates in the time of appearance of some phenomena which can present an equal development in deaf and hearing children (e.g. babbling); a delayed beginning of some language aspects (vocabulary); or a qualitative and widely different acquisition of some structures compared to normal hearing children (morpho-syntax).

1.5.1. Babbling

Typically developing children start to produce combinations of vowels and consonants in well-formed syllables (e.g., *dada*, *papa*) between 6 and 10 months. These children's productions are known as babbling and are considered as the first form of linguistic production (Oller & EIlers 1988; Marshark 2009; Bonifacio 2011; Guasti 2017). Babbling occurs in two consecutive phases: *canonical babbling* (*baba*, *mama*), and *variegating babbling* (*tadada*), which are deeply influenced by the language or the languages the children are exposed to, namely their experimentations are based on the most used vowels and consonants of the language to which they are exposed. Considering this, babbling presents the typical prosody, intonation patterns, and timing of the language or the languages heard by the children. Babbling predicts children's language development. In fact, a child that has produced a high number of variegating babbling will show an abundant lexicon at the age of 2 (Bonifacio 2010).

Hearing-impaired children begin to babble later, between 12 and 25 months (Oller & Eilers 1988). The fact that hearing-impaired children babble suggest that babbling is an innate behaviour, developing in all typically developing and hearing-impaired children. However, while the former show both canonical and variegating babbling, the latter stops the babbling period after the canonical phase (Marshark 2009).

1.5.2. Vocabulary development

Children with hearing impairment show a poor receptive and productive vocabulary if compared to children with typical language development. At 18 months, typically developing children undergo

the period known as *vocabulary explosion*, during which they acquire a high number of words (around 100 words) in a very short time. At the same age, hearing-impaired children instead struggle to acquire their first words which are usually related to concrete entities without more than one meaning (Moeller et al. 1986; Ledeberg 2003). Several studies on vocabulary acquisition in Italian-speaking children with typical language development or hearing impairment have pointed out that, even though children suffering from hearing impairment show a delayed acquisition of vocabulary if compared to their typically developing age peers, they show comparable or better performances compared to typically developing children with the same auditory age. Hence, children with hearing impairment can master between 500 and 600 words 18 months after the fitting with a HA or a CI (Caselli et al. 2012, Chilosi et al. 2013, Rinaldi et al. 2013). In addition to this, in production tasks, hearing-impaired children show better vocabulary competence than in comprehension tasks (Chilosi et al. 2013). Assuming Chilosi et al. 2013, the difficulties in the acquisition of vocabulary in children with hearing impairment are caused by the later exposure to the oral language, which causes a delay in the establishment of children's neural connections, therefore preventing the normal processing of vocabulary (Chilosi et al. 2013).

1.5.3. Morpho-syntactic development

Morpho-syntactic development is strictly related to the acquisition of vocabulary: a too small number of words prevents a proper sentence formation. This condition is equally found in children with typical language development and children with hearing impairment.

Individuals with hearing impairment avoid producing complex structures, preferring short sentences, and experience difficulties in the use of prepositions and functional elements, such as determiners, auxiliaries and pronouns, the presence of which is of primary importance in order to correctly interpret a sentence. Morpho-syntactic errors concern the omission or the substitution of determiners, prepositions, auxiliary verbs, and clitic pronouns. Subjects with hearing impairment also incorrectly add determiners and omit copulas. They frequently make errors in gender and number agreement, and they show difficulties with verbal inflections, thus producing agreement errors between subject and the finite verb (for English: Quigley & Paul 1984; De Villiers 1988; De Villiers e al. 1994; for French: Tuller 2000; Tuller & Jakubowicz 2004; Delage & Tuller 2007; Delage 2008; for Italian: Taeschner et al. 1988; Rampelli 1989; Volterra & Bates 1989; Caselli et al. 1994; Emiliani et al. 1994; Fabretti 2000; Maragna 2000; Ajello et al. 2001; Volterra et al. 2001; Franchi 2004; Chesi 2006; Fabretti & Tomasuolo 2006; Volpato 2008, 2010, 2012; Volpato & Adani 2009; Volpato & Vernice 2014). According to De Villiers (1994), children and adolescents with hearing impairment find hard to employ syntactic markers such as inflectional morphemes, determiners and pronouns

because they are less salient in the speech stream than content words, since they are unstressed and carry minimal semantic information. The same difficulties were described by Chesi (2006) for a group of 13 Italian-speaking children with hearing loss. According to Chesi, the production of clitic pronouns in preverbal position is more problematic than the production of clitic pronouns in postverbal position. Moreover, the results collected by Chesi show that the production of determiners is less impaired than the production of clitic pronouns, even though they share the same phonological characteristics. Within the determiners, children with hearing loss show more difficulties in the production of singular and plural masculine determiners.

In Chapter 2, morpho-syntactic errors related to complex structures of Italian will be analysed more in detail.

1.6. WRITTEN LANGUAGE DEVELOPMENT

Conversely to language acquisition which takes place spontaneously and effortlessly, children learn to read consciously and struggling during the first years of school. According to some studies carried out on English-speaking children, they are supposed to reach a good competence within the end of the fifth year of school, since reading is essential for learning and enables the individual to access information and culture allowing him/her to be actively part of the community.

Reading is not a minor ability, consisting in decoding letters and words, it is more complex than it seems since it involves higher mental processes. For instance, the child must learn the differences between spoken and written language.

A fruitful reading is the result of several factors: the reader has a prior knowledge of a topic, and s/he is able to relate this information with the data contained in the text resorting to inferential processes. The reader must integrate information at various levels of the text (words, phrases, sentences, paragraphs, whole texts). Finally, a good reading is led by well-formedness metacognitive processes of monitoring, mental review, self-questioning, and knowledge of text structure to organize learning and remembering from printed material (Quigley & Paul 1984).

Previous studies have pointed out a strong correlation between language acquisition and the development of reading. In fact, a stimulating communication context characterised by a strong interaction between the child and the parents and/or other people, establishes a cognitive base for language, internalizes a structured symbol system, and allows the child to store a variety of experiences and learning strategies to manipulate and expand the experiences and the symbol system (Quigley & Kretschner 1982; Bishop & Adams 1990; Maragna 2000; Trovato 2014).

As for spoken language, children with hearing impairment show a delay in reading competence compared to their typically developing age peers. This may be caused by the lack of appropriate

exposure to an oral language during infancy and early childhood. Whatever the cause, deaf children are likely to arrive at school with a very limited knowledge base, inadequately developed cognitive and linguistic skills, and little or no comprehension of figurative language, which will result in problems of decoding and predicting in the reading process (Quigley & Paul 1974; Geers 2005; Jameson & Goswami 2005; Archbold et al. 2006; Ibertsson et al. 2006). Individuals with hearing impairment show a life-long deficient reading. Taking into account some data on the reading competence of American subjects with hearing loss, only 10% of the population suffering from hearing loss has a competence higher than a 7th-8th grade pupils Chamberlain & Mayberry 2008).

It has been observed that reading development in hearing-impaired children is influenced by phonological awareness and receptive vocabulary (Trovato 2014). A delay in phonological awareness prevents the deaf child to identify and modify the phonemes of a word, this is caused by a late exposure to the oral language, which also influences the acquisition of vocabulary as said in section 1.5.2. above. These problems in reading development can be bypassed by an early intervention on deafness.

1.6.1. Written language development in children with typical language development

Within the third year of life, children are able to manage an oral language, and when they enter school show adult-like behaviour in several aspects of the language. This is not the case when they start learning how to write. Indeed, like reading, writing is a high demanding cognitive activity, which requires the simultaneous activation of several competences. For instance, at the same time the child must respect orthography and grammar rules, be aware of the different text typologies, plan his/her own ideas, and pay attention to the addressee to whom s/he is writing.

Writing development is influenced by several variables, such as the development of fine motor skills, language and cognitive functions, which are not perfectly mastered by the child at the beginning of school.

The development of cognitive and neurological processes is fundamental for the development of concrete thinking and the increase of making pre-logic decisions in children between 6 and 12 years, while memory, attention and executive functions are indispensable for the achievement of good motor grapheme abilities, which allow the child write letters, words, and texts (Dominutti 2017). During this time span, it is important for the child to exercise and improve reading abilities, so as to fix phonological processes and increase lexicon.

During adolescence, the student can master abstract and logical thinking. Short memory can keep seven items at a time, and cognitive abilities have successfully developed. The writing becomes more

automatized, releasing some cognitive abilities which can now absolve other tasks such as planning, producing, reviewing and modifying items (Dominutti 2017).

Taking these findings into account, Loban (1976) assumes that children reach a good proficiency of the written language at around 12 years. However, it is not possible to identify specific stages during writing development, but it is possible to detect three stages during which the planning of the text gradually separates from its production. During the first phase, children's mental activity is strictly related to the production of texts and is thus impossible to separate the planning process from the production. During this first phase, the child resorts to the *flexible-focus strategy*, namely s/he produces a large quantity of text but without any attention to the argument, since children in this age have limited attention resources. The second phase involves a first separation between the planning and the production of ideas, since the child has developed writing abilities. During this phase, children resort to the *fixed-topic strategy* through which children start to master not only the text quantity but also its quality. The third and last phase takes place during adolescence, when text planning is separated from text production. During this phase, adolescents show their acquired specific behaviours in planning a text. During this third phase, students resort to the topic-elaboration strategy, which allows them to focus their attention to the general argument, and to add sub-arguments to the main argument.

1.6.2. Written language development in children with hearing impairment

As for language development, individuals with hearing impairment show a delay during writing development (Miller 1997; Spencer et al. 2003; Geers & Hayes 2010; Wu et al. 2015), especially morpho-syntax seems to be the most impaired aspect of the language. However, the phonological information, necessary for the orthographic encoding of the text, seems not to be the main difficulty during the writing activity.

Following Arfè (2003), even though individuals with hearing impairment respect the discourse rules which allow one to write a proper text, they still produce texts with low or absent meaning because the organisation of contents is influenced by their difficulties in the use of lexicon and syntax. This finding has been confirmed by Boscolo et al. (2007), who found that individuals with hearing impairment showed delayed syntactic abilities compared to their typically developing age peers. Thus, they resort to short sentences avoiding complex structures. However, syntax does not completely influence the writing of a narrative text since individuals with hearing impairment are capable to transmit the required contents in any case.

As showed above, studies on the analysis of writing abilities in individuals with hearing impairment are mostly focused on narrative texts. Marschark & Spencer (2010) proposed further studies focused

on the expository text which is very used at school, for example in scientific dissertations, in summaries, or in the answers during school assignments. When students are required to develop an expositive text, they must resort to several abilities at the same time, including the organisation and the planning of the contents related to a specific topic, and the control of linguistic aspects.

As a matter of fact, previous studies carried out on the writing abilities of individuals with hearing impairment have pointed out that errors found in the written language are the same found in the oral language. Therefore, deaf individuals also show a limited vocabulary, difficulties with free and bounded morphology, and difficulties with complex sentences in their written performances.

Some studies on writing development in children with hearing impairment also take into account clinical factors concerning the age at diagnosis and the age at CI fitting. Yasamal et al. (2013) showed that children fitted with a CI before 4 years performed better than children who received a CI later. Therefore, an early diagnosis and fitting may also have good results on writing.

An interesting study on the writing abilities in Italian-speaking children fitted with CIs was carried out by Dominutti (2017) in her bachelor's thesis[7], who analysed the writing skills of thirteen Italian-speaking children and adolescents with hearing impairment and fitted with CIs.

The experimental group was composed of thirteen children and adolescents with hearing impairment (five boys, eight girls) suffering from profound sensorineural hearing loss and fitted with mono or bilateral CI. Participants were selected and tested at the Ear Nose Throat Clinic (ENT Clinic) at Padua University Hospital. They ranged in age between 7;4 (years; months) and 15 years (mean age: 10 years). Ten children were enrolled in the elementary school; one in the middle school; and two adolescents were enrolled in high school. Half of the participants was supported by speech therapists, special needs teachers, communication assistants, while the other half did not receive any support. Individuals with CIs were included in the study only if they reached 85% of correctness during the assessment of their audio-perceptual abilities. Participants were assessed with the *Batteria per la Valutazione della Scrittura e della Competenza Ortografica-2* 'Battery for the assessment of writing and orthography' (BVSCO-2, Tressoldi et al., 2013). The BVSCO-2 is composed of two tasks: the production of a narrative text and the production of a descriptive text. For this study, participants were assessed only on the production of descriptive texts. Therefore, the analysis was more vocabulary-oriented than syntax-oriented, since descriptive texts imply a large use of words rather than complex syntax. The BVSCO-2 comprises three different tasks addressed to three different age ranges. For this reason, participants were divided in three different groups: the first group included all the children within the first half of the third year; the second group included all the children within

[7] under the supervision of Trevisi, Montino and D'Ortenzio

the fifth year of school; the third group included the adolescents enrolled in middle and high schools. Participants received a picture together with oral and written instructions. They were given 10 minutes to write the description of the picture. This task typology allows the collection of comparable data among participants. The following pictures provide an example of the task administered to CI children and adolescents:

Fig. 8: picture used to administer the first group of children. The picture was presented with the following instruction: Imagine that you have watched the following scene while you were walking around your city/village. Try to describe it to you friends living in another city.

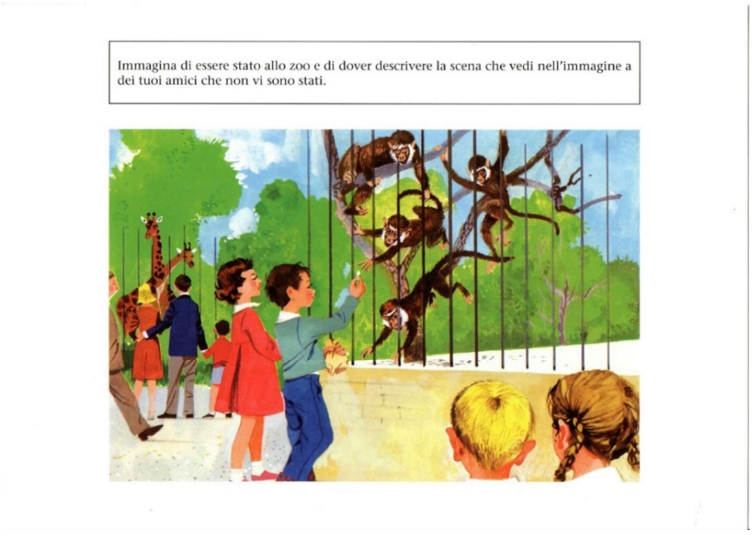


Fig. 9: picture used to administer the second group of children. The picture was presented with the following instruction: Imagine that you have been to the zoo and try to describe the following scene to your friend who did not come.

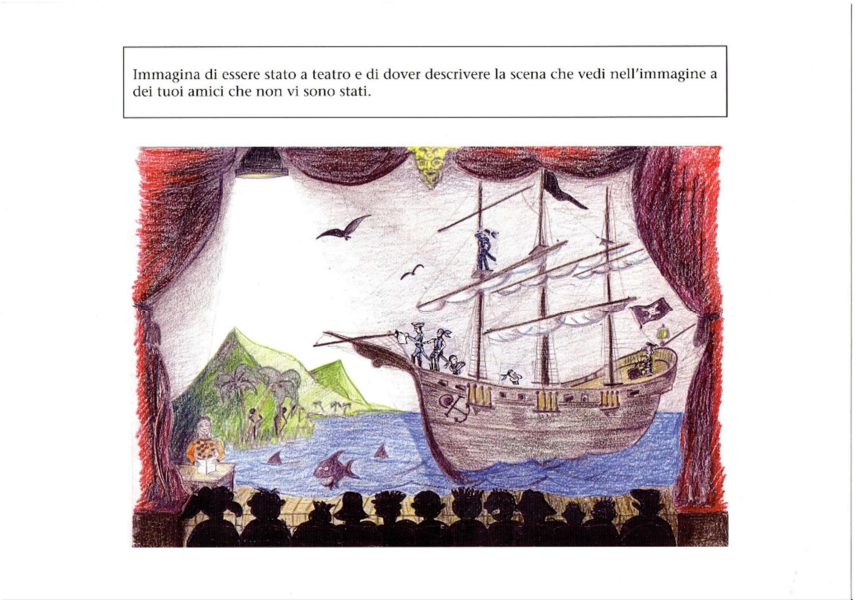


Fig. 10: picture used to administer the third group of participants. The picture was presented together with the following instruction: Imagine o have been to the theatre and try to describe the scene to your friend wo have not come.

The data collected followed the tendencies described by previous studies, namely children fitted with CIs produce short texts which usually contain the required contents. Older children showed a better performance than younger CI children. Indeed, they followed the instructions, produced well-structured texts, described all the objects in the picture, respected the hierarchy in the text, presented better morphosyntactic knowledge. However, resorting to complex structures was not always felicitous, since children often made errors in subject-verb agreement, in the position of elements in the sentence.

The use of free morphology was age-adequate and more complex structures, such as clitic pronouns, were not impaired. Participants preferred simple SVO sentences which have been expanded by adjectives and /or adverbs. Passive sentences and relative clauses are rare.

According to Dominutti's (2017) conclusions, children who received an early CI showed better performances than those who received a CI later, thus confirming the findings by Yasamal et al. (2013). Moreover, most of the CI children show writing abilities comparable to their age peers. Therefore, the importance of an early diagnosis of deafness followed by an early fitting with HAs and CIs is confirmed. In addition to this, since many participants are administered with a speech therapy, Dominutti supposes that good performances may be the result of an adequate audio-perceptual training, strengthening of language and learning abilities.

1.7. CONCLUSIONS

This chapter was thought to give an overview of the anatomy and the functions of the healthy ear, so as to analyse hearing loss, which is a damage in the middle or inner ear that causes an unsuccessful detection and discrimination of sounds. When the grade of hearing loss is equal to or higher than 70 dB, a CI is prescribed by the doctor. However, even though CIs are considered as gold-standard in the treatment of hearing loss, children still show a delay in some language levels, such as phonology, semantics, morphology, syntax and pragmatics.

As shown by several studies, children with CIs show impaired language abilities if compared with their typically developing age peers, especially in morphology and syntax (for English: Quigley & Paul 1984; De Villiers 1988; De Villiers e al. 1994; for French: Tuller 2000; Tuller & Jakubowicz 2004; Delage & Tuller 2007; Delage 2008; for Italian: Taeschner et al. 1988; Rampelli 1989; Volterra & Bates 1989; Caselli et al. 1994; Emiliani et al. 1994; Fabretti 2000; Maragna 2000; Ajello et al. 2001; Volterra et al. 2001; Franchi 2004; Chesi 2006; Fabretti & Tomasuolo 2006; Volpato 2008, 2010, 2012; Volpato & Adani 2009; Volpato & Vernice 2014). This topic will be at the core of chapter 2. Deaf children show a preference for short sentences and avoid more syntactically complex structures, such as relative clauses or passive sentences, they incorrectly add determiners and omit copulas. They frequently make gender and number agreement errors, and they show difficulties with verbal inflections, thus producing agreement errors between the subject and the finite verb. These same errors have been found in CI children's written text, as Dominutti (2017) showed.

The common idea in studies on language acquisition and writing development is the importance of an early diagnosis of deafness followed by a fitting with a HA or a CI. Indeed, children receiving an early CI showed a better performance in both oral and written tasks than children receiving a CI later. The next chapters will focus on syntactic delays found in CI children and described by previous studies in several languages, in order to introduce one of the studies carried out for this PhD thesis, namely the analysis of syntactically complex structures in Italian-speaking CI children.

2. THE ACQUISITION OF MOVEMENT-DERIVED STRUCTURES IN CHILDREN WITH A HEARING IMPAIRMENT

2.1. INTRODUCTION

This chapter presents some of the studies carried out on children with hearing loss fitted with conventional hearing aids (HAs) or cochlear implants (CIs). It focuses on the analysis of relative clauses, simple and long-distance *wh*-questions, and clitic pronouns. These structures will be analysed in chapter three. The chapter is organised as follows. Section 2.2. is dedicated to the studies carried out on the production and comprehension of subject and object relative clauses. Section 2.3. discusses the acquisition of simple and long-distance *wh*-questions. Section 2.4. resumes a study carried out on the processing of clitic pronouns in Italian-speaking children fitted with CIs.

2.2. PRODUCTION AND COMPREHENSION OF RELATIVE CLAUSES

Relative clauses are at the core of many studies carried out on several populations and in several languages: healthy adults (De Vincenzi 1991; Cooke et al. 2002; Wingfield et al. 2003); adults with an acquired language disorder (agrammatic patients: Thompson & Shapiro 1995; Grillo 2008; Garraffa & Grillo 2008); typically developing children (Labelle 1990; Pérez-Leroux 1995; Varlokosta & Armon-Lotem 1998; Guasti & Cardinaletti 2003; Utzeri 2007; Arosio et al. 2009; Brandt et al. 2009; Belletti & Contemori 2010; Volpato 2010; Adani 2011); children with SLI (Dick et al. 2004; Friedmann & Novogrodsky 2007; Levy & Friedmann 2009; Contemori & Garraffa 2010); children with developmental dyslexia (Guasti et al. 2015; Pivi et al. 2016; Delage & Durrleman 2018); children and adolescents with hearing impairment fitted with HAs or CIs (Quingley & Paul 1984; De Villiers 1988; Friedmann & Szterman 2006; Delage 2008; Friedmann et al. 2008; Volpato & Adani 2009; Volpato 2010, 2012; Friedmann & Haddad-Hanna 2014; Volpato & Vernice 2014). All these studies found an asymmetry in the processing of subject and object relative clauses common to both healthy and unhealthy populations and both adults and children. The subject-object asymmetry consists in a better production and comprehension of subject over object relative clauses. The difficulties in the processing of object relative clauses have been explained in terms of a violation of a locality principle (i.e., Relativized Minimality, Rizzi 1990, 2004. See also: Grillo 2008; Garraffa & Grillo 2008; Friedmann et al. 2009; Belletti & Contemori 2010; Volpato 2010; Friedmann & Haddad-Hanna 2014; Volpato & Vernice 2014), namely the subject functions as an intervener in the coindexed chain between the moved object and its copy in the position where it was generated (cf. Friedman, Belletti and Rizzi 2009).

Indeed, subject relative clauses are acquired and mastered at a younger age than object relatives. Subject relative clauses are correctly produced or comprehended at around the age of 3 (production: 61% at age 3-3;11; 90% at age 4; comprehension: 91% ate age 3;4-3;11, data from Belletti & Contemori 2010). On the other hand, object relative clauses are mastered later, at around the age of 7 (data from Utzeri 2007). However, some differences are to be mentioned between the production and the comprehension of these structures. On the one hand, object relative clauses are produced within the age of 7;0 (Utzeri 2007; Carpenedo 2010; Re 2010; Belletti & Contemori 2011) and then they are replaced by the production of causative structures or passive relatives (object relatives production: 37% at age 3;0; 52% at age 4;0; 45% at age of 5-6;0; 33% at age 6;10-7;10; 10% at age 9;4-10;3, data from Manetti & Belletti 2013). On the other hand, the comprehension of object relative clauses increases with age: younger children perform worse than older children (53% at age 3;4-3;11; 83% at age 4-4;10; 74% at age 5-5;11; 85% at age 6-6;11; 89% at age 7-7;9, data from Adani 2011). Moreover, since Italian is a *pro-drop* language and allows postverbal subjects, the comprehension of a further type of object relative was analysed, namely object relative clauses with postverbal embedded subjects (*Mi piace il bambino che abbracciano i cani* 'I like the child-OGG that hug-3pl the dogs-SOGG'), which are still problematic for children between 7;0 and 7;9 years (Adani 2011).
Being the aim of this thesis to provide an analysis of Italian syntactically complex structures derived by *wh*-movement, two studies on the production and the comprehension of Italian subject and object relative clauses in children with hearing impairment and fitted with CIs will be now presented.
Volpato and Vernice (2014) compared the production of subject and object relative clauses in a group of Italian-speaking children with CIs with three different control groups matched on comparable linguistic, auditory and chronological age. The experimental group was composed of thirteen children suffering from profound hearing loss. They were hearing impaired since birth and were born in hearing families; therefore, they did not know or use any sign language. Children with hearing impairment ranged in age between 7;9 and 10;8 (mean age: 9;2). They were fitted with HAs between the age of 0;5 and 1;8, they received a CI between the age of 1;9 and 3;4. The duration of use of the CI varied from 4;5 years to 8;6 years. The three control groups were formed by thirteen children each. Children matched for linguistic age were ranged in the age from 5;7 to 7;9. Children of the auditory group were ranged in the age between 4;11 and 9;4. Children matched for chronological age were ranged in the age between 7;5 and 10;3. The statistical analysis showed that all the control groups performed slightly better than the experimental group (children with CIs). Moreover, the study confirmed the subject-object asymmetry in the production of relative clauses, namely subject relative clauses are produced in a higher rate than object relative clauses. The CI group produced 88% of subject relatives, while the controls matched on comparable linguistic age produced 99% of subject

relatives, controls of comparable auditory age produced 96% of subject relatives, and controls matched on the same chronological age produced 100% subject relatives. When children with CIs avoided subject relatives, they produced simple SVO sentences (5%), substituted the complementizer *che* 'that' for the *wh*-fillers *dove* 'where' and *quando* 'when' (2%), or they resorted to other strategies (5%). The CI group produced 23% object relatives. The younger control groups, namely those matched on linguistic age and auditory age, performed slightly better than children with CIs (respectively: 33% and 30%). Normal hearing children matched on the chronological age produced less object relatives than the experimental group (15%). However, this group produced a high rate of passive relatives and causative structures, which can be considered as the sign of a proper language acquisition. CI group replaced the production of object relatives by producing: ambiguous sentences (17%); passive relatives (26%); sentences in which *wh*-fillers replaced the complementizer (6%); sentences in which the complementizer was omitted (1%); incomplete or ungrammatical sentences (3%); sentences with Theta-role inversion (4%); SRs with head inversion (3%); causative structures (3%); simple SVO order sentences (6%); or they resorted to other strategies (8%). These strategies emerge to a smaller extent in the production of normal hearing children of the same age. A further outcome of this study is that older children, from both the experimental and control groups, resorted to passive relatives when an OR was elicited. The production of passive relatives instead of ORs is largely attested in the production of normal hearing children from the age of 8 (Re 2010; Carpenedo 2011), adults and adolescents, and could be considered as an age-appropriate performance (Utzeri 2007; Belletti & Contemori 2010; Volpato 2010; Manetti & Belletti 2013; for the analysis of the preference for passive relatives over ORs, see Belletti 2009).

Children with CIs show the same tendencies as their normal hearing TD age peers also in the comprehension of relative clauses. Volpato (2010, 2012) analysed the comprehension of subject relative clauses and two types of object relative clauses, namely object relative clauses with preverbal and postverbal embedded subjects. The experimental group was composed of thirteen children with profound hearing loss and fitted with CIs ranged in age from 7;9 to 10;8. The control group was composed of thirteen normal hearing children matched on morphosyntactic abilities, who ranged in age from 5;7 to 7;9. Both groups showed the same subject-object asymmetry, namely subject relative clauses were easier to comprehend than object relative clauses. Moreover, a further asymmetry was found between object relative clauses with preverbal and postverbal embedded subject, namely the former structure was easier than the latter. However, even though the control group was chronologically younger than the experimental group, they performed better than children with CIs (subject relatives: CI: 89%; TD 93%; object relatives with preverbal embedded subject: CI: 68%; TD:81%; object relatives with postverbal embedded subject: CI: 31%; TD: 66%), and this difference

was found to be statistically significant. In Volpato (2010), ambiguous sentences were also analysed, namely sentences that could be interpreted either as subject or object relatives with postverbal embedded subject. This analysis was carried out in order to investigate if children from both groups preferred a subject reading over an object one. Results showed that CI and TD participants interpreted most ambiguous sentences as subject relatives, hence preferring a subject reading. A further outcome of this study was the preference of children with CIs for the comprehension of sentences with number match conditions, namely the subject and object shared the same number features. Conversely, TD children showed a better performance in sentences with a number mismatch condition, namely they performed better when the subject and the object had different number features.

2.3. PREVIOUS STUDIES ON SIMPLE AND LONG-DISTANCE *WH*-QUESTIONS

Starting from age 2;0, Italian-speaking children are able to produce several non-ambiguous sentences introduced by different *wh*-elements (who, what, where, when, how, why) (Belletti & Guasti 2015). The production and comprehension of subject and object questions including reversible verbs appears at age 5;0. Like relative clauses, *wh*-questions show a subject-object asymmetry, hence the former structure is easier to process than the latter one (De Vincenzi et al. 1999; Guasti et al. 2012; Del Puppo et al. 2016). This asymmetry is less evident in 10 to 11-year-old children, who show 80% of accuracy in the production of object *wh*-questions. Furthermore, children show an asymmetry between *who* and *which+NP* questions, the latter being harder than the former (De Vincenzi et al. 1999). Guasti, Branchini and Arosio (2012) investigated the production of *wh*- questions in a group of thirty-five young children aged 4-5 years and they found that children produce high percentages of subject questions (88% *who* questions; 80% *which* questions), while the percentage of object questions is lower (71% and 73%, respectively). Even at an older age (6;0-9;0 years), object questions show lower percentages of occurrence than subject questions (Del Puppo et al. 2016). In adults' production, *wh*-questions introduced by *who* are almost at ceiling (98% subject questions, 93,5% object questions), while for *which*-questions lower percentages of accuracy are observed (83% subject questions, 85% object questions). Various strategies are adopted when object questions are targeted, all of which are correct and appropriate for the context. Beyond the structure with post-verbal subject, the structure with left-dislocation of the subject and with a null-subject are employed (Guasti et al. 2012).

In populations with hearing impairment, the acquisition of *wh*-questions is delayed as it happens in all the structures involving *wh*-movement. Several studies on children with hearing impairment fitted with HAs or CIs have pointed out poorer performance of this population compared to the performance of typically developing (TD) children (English: Quigley et al. 1974; German: Ruigendijk & Friedmann 2017; Penke & Wimmer 2018; Hebrew: Friedmann & Szterman 2011; Palestinian-Arabic:

Friedmann & Haddad-Hanna 2014, Italian: Volpato & D'Ortenzio 2017). Like TD children, children with a hearing impairment show the typical asymmetries between subject and object questions, and between *who* and *which* questions, i.e. subject and object *who* questions are easier than subject and object *which* questions.

Friedmann and Szterman (2011) analysed comprehension, production and repetition abilities of *wh*-questions by Hebrew-speaking children with moderate to profound hearing loss, fitted with HAs or CIs. The experimental group was composed of eleven children with hearing loss ranged in age from 9;1 to 12;4. Their performance was compared that of with two control groups: the first group, composed by twelve children aged from 7;5 to 9;0, was used for the comparisons of comprehension and production of *wh*-questions; the second group, composed of thirty-five 5;0 years children, was used during the repetition experiment. Children from both the experimental and the control groups were assessed with a character selection task to investigate the comprehension of subject and object *who* and *which* questions. Results showed better performance of the control group over the experimental one. While the normal hearing children performed almost at ceiling in all the structures analysed, children with hearing loss presented double asymmetries: the subject-object asymmetry, and the *who*-*which* asymmetry (subject who: 95%; object who: 96%; subject which: 89%; object which: 69%). Contrary to the results after the character selection task, Hebrew-speaking children showed different tendencies during an elicited production task. Indeed, they showed the typical subject-object asymmetry in the elicited production of subject and object *who* questions (subject: 78%; object: 61%). As for the previous experiment, in the production of *wh*-questions normal hearing children did not show any asymmetry between subject and object questions, they performed both structures almost at ceiling (99%). The last experiment concerned the repetition of subject and object *which* questions and also in this case the performance of the experimental group was lower than that of the control group. Thus, confirming the delay of children with hearing impairment in the processing of object *wh*-questions. The same results showed for Hebrew-speaking children with hearing impairment were found in a later study on German-speaking children with hearing impairment (Ruigendijk & Friedmann 2017). German children also show two asymmetries: between subject and object *wh*-questions, and between *who* and *which* questions.

Following these studies, Volpato and D'Ortenzio (2017) ran a pilot study on the production of *who* and *which*+NP questions by a group of eight Italian-speaking children with hearing impairment fitted with CIs. Results showed that the experimental group performed similarly to the control group in the production of subject and object *who* questions (subject *who* questions: CI: 90%; TD: 90%; object *who* questions: CI: 77%; TD: 79%), while in the production of *which+NP* questions, children with CIs showed a worse performance compared to the controls (subject *which* questions: CI:67%; TD:

77%; object *which* questions: CI:52%; TD: 67%). As shown by the percentages, both the experimental and the control group performed better in *who* questions and showed a marked subject-object asymmetry in *which* questions. As pointed out by previous studies, a high individual performance variability between participants was observed, namely the production of *wh*-questions by some children with CIs was comparable to their normal hearing peers, while some participants still showed a delay in the production of these structures. In particular, a higher production of ungrammatical sentences was observed in CI children as opposed to controls (CI: 15%; TD: 7%).

Since I will also analyse long-distance *wh*-questions, it is worth mentioning a pioneering study carried out on these structures by de Villiers et al. (1994). They investigated the interpretation of long-distance *wh*-questions in children suffering from hearing loss. The experimental group was composed of fifty-two students with hearing loss ranged in age from 11 to 19. Their performance was compared with two different control groups, one composed of twenty normal hearing children with a mean age of 9;1, and the other composed of twenty normal hearing college students. Participants were administered with ten stories containing two possible answers for the *wh*-questions: one appropriate given a long-distance interpretation, and one for the short distance interpretation of the *wh*-question. Overall, the results showed a better performance of the control groups compared with the performance of the individuals with hearing loss. De Villiers et al. (1994) suggested that the lack of long-distance readings is due to either (i) an inflexibility of interpretation that represents a parsing conservatism, or (ii) a failure to handle cyclic movement or any movement across more than a single clause. In the first case, the long-distance reading is preferred to more rare reading strategies, such as medial questions. The second case suggests a delay in the acquisition of the CP node. In addition to these outcomes, de Villiers et al. (1994) reported the very low frequency of long-distance *wh*-questions in the experimental and control groups' speech.

2.4. PRODUCTION OF CLITIC PRONOUNS IN ITALIAN-SPEAKING CHILDREN WITH A COCHLEAR IMPLANT

Several studies have shown that the acquisition of clitic pronouns is difficult for many types of language learners of Italian due to simultaneous activation of the individual's phonological, morphosyntactic, syntactic and pragmatic competences.

Clitic pronouns start to appear in children's productions between 2;6 and 3;0 years. However, children seldom and optionally insert clitic pronouns in their spontaneous speech. The full mastery of clitic pronouns is achieved between 4;0 and 5;0 years of age (Cipriani et al. 1993; Pizzuto & Caselli 1993; Antelmi 1997; Schaeffer 2000; Tedeschi 2009).

Previous studies on several populations have demonstrated that SLI children omit clitic pronouns more often than TD children and these strategies characterises their productions for a longer period (Bortolini et al. 2006). Furthermore, a study on adult L2 learners of Italian, pointed out that the production of a clitic pronoun is often avoided by producing the NP corresponding to the clitic pronoun or omitting the NP altogether (Leonini & Belletti 2003).

Taking in account these findings, Guasti et al. (2012) analysed the production of direct object clitic pronouns in children with CIs. They assessed a group of thirty-three children with hearing loss and fitted with CIs (CI group) with an elicited production task. Children ranged in age between 4;2 and 6;10 years. They were all born deaf from hearing families, except for one participant who contracted meningitis at 0;11 months. They were diagnosed with hearing impairment within the age of 4;3 years and received a CI by the age of 4;8. Their performance was compared with a control group composed of thirty-three normal hearing children matched on chronological age (NH group). The task used was developed by Arosio et al. (2010) with the purpose to investigate the production of direct object clitic pronouns (DO-CL) and past participle agreement.

For each participant, sixteen responses were collected for a total amount of 528 responses per group. As expected, the experimental group showed a lower clitic production than their normal hearing age peers. This finding was also confirmed by the statistical analysis. children with CIs were more likely to omit clitic pronouns than normal hearing children, and they rarely substituted clitic pronouns with full NPs. The past participle agreement was found as problematic both in the presence and absence of the clitic pronoun. Interestingly, Guasti et al.'s (2012) children with CIs produced the same raw number of clitics as the 3;0 years old children in Schaeffer's (2000) study. This means that children with CIs are linguistically two years behind their normal hearing age peers, suggesting that clitic production may be a taxing area for them. Children with CIs also produced fewer past participle agreements than their NH controls, and at a similar frequency as the 3;0 to 4;0-year-old NH children in Moscati and Tedeschi (2009). Indeed, like some younger normal hearing children, they failed to provide agreement consistently, using the default masculine form instead. The failure to use past participle was more evident when the clitic was expressed, meaning that children with CIs could already use clitics but did not master all the grammatical consequences of their use.

Finally, Guasti et al. (2012) found correlations between age at implantation and use of clitics, namely children with hearing impairment who received an early CI produced a higher rate of clitics than children who received a CI later. Therefore, Guasti et al. claim that, during the evaluation of the language deficit in CI children, it is important to consider the age at implantation because it may influence the production of clitics.

3. ANALYSIS OF MOVEMENT-DERIVED SENTENCES IN CHILDREN FITTED WITH COCHLEAR IMPLANTS

3.1. INTRODUCTION

Chapter 2 was devoted to the presentation of several studies carried out in several languages; said studies focused on the processing of movement-derived sentences in children with hearing loss fitted with HAs or CIs. A commonality between these studies is a deficient performance of the individuals with hearing loss when they process syntactically complex structures.

The aim of this chapter is twofold. On the one hand, it provides new data on well-analysed structures in Italian and other languages (i.e., restrictive relative clauses and *wh*-questions). On the other hand, the chapter provides a first analysis of those structures which are never, or rarely, analysed in the population of children fitted with CIs (i.e. left-dislocated sentences containing resumptive clitic pronouns, cleft sentences, long-distance *wh*-questions, restrictive genitive and oblique relative clauses). For the sake of clarity, the structures analysed for this study are: restrictive subject relative clauses, restrictive object relative clauses with preverbal subjects, restrictive object relative clauses with postverbal subjects, restrictive genitive and oblique relative clauses, subject and object *who* questions, subject and object *which*+NP questions, subject and object long distance *wh*-questions, cleft sentences, left dislocated sentences with resumptive clitic pronouns.

Participant's linguistic competence was assessed resorting to several testing methodologies, in order to take advantage of the different methods used in previous studies. Indeed, the sentence repetition task yields the analysis of children's abilities to process several syntactic structures using only one task (Friedmann & Szterman 2011; Szterman & Friedmann 2015; Del Puppo et al. 2016). Elicited production tasks enable the study of little frequent structures in spontaneous speech (e.g. object relatives), also allowing the control of the meaning associated with the target utterance (McKee et al. 1998). Comprehension tasks make it possible to analyse whether children have correctly acquired a certain structure even though they do not produce it (Fraser et al. 1963).

The chapter is organised as follows. The participants of the experimental and control groups will be presented in section 3.2. The details of the methodology used during assessment will be provided in section 3.3. Section 3.4 is dedicated to the sentence repetition task (Del Puppo et al. 2016); section 3.5 is devoted to the elicitation and comprehension of subject and object restrictive relative clauses (Volpato 2010); and Section 3.6 describes the elicitation task of *wh*-questions (Guasti et al. 2012, 2015). These sections begin with the description of the structures analysed by the task, the description of the task, the participants considered for that experiment, the data collected and a final discussion.

The chapter ends with a general discussion of the analysed data trying to distinguish between easier and more complex structures.

3.2. PARTICIPANTS

Thirty Italian-speaking children and adolescents fitted with CIs (CI group)[8] were selected and tested at the Ear Nose Throat Clinic, Department of Neurosciences, University of Padua (ENT Clinic).

The experimental group is composed of eleven boys and nineteen girls. Twenty-eight participants suffer from severe-to-profound hearing loss, one participant presents a mixed hearing loss, and one participant is affected by progressive hearing loss. Participants ranged in age between 7;3 (years; months) and 14;5 (mean age: 10;3). They were diagnosed and received their first HAs between the birth (Neonatal hearing screening) and 6;2. Participants received their first CI in an age comprised between 0;7 months and 12;1 years. Twenty-six participants benefit from a bilateral stimulation, namely they are fitted with two CIs (fourteen participants) or with a CI and a contralateral HA (twelve participants). Four participants are monolaterally stimulated, i.e. they benefit of the only use of a CI. Fifteen participants follow a speech therapy, the other half has concluded the rehabilitation programme. For five participants (SV, FP, CO, AR, MA), the data related to the age of diagnosis and HAs fitting are missing since they come from different hospitals and it was not possible to find the missing data. Since the ENT Clinic is a well-known centre in Italy for CIs, the participants come from several regions of Italy for their periodic follow-up. Twenty-one participants come from Northern Italy, seven participants come from Central Italy, and two participants come from Southern Italy. The selected participants reported good percentages of correctness during the speech perceptual tests[9] administered by the speech therapists during the follow-up examinations. However, considering that follow-up examinations were administered before the assessment of movement-derived sentences and that they consist of speech perception tests, audiometry, and mapping of the CI, not all the participants completed the planned tasks for the assessment of linguistic abilities. Some of them indeed preferred to stop the experiment when they were excessively tired.

[8] As pointed out by one of the reviewer of this work, the number of the participants at these experiments is small. However, many studies carried out on language acquisition in children with typical and atypical language acquisition present small groups of participants (Friedmann & Szterman 2011; Guasti et al. 2012; Volpato 2012; Adani et al. 2013; Vernice et al. 2013; Szterman & Friedmann 2014; Volpato & Vernice 2014; Arosio et al. 2016, 2017; Penke & Wimmer 2018).

[9] Speech perception tests usually include several tasks for the recognition of stress patterns, consonants, vowels, disyllabic and trisyllabic words, and sentences.

When participants stopped the assessment, it was not possible to continue it during a second meeting because of their provenance and the inconvenient timing of the follow-up period[10]. The following table displays CI participants' personal and clinical data.

Tab. 5: Personal and clinical data related to the experimental group (CI group). The "" marks that some data are missing (ID= identity; HL= hearing loss; CI=cochlear implant; HA=hearing aid).*

ID	Age	Sex	HL Type	Age of HA	Age of CI	Length of use of CI	Type of stimulation	Contralateral stimulation	Speech therapy	Area of provenance in Italy
SV	8;2	F	sensorineural	*	1;2	7;0	Bilateral	CI	Yes	North
FZ	11;1	M	mixed	3;0	6;7	4;4	Bilateral	HA	No	Centre
EF	8;10	F	sensorineural	2;2	3;3	5;7	Bilateral	HA	Yes	North
RB	10;2	F	sensorineural	1;0	9;8	0;4	Bilateral	HA	Yes	North
MS	10;0	M	sensorineural	0;5	1;2	8;8	Bilateral	HA	Yes	North
MC	13;4	F	sensorineural	2;6	4;6	8;8	Bilateral	CI	No	Centre
VZ	7;10	F	sensorineural	0;2	1;6	6;4	Monolateral	---	Yes	North
GT	8;6	M	sensorineural	0;7	4;7	3;9	Bilateral	HA	Yes	North
CS	14;3	F	sensorineural	0;7	1;6	12;7	Bilateral	CI	Yes	Centre
AM	12;8	M	sensorineural	4;6	12;1	0;7	Bilateral	HA	Yes	North
MG	11;6	F	sensorineural	0;6	6;7	4;9	Bilateral	HA	No	North
MM	9;9	F	sensorineural	0;5	2;9	7;0	Bilateral	CI	Yes	North
FP	13;10	F	sensorineural	*	3;1	10;9	Bilateral	CI	No	Centre
NV	8;1	M	sensorineural	0;4	1;7	6;4	Bilateral	CI	Yes	North
DB	12;10	M	sensorineural	0;10	6;7	6;3	Bilateral	CI	No	North
AT	9;0	M	sensorineural	0;3	7;10	1;2	Bilateral	HA	Yes	North
CO	8;4	F	sensorineural	*	1;1	7;3	Bilateral	CI	No	North
AP	14;5	F	sensorineural	3;0	10;8	3;7	Bilateral	HA	No	Centre
CV	11;2	M	sensorineural	3;0	7;0	4;2	Bilateral	HA	Yes	North
AR	10;4	F	sensorineural	*	2;2	8;2	Bilateral	HA	Yes	North
AZ	10;5	M	sensorineural	0;6	2;3	8;2	Bilateral	CI	Yes	North
FZ (2)	10;5	F	sensorineural	0;6	7;3	3;2	Bilateral	HA	No	North
ER	8;6	F	sensorineural	0;6	1;0	7;6	Bilateral	CI	No	Centre
AO	14;2	F	progressive	6;2	10;10	3;4	Bilateral	CI	No	North
EN	7;5	F	sensorineural	birth	0;7	6;10	Bilateral	CI	No	North
AF	7;8	F	sensorineural	1;5	2;2	5;6	Monolateral	---	Yes	North
AM	12;2	M	sensorineural	0;4	1;3	10;9	Monolateral	---	No	South
AI	8;1	F	sensorineural	3;1	3;7	4;9	Bilateral	CI	No	Centre
MA	7;11	M	sensorineural	*	1;8	6;3	Monolateral	---	No	South
CB	7;3	F	sensorineural	0;5	1;6	5;7	Bilateral	CI	No	North

A control group was formed by twenty-five Italian speaking typically developing children (TD group). They ranged in age between 5;2 and 13;3 (mean age: 8;9). They were fifteen girls and ten

[10] After the activation of the CI, patients are checked at predetermined intervals: one month, three months, six months, nine months, twelve months after the activation of the CI/s. Then, when the functioning of the CI has stabilised, patients are checked every year or in case of need.

boys. Eighteen participants came from Northern Italy, six from Central Italy, and one of the participants came from Southern Italy. The control group was not selected through a severe random sampling procedure (i.e. establishing a collaboration with a school) but it presents a convenience sample[11]. The participants were selected at the ENT Clinic among CI participants' siblings, they were reached via email among the list of the author's colleagues, or among the members of Lisabilità[12], some of them were selected among the author's personal contacts, other children were selected and tested by a MA student for the essay she wrote at the end of the course of Linguistics for deafness and hearing impairments. The reason why children of the control group were recruited randomly and from several settings was due to the fact that no school, among the contacted ones, allowed for data collection. The following table resumes the main information about the participants of the control group.

Tab. 6: personal data of the participants at the control group (ID=identity)

ID	Age	Sex	Area of Provenance in Italy
GM	9;6	F	South
CL	7;0	F	North
SA	10;11	F	North
AO	7;10	M	North
AR	7;2	F	North
PN	9;5	M	North
NL	7;1	M	North
AL	9,11	F	North
MM	10;3	F	North
FIL	8;8	M	Centre
FED	12;1	M	Centre
AM	6;10	M	North
EM	10;4	F	North
FV	7;10	M	Centre
GD	9;7	F	Centre
AN	8;3	M	Centre
SB	13;3	F	Centre
GG	8;0	F	North
SG	5;2	F	North
AP	8;8	F	North
TM	7;11	M	North
GD	8;1	F	North
ML	7;11	F	North
MM (1)	8;1	M	North
AJ	7;10	F	North

[11] According to Dörneyi (2010) as reported by Bier (2016) the convenience sample members are selected for a research if they meet certain practical criteria, such as geographical proximity, availability at certain time, or easy accessibility.
[12] Lisabilità is a Venetian association that promotes Italian Sign Language as Augmentative and Alternative Communication (AAC)

Since the children of the TD group are younger than the children of the CI group, their mean age is 8;9, only the data of some of them were taken into account so as to pair the participants with CIs with a normal hearing child of comparable chronological age.

3.3. METHODOLOGY

The assessment of CI and TD children lasted 45 minutes. This was the time limit imposed by the ENT Clinic so as to include the data collection in the schedule of the ward. Moreover, speech therapists recommend not to exceed 45 minutes in order not to tire the children after their follow-up medical examination, which lasts more than an hour and consists in speech perception tests, audiogram, and the CI mapping. It was decided to use the same timing also with TD children so as to control the time variable and not to facilitate them with a longer time span. Nevertheless, TD children completed the linguistic assessment in shorter time than children with CIs.

The four tasks were administered to all the participants in the same order. The assessment started with the first half of the sentence repetition task (sentences 1 to 25) (Del Puppo et al. 2016). Then children were assessed with a reduced version of the preference task to elicit the production of relative clauses (Volpato 2010). Subsequently, participants were administered a reduced version of the character selection task to assess the comprehension of relative clauses (Volpato 2010). Then, participants were administered the elicitation task of *wh*-questions (Guasti et al. 2012, 2015). The assessment part was concluded by the second part of the sentence repetition task (sentences 26 to 49).

The sentence repetition task was administered as first in order to get a primary overview of the children's proficiency with syntactically complex structures. The authors of the task suggest a pause after the first half of the task since it is a long and demanding task for the children. For this study, the pause between the two parts of the test was used to administer the other tasks planned for the data collection.

Both the production and the comprehension of restrictive subject and object relative clauses were assessed. In both cases, due to the time restriction, a reduced version of the two tests was used. Moreover, because the structures analysed are similar, and in order not to influence the participants' performance during the preference task, the production of relative clauses was assessed before the comprehension of these structures.

The task for the elicited production of *wh*-questions is administered through a power point presentation on a laptop. Taking advantage of this, this test was administered almost at the end of the assessment part. Differently from previous tasks, children's parents or care givers were involved during the task of elicited production of *wh*-questions.

Children fitted with CIs were tested in a quiet room at the ENT Clinic. TD participants were tested in different places: CI children's siblings were tested at the ENT Clinic, the members of Lisabilità were tested in a room of the Department of Linguistics and Comparative Cultural Studies of Ca' Foscari University of Venice, other children were tested at their homes.

Participants were audiotaped, and their responses were transcribed by the experimenters on dedicated Excel files.

All the experiments were conducted with the informed and overt consent of each participant or their caregiver in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki 2001) and the standards established by the local Institutional Review Board.

3.4. THE REPETITION TASK

This section focuses on the repetition task[13] developed by Del Puppo et al. (2016). Section 3.4.1. presents all the major characteristics of the structures assessed with this task. The task is described in section 3.4.2. Participants involved in this experiment are presented in section 3.4.3. The data collected are analysed in section 3.4.4. Finally, section 3.4.5. provides a brief discussion of the results of the sentence repetition task.

3.4.1. Structures analysed

The task aims to investigate the following structures: left-dislocated sentences containing resumptive clitic pronouns, cleft sentences, subject and object long-distance *wh*-questions, genitive and oblique relative clauses.

The common feature of these structures is a long-distance dependency between the moved element in the left periphery of the sentence and the 'trace' or 'gap' left in the position where they are merged. The following examples show the movement of the constituents in the different sentence structures.

(1)*Left-dislocation sentences containing resumptive clitic pronouns*

La bambola, il bambino la pettina sempre <la bambola>

the doll, the boy DO-CL_{3SF} combs always <the doll>

'The doll, the boy always combs her.'

[13] The results of this experiment were presented during the International conference on the acquisition of Romance languages – The Romance Turn IX that took place in Bucharest, 30th August-1st September 2018.

(2)*Cleft sentences*

È il PINGUINO che le mucche fermano <il pinguino>

(it) is the PENGUIN that the cows stop <the penguin>

'It is the PENGUIN that the cows stop!'

(3)*Long-distance subject and object wh-questions*

a. Quale gallina hai detto che <quale gallina> sgrida le pecore?

which chicken did (you) say that <which chicken> scolds the sheep?

'Which children did you say that scolds the sheep?'

b. Quale animale hai detto che le scimmie grattano <quale animale>?

which animal did (you) say that the apes scratch <which animal>?

'Which animal did you say that the apes scratch?'

(4)*Oblique relative clauses*

La bambina lava il cane a cui il padrone dà i biscotti <cane, a cui>

the girl washes the dog to whom the owner gives the cookies <dog, to whom>

'The girl washes the dog to whom the owner gives the cookies.'

(5)*Genitive relative clauses*

Il maestro pettina la signora la cui figlia <la cui figlia> lavora

the teacher combs the lady whose daughter <whose daughter> works

'The teacher combs the lady whose daughter works.'

A more detailed analysis of the sentences presented in the examples (1-5) above will be provided in the following subsections.

3.4.1.1. Left dislocated sentences with resumptive clitic pronouns

In left dislocated sentences, a TOPIC appears in sentence-initial position[14] (Renzi et al. 2001). The moved object can be any type of complement, such as a direct object (6), an indirect object (7), or an object clause (8).

(6)La macchina$_i$, Gianni la$_i$ lava <la macchina>

the car$_i$, John DO-CL$_{3SFi}$ washes <the car>

'John washes the car.'

[14] Broadly speaking, the TOPIC is "what the utterance is about". Not always the TOPIC coincides with the subject of a sentence, as for example in left dislocated sentences.

(7)Alla sorella$_i$, il bambino (le$_i$) regala un fiore <alla sorella>
to the sister$_i$, the boy (IO-CL$_{3SFi}$) gives a flower <to the sister>
'The boy gives a flower to the sister.'

(8)Che non abbiano pulito, mi infastidisce molto <che non abbiano pulito>
that (they) had not tidied up, to me annoys a lot
'It annoys me a lot that they had not tidied up.'

As examples (6-7) above show, the moved element is coindexed (i) with a clitic pronoun. This is optional in the case of left dislocated indirect objects but is obligatory when the left dislocated element is a direct object (Cinque 1990).

Differently from strong pronouns, Italian direct object (DO) clitic pronouns are phonologically weak elements which are unstressed (Cardinaletti & Starke 1999). In Italian, the position of clitic pronouns in the sentence depends on the finiteness of the verb. If the verb carries tense and φ-features, clitic pronouns are proclitic on the inflected verb giving rise to a sentence with a non-canonical word order of the constituents Subject-Object-Verb (SOV) (10). If the verb does not carry tense and φ-features, clitic pronouns are enclitic on the non-finite verb giving rise to a sentence with canonical order of constituents Subject-Verb-Object (SVO) (11).

(9)Ho salutato la mamma in stazione
I have greeted mummy at the train station
'I greeted mummy at the train station.'

(10)L'ho salutata in stazione
DO_CL$_{3SF}$ (I) have greeted$_{3SF}$ at the train station
'I greeted her at the train station.'

(11) Ricordo di averla salutata in stazione
(I) remember to have DO-CL$_{3SF}$ greeted at the train station
'I remember to have greeted her at the train station.'

According to Belletti (1999), the cliticization is a complex process which follows two main steps. The first part of the derivation is a phrasal movement involving the DP whose head is the clitic pronoun. The second part of the derivation is head movement incorporating the clitic pronoun into the functional head I (also see Sportiche (1996) and Cardinaletti & Starke (1999)). The schematic representation in (12) illustrates the described steps. Moreover, when V occupies a high position in

the sentence, the clitic fills an enclitic position. On the contrary, if V finds in a low position, the clitic fills a proclitic position.

(12) (V/Aux$_{-fin}$) [$_{D}$ CL] (V/Aux$_{+fin}$) … [$_{DP}$ <[$_{D}$ CL]>] … <[$_{DP}$ [$_{D}$ CL]]>

Belletti and Guasti (2015) claim that the difficulty in the interpretation of DO clitic pronouns may be caused by this mixed-type displacement, since the cliticization process involves both a phrase and a head movement.

Morpho-syntactically, DO clitics are marked for person, number and gender. In periphrastic sentences, they trigger obligatory past participle agreement in the third person, as the following example shows:

(13) (Maria/Gianni) l'ho salutat**a**/**o** all'università
(Mary/John) I CL-have greet/$_{Agr\ fem,\ sing/masc}$, at the university
'I greeted Mary/John at the University.'

Past participle agreement is the first step of the derivation in which the clitic pronoun moves as a phrase (DP) and passes through the specifier of a functional head hosting the past participle (Kayne 1989; Friedmann & Siloni 1997; Belletti 2006; Cardinaletti and Starke 1999). Two feature checking operations take place under cliticization. The first corresponds to the checking of the past participle agreement features (Agr) involving movement of the clitic as a head. The second involves the checking of a specificity (D) feature, i.e. the clitic itself, corresponding to the phrasal part of the cliticization process assumed in (12).

Like DO clitics, reflexive (RE) clitics occur in preverbal position when the verb in the sentence is finite (14) and in postverbal position when the verb of the sentence is non finite (15).

(14) La mamma si lava
mommy RE-CL$_3$ washes
'Mommy is washing herself.'

(15) La mamma ha detto di lavarsi
mommy has said to wash RE-CL$_3$
'Mom said to wash himself/herself.'

Differently from DO clitics, third person RE clitics are only marked for person, as shown by examples (14-15) above. Interestingly, when the verb in the sentence is present perfect, RE clitics select for the auxiliary *essere* 'to be' and the past participle must agree in number and gender with the subject of the sentence.

Following Burzio (1986), RE clitics have a distinct underlying syntactic structure than DO clitics. Thus, while DO clitics undergo a twofold movement (phrasal movement and head movement), RE clitics are base-generated in a clitic position and form a chain with an empty category in object position (Burzio 1986). With that in mind, it is probable that some differences occur in the production of DO and RE clitics since they show different structures and have different morphological inventories.

3.4.1.2. Cleft sentences

Cleft sentences are at the core of several studies carried out in several languages (Akmajian 1970; Halliday 1976; Emonds 1976; Chomsky 1977; Longobardi 1985; Collins 1991; Kiss 1999 in Frascarelli 2000). Their peculiarity is to allow the 'physical' detachment of a discourse prominent constituent from the rest of the sentence. This specific structure gives emphasis on a precise piece of information in the sentence, allowing the correction of a preceding statement.

Italian cleft sentences are usually bi-clausal copulative constructions. The first element to appear is the copula, since Italian is a *pro-drop* language and does not possess expletive elements (cf. *it* in the English translations below). The second element is the clefted constituent. When the clefted constituent holds the subject role of the subordinate verb, the copula agrees with the cleft phrase in number and person (16 a-c); when the past participle is present, it also agrees in gender (16d-f). The copula may agree with the DP cleft phrase also when said ceft bears a different syntactic role. In this particular case, some varieties of substandard Italian may allow a mismatch in number features (17b).

(16) a. È GIOVANNI che <Giovanni> compra il giornale
pro is$_{3SM}$ JOHN that <John> buys the newspaper
'It is JOHN that buys the newspaper.'

b. Sono I CANI che la nonna pettina <i cani>
pro are$_{3PLM}$ THE DOGS that the grandmother combs <the dogs>
'It is THE DOGS that the grandmother combs.'

c. Sei TU che <tu> devi pagare il caffè
pro are$_{2S}$ YOU that <you> must pay the coffee
'It is YOU that must pay the coffee.'

d. È stata TERESA a cucinare i muffin
pro was$_{3SF}$ TERESA to cook the muffins
'It was TERESA that cooked the muffins.'

e. Sono stati I BAMBINI a rompere il vaso
pro were$_{3PLM}$ THE CHILDREN to break the vase
'It was THE CHILDREN that broke the vase.'

(17) a. Sono I RAGAZZI che voglio salutare <i ragazzi>
pro are$_{3PL}$ THE BOYS that (I) want to greet <the boys>
'It is THE BOYS that I want to greet.'

b. È I RAGAZZI che voglio salutare <i ragazzi>
pro is$_{3S}$ THE BOYS that (I) want to greet <the boys>
'It is THE BOYS that I want to greet.'

Furthermore, other types of nominal phrases headed by common nouns, proper nouns and pronouns can be clefted. Other types of syntactic categories may occur in postcopular position, namely prepositional phrases (18), adverbial phrases (19), verbal (20) and complementizer phrases (21) and adjectival phrases (22).

(18) È CON MARTA che il cane gioca <con Marta>
pro WITH MARTA that the dog plays <with Marta>
'It is WITH MARTA that the dog plays.'

(19) È ATTENTAMENTE che devi ascoltare <attentamente> la maestra
pro is CAREFULLY that (you) should listen <carefully> to the teacher
'It is CAREFULLY that you should listen to the teacher.'

(20) È MANGIARE TROPPI DOLCI che ti fa ingrassare <mangiare troppi dolci>
pro is EAT TOO MUCH SWEETS that makes you fatten <eat too much sweets>
'It is EAT TOO MUCH SWEETS that makes you fatten.'

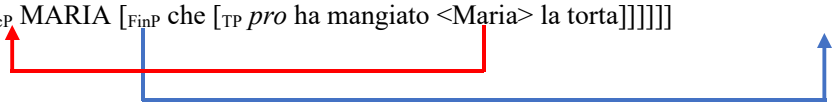
(21) È PERCHÉ LAVORAVA MALE che è stato licenziato <perché lavorava male>
pro BECAUSE HE WORKED BADLY that he was laid off <because he worked bad>
'It is BECAUSE HE WORKED BADLY that he was laid off.'

(22) È LEGGERO che lo vorrebbe, Luisa, il computer <leggero>
pro LIGHT that DO-CL$_{3SM}$ would, Luisa, the computer <light>
'It is LIGHT, that Luisa would like her computer.'

As shown by the examples (16-22) above, Italian cleft sentences are introduced by the complementizer *che* 'that'. They involve an antecedent-gap relation between the clefted object and its 'trace' or 'copy' in the position where it was generated. During object extraction, it is possible to run into intervention effect if the subject contained in the cleft sentence shares the lexical restriction with the object constituent (Friedmann et al. 2009).

More in detail, according to Belletti (2008), cleft structures are derived by two complementizer systems. Indeed, the derivation involves two clausal domains: the projection of the copula, and the embedded clausal projection which is selected by the copula. The subject position in the matrix TP is filled by a pronominal null element *pro*. The clefted object undergoes *wh*-movement from its base-position in the subordinate clause to the specifier of FocP within the same clause. Finally, a lower part of the cleft clause FinP is extraposed. (23) exemplifies Belletti's theory:

(23) È MARIA che ha mangiato la torta
[$_{CP}$ [$_{TP}$ *pro* [$_{vP}$ è [$_{FocP}$ MARIA [$_{FinP}$ che [$_{TP}$ *pro* ha mangiato <Maria> la torta]]]]]]



Furthermore, the copula in vP takes as its complement a 'small clause' (Stowell 1983; Burzio 1986; Moro 1997). The 'small clause' contains a subject and a predicate, the first is a DP (Jayaseelan & Amritavalli 2005), the second is a relative-like CP. Assuming Rizzi (2005), the CP is reduced or truncated, namely the CP projection[15] lacks the Force head. Therefore, the highest available position is the Focus head (Rizzi 2005), which is made available by the copula as landing site for the moved element (Belletti 2008).

[15] Taking into account the internal shape of the CP projection, as stated by several works (Rizzi 1997; Mioto 2003; Benincà & Poletto 2004; Bocci 2004; Grewendorf 2005; Haegeman 2006), the Force head is at the top of the projection, followed by the Focus head, which precedes the Fin head located at the bottom of the projection.

According to Belletti (2008), the cleft pronoun, which is null in Italian (*pro*) and is comparable to *it* in English, *ce* in French, *es* in German, is firstly merged in the CP-small clause as the specifier of a Predication Phrase. Secondly, in order to satisfy the Subject Criterion (Rizzi 2006; Rizzi & Shlonsky 2007), it is moved to the subject position in the matrix clause giving rise to sentences in which the canonical order of constituents is maintained.
Moreover, Belletti claims that the predicate of clefts obligatorily undergoes extraposition: FinP extraposes to a higher position in the clause to remain in the required local configuration with the cleft pronoun after its movement to the matrix clause has occurred (24):

(24) [$_{CP}$ [$_{TP}$ *pro* [$_{vP}$ be [$_{FocP}$ S_{ubj} [$_{PredP}$ <*pro*> *Pred* [$_{FinP}$ che [$_{TP}$ <S_{ubj}> …]]]]]]

Italian also allows so called implicit cleft sentences, with a non-finite embedded clause (16 d-e) and (25).

(25) È LA TIGRE a graffiare il muro
pro is THE TIGER to scratch the wall
'It is THE TIGER that scratches the wall.'

Implicit clefts are more restricted than explicit ones. Indeed, the implicit, infinitival alternative is sometimes preferred to the finite one: often this is due to the possibility of avoiding redundancy effects, which may manifest when the copula and the subordinate verb share the same mood and tense features.
Clefted constituents cannot be resumed by clitic pronouns:

(26) a. Carlo mangia la mela
'Charles eats the apple.'

b. *È LA PERA che la mangia
pro is THE PEAR that DO-CL_{3SF} eats
'*It is THE PEAR that her eats.'

c. È LA PERA che mangia
pro THE PEAR that (he) eats
'It is THE PEAR that he eats.'

This is a property that clearly differentiates cleft sentences from topicalized, left-dislocated object DPs, which obligatorily require clitic resumption (Cinque 1990).

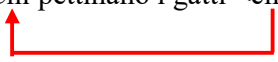
Cleft sentences appear in children's spontaneous language at around the age of 2;0 (Demuth 1984; Labelle 1990; Santos 2006) and, also for this structure, an asymmetry between subject and object clefts has been observed, namely the former are produced more often than the latter (Santos 2006, Del Puppo 2016). The same asymmetry has been found also in the comprehension of these structures (Lampert & Kinsbourne 1980). Accuracy increases as children grow older; at the age of 10, children master cleft sentences quite at ceiling (97%, Hupet & Tilmans 1989).

3.4.1.3. Long-distance wh-questions

Wh-questions have been analysed in several studies (Chomsky 1977; de Villiers et al. 1994; Dabrowska 2004, 2008; Verhagen 2005, 2006; Goldberg 2006, 2008; Dabrowska et al. 2009).

All these studies assume that in long-distance *wh*-questions the *wh*-element undergoes cyclic movement (Chomsky 1977) through the CP nodes of each embedded sentence starting from the position where it is generated/interpreted in the subordinate clause to a new position in the main clause (de Villiers et al. 1994). The examples below compare the number of movements in simple *wh*-questions as in (27) with long-distance *wh*-questions as in (28).

(27) Chi pettinano i gatti <chi>?



who comb the cats <who>?

'Whom did the cats comb?'

(28) Chi Gianni ha detto <chi> che i gatti pettinano <chi>?

who John said <who> that the cats comb <who>?

'Whom John said that the cats comb?'

The *wh*-phrase leaves an unpronounced copy in its base position, and as a consequence of cyclic movement, in the left periphery of each embedded clause.

(29) [$_{CP}$ Quale animale [$_{TP}$ *pro* hai detto [$_{CP}$ <quale animale> che [$_{TP}$ le scimmie grattano [$_{vP}$ <le scimmie> <grattano> <quale animale>?]]]]]

[$_{CP}$ Which animal [$_{TP}$ pro have said [$_{CP}$ <which animal> that [$_{TP}$ the apes scratch [$_{vP}$ <the apes> <scratches> <which animal>?]]]]]

According to Dabrowska et al. (2009), in adults and children's spontaneous speech, long-distance *wh*-questions contain no more than one finite subordinate clause. Moreover, Dabrowska (2004; see also Verhanden 2005) claims that long-distance *wh*-questions are particularly stereotypical structures since, in most of the cases, the subject in the main clause is *you*, the verb is *say* or *think*, and the auxiliary nearly always *do*. In addition to this, the main clause rarely contains an additional element. This type of structures is acquired by children at around 4;0 years or even earlier, in spite of their complexity (de Villiers 1995; de Villiers et al. 1990; Thornton & Crain 1994). However, children's spontaneous speech presents lower rate of produced long-distance dependencies. Nevertheless, studies carried out on the elicited production of long-distance *wh*-questions have demonstrated that 3;0-year-old children are able to produce these structures (Thornton 1990). De Villiers et al. (1994) claimed that in order to acquire long-distance *wh*-questions, children must have acquired some fundamental linguistic abilities. Indeed, they must have developed the CP node; they must already have acquired long-distance movement and cyclic movement; they must be able to distinguish adjuncts from arguments; they must have acquired subcategorization frames for verbs and their complements; they must be able to mark cases across clause boundaries; finally, they must have already learned the requirements and restrictions of *wh*-traces.

3.4.1.4. Oblique and genitive relative clauses

Relative clauses are subordinate clauses which modify a nominal element known as antecedent of the relative clause. Restrictive relative clauses modify the antecedent limiting the number of its referents, as in (30)[16].

(30) Mi piace il bambino che la mamma abbraccia
I-OBL-DAT like the child that the mommy hugs
'I like the child that the mother hugs.'

Assuming Kayne's (1994) Antisymmetry theory, restrictive relative clauses are c-commanded by the determiner; the relative clause is the complement of the determiner (Kayne 1994:87; Bianchi 1999:39), as shown in (31).

[16] Relative clauses can also describe a property of the antecedent. In this case they are identified as appositive relative clauses (Cinque 1988; Andorno 2003):
(i) La maglia, che è rossa, è appesa nell'armadio
'The t-shirt, that is red, is hanging in the wardrobe'
Appositive relative clauses differentiate from restrictive relative clauses also for prosodic and orthographical characteristics. Indeed, appositive relative clauses are pronounced with a descending intonation or a pause after the matrix clause and in writing they are separated from the matrix clause by a comma (Cinque 1988).

(31) [$_{DP}$ D° CP]

The D° head in (31) will be called the 'external determiner' of the relative structure. Moreover, the determiner of the relative 'head' selects the relative CP. Since the 'head' of the relative clause intervenes between the external determiner and the C° head of the relative CP, the only position available for the moved element is in Spec, CP, as shown in (32):

(32) [$_{DP}$ le [$_{CP}$ figlie$_i$ [$_{CP}$ che la mamma abbraccia t$_i$]]]

In standard Italian, subject and object relative clauses are introduced by the complementizer *che*, which is also used to introduce subordinate clauses. Oblique relative clauses are introduced by a relative pronoun, *cui* or *quale* 'which', that pied-pipes a preposition or/and an article with it, as example (33)-(36) show.

(33) *Subject relative clause*
La bambina che <la bambina> lava il cane
the girl that <the girl> washes the dog
'The girl that washes the dog.'

(34) *Object relative clause*
Il cane che la bambina lava <il cane>
the dog that the girl washes <the dog>
'The dog that the girl washes.'

(35) *Oblique relative clause with cui*
Il cane a cui danno un biscotto <cane, cui>
the dog to which (they) give a cookie < the dog, which>
'The dog to which is given a cookie.'

(36) *Oblique relative clause with quale*
La bambina alla quale regalano un gioco < bambina, quale>
the girl to-the which (they) give a toy <the girl, which >
'The girl whom is given a toy.'

Both the structures in (33) and (36) are pied piping relatives (Bianchi 1999) since they presume the movement of the relative pronoun and the DP which they modify. Kayne's (1994) assumptions will be adopted in order to explain the structure of pied piping relative clauses.

Assuming Kayne (1994), as reported by Bianchi (1999), relative pronouns are the original determiners of the relative 'head'. Therefore, as shown by (37), the constituent [$_{DP}$ who [$_{NP}$ boy]] first raises to Spec, CP (37b), then the NP [child] moves to a position that asymmetrically c-commands the relative determiner *who* and is, in turn, c-commanded by the external determiner (37c).

(37) a. [$_{DP}$ the [$_{CP}$ C° I saw [$_{DP}$ who [$_{NP}$ child]]]]
b. [$_{DP}$ the [$_{CP}$ [$_{DP}$ who [$_{NP}$ child]]$_i$ [$_{CP}$ C° [$_{IP}$ I saw t$_i$]]]]
c. [$_{DP}$ the [$_{CP}$ [$_{DP}$ child [$_{DP}$ who t$_{NP}$]]$_i$ [$_{CP}$ C° [$_{IP}$ I saw t$_i$]]]]

The analysis given in (37) can be employed for relative clauses featuring the pied piping of a lexical element along with the relative determiner to Spec, CP. In (38), the relativized phrase is a PP embedded in the relative DP which is preceded by the NP 'head'.

(38) Il film da cui era ossessionato
The movie about which he was obsessed

Kayne's (1994:89) proposal is to apply the analysis in (37) to the sentence in (38) explaining that the NP 'head' raises to the Spec of the pied-piped constituent, leaving behind the relative determiner. Thus, (38) is derived following the steps described in (39).

(39) a. [$_{DP}$ the [$_{CP}$ C° [$_{IP}$ he was obsessed [$_{PP}$ about [$_{DP}$ which [$_{NP}$ movie]]]]]]
b. [$_{DP}$ the [$_{CP}$ [$_{PP}$ about [$_{DP}$ which [$_{NP}$ movie]]] [C° [he was obsessed t]]]]
c. [$_{DP}$ the [$_{CP}$ [$_{PP}$ [$_{NP}$ movie] [$_{PP}$ about [$_{DP}$ which t$_{NP}$]]] [C° [$_{IP}$ he was obsessed t$_{PP}$]]]]

The representations in (37c) and (39c) give the correct linear order of the elements, with the NP 'head' occurring immediately after the external determiner. The final structure is realized through two steps: (i) the relative DP or the pied-piped PP move to Spec, CP; and (ii) the NP moves out of the complement position of the relative D°, and reaches the most prominent specifier position within the relative clause – the one that asymmetrically c-commands everything else within the relative CP.

Children start acquiring oblique relative clauses very late in the language acquisition process. Indeed, to form pied-piping relatives, children need to learn relative pronouns, and this occurs during school

years (McDaniel, McKee & Bernstein 1998; Emonds 1986; Sobin 1997). Guasti and Cardinaletti (2003) assume that learning relative pronouns, and consequently learning pied-piping, is a process similar to what happens in non-early second language acquisition. This can explain the time that children need to learn them and the difficulties they have.

Depending on the register of the conversation, relative clauses may assume two different forms. The first, typical of the spoken-colloquial language, is known as *non-standard* relative clause and is introduced by a complementizer (in Italian *che* 'that') and may contain a resumptive clitic pronoun (40). The second type, mostly used in written language and formal conversation, is called *conventional* relative clause and is introduced a relative pronoun that pied-pipes a preposition with it (41) (Cinque 1988; Guasti & Cardinaletti 2003).

(40) Ho visto il bambino che l'orso lo ha morso
(I) have seen the child that the bear DO-CL_{3MS} has bitten
'I saw the child that the bear has bitten.'

(41) Ho visto la signora il cui figlio l'orso ha morso
(I) have seen the lady whose child the bear has bitten
'I saw the lady whose child the bear has bitten.'

Non-standard relatives are acquired before pied-piping or conventional relatives (Guasti & Cardinaletti 2003). Generally, this order of appearance is due to the fact that pied-piping relatives are avoided in the spoken colloquial language, which is the input that children receive during the early years of language acquisition (Guasti 1994). Moreover, non-conventional relatives are preferred by younger children since they represent an easier structure because of the lack of pied-piping and the presence, sometimes, of a resumptive pronoun. The use of a resumptive pronoun involves the base generation of an empty null operator in Spec, CP that binds the pronominal variable at logical form (LF). As a consequence, in non-conventional relatives containing a resumptive pronoun *wh*-movement does not take place (Haegeman 1994; Guasti 1994; Guasti & Cardinaletti 2003). Italian-speaking children resort to the resumptive strategy mostly in relatives on the indirect object and in genitive and locative relatives, while they never or rarely resort to this strategy in subject relative clauses (Guasti & Cardinaletti 2003). In addition to this, as said above, children do not produce conventional relatives since they must have acquired relative pronouns to correctly produce these sentences.

3.4.2. The task

The sentence repetition task allows a deep analysis of one's expertise of recalling acquired knowledge. Indeed, the repetition of a sentence is not an automated task since it presumes both the comprehension and the production of the heard utterances, and the control of used words (Devescovi et al. 2007) and syntax (Friedmann & Szterman 2011; Szterman & Friedmann 2015; Del Puppo et al. 2016). Therefore, the tested individuals must repeat sentences whose syntactic structure has been presumably already acquired. Differently from other testing methodologies, such as elicitation tasks, the sentence repetition method allows the analysis of different syntactic structures using one and the same task and the control of the correct production of the target sentences (Del Puppo et al. 2016). Moreover, the efficacy of this methodology in detecting syntactic deficits has been demonstrated by previous studies carried out in different populations (patients with agrammatic aphasia: Friedmann & Grodzinsky 1997; Friedmann 2007; children with hearing impairment: Friedmann & Szterman 2011; Szterman & Friedmann 2015; children with SLI: Del Puppo et al. 2016).

The experiment carried out for this research represents the first attempt to use a sentence repetition task for the assessment of syntactic knowledge in Italian-speaking children with hearing impairment and fitted with CIs.

The task used for this experiment is a repetition task developed by Del Puppo et al. (2016) (APPENDIX A). The task contains forty-nine items in total: thirty-three experimental sentences and sixteen filler sentences. Experimental sentences analyse Italian syntactically complex sentences, such as left-dislocated sentences with resumptive clitic pronouns, cleft sentences, long-distance *wh*-questions, oblique and genitive relative clauses. Simple SVO sentences, coordinate sentences, dependent subordinate clauses, passive sentences were used as fillers. More in detail, the task contains:

- Two genitive relative clauses;
- Two oblique genitive clauses;
- Four oblique relative clauses introduced by the pronoun *quale* 'which';
- One oblique relative clause introduced by the pronoun *cui* 'who';
- Four long-distance subject *wh*-questions;
- Eight long-distance object *wh*-questions;
- Six left-dislocated sentences containing a resumptive clitic pronoun;

- Six cleft sentences;
- Sixteen filler sentences.

Sentences contain high-frequency animate and non-animate nouns and active and passive verbs. The following table provides some examples of the structures analysed in the sentence repetition task.

Tab. 7: sentence macrotypes, types and examples of the structures analysed by the sentence repetition task (Del Puppo et al. 2016)

MACROTYPE	TYPE	ITEM	N
Relative clauses	Genitive relatives	*Il postino saluta la signora il cui figlio disegna* The postman greets the lady whose son paints	2
	Oblique genitive relatives	*Il papà guarda il bambino alla cui zia piacciono i gatti* The father looks at the child whose aunt likes cats	2
	Oblique relatives *quale*	*Il cane morde i ragazzi ai quali il nonno compra il gelato* The dog bites the boys to whom the grandfather buys the ice-cream	4
	Oblique relatives *cui*	*La bambina lava il cane a cui il padrone dà i biscotti* The girl washes the dog to whom the owner gives the cookies	1
Long-distance wh-questions	SQ	*Quale gallina hai detto che saluta le pecore?* Which chicken did you say that greets the sheep?	4
	OQ preverbal subject	*Quale coniglio hai detto che i cavalli spingono?* Which bunny did you say that the horses pull?	8
	OQ postverbal subject	*Quale pulcino hai detto che fermano le giraffe?* Which chick did you say that stop the giraffes?	
Left-dislocated sentences with resumptive clitic pronouns	Number match	*La bambola, il bambino la pettina sempre* The doll, the boy combs her always	4
	Number mismatch	*I leoni, il pinguino li colpisce forte* The lions, the penguin hits them heavy	2
Cleft	Subject	*È La GALLINA che viene picchiata dalla pecora!* It is the CHICKEN that the sheep hits!	4
	Object	*È la MOSCA che gli uccelli mangiano!* It is the FLY that eat the birds!	2
Filler		*Il signore bagna i ragazzi e il lupo mangia una banana* The man wets the boys and the wolf eats a banana	16

The aim of the task is to investigate the nature of potential errors during repetition, whether due to the lack of competence of the syntactic structure, or to reduced memory resources. For this reason, the experimental sentences were matched to filler sentences on the basis of the number of syllables contained in each sentence. This expedient is useful to detect errors ascribed to language-external factors such as memory or attention (Friedmann & Szterman 2011; Szterman & Friedmann 2015).

Indeed, if both the experimental sentence and the filler sentence of the same length are inaccurately repeated, the error may be due to memory. If the repetition of filler sentences is accurate and the repetition of the experimental sentences is not, the problem may be due to the syntactic complexity of the sentence (Friedmann & Szterman 2011; Szterman & Friedmann 2015).
The following table offers some examples of length-matched experimental and filler sentences and it reports the number of syllables of each sentence.

Tab. 8: Number of syllables contained in each macrotype and related examples.

SYLLABLES	MACROTYPE	ITEM
12	**Cleft**	*È il CAMMELLO a tirare la mucca!*
		It is the CAMMEL that pulls the cow!
	Filler	*La nonna vuole mangiare una pera*
		The grandmother wants to eat a pear.
14	**Left-dislocated sentences with resumptive clitic pronouns**	*La bambola, il bambino la pettina sempre*
		The doll, the boy combs her always
	Filler	*Il bambino gioca al parco con l'aquilone*
		The boy plays with the kite in the park
16	**Long-distance wh-questions**	*Quale gallina hai detto che sgridano le papere?*
		Which chicken did you say that the goats scold?
	Filler	*La nonna ha detto che domani compra il giornale*
		The grandmother said that she will buy the newspaper tomorrow
16	**Cleft**	*È la GALLINA che viene picchiata dalla pecora!*
		It is the chicken that is beaten by the sheep!
	Filler	*Il papà ha detto che oggi passeggia con il cane*
		Daddy said that he will go for a walk with the dog
19	**Genitive relatives**	*Il maestro pettina la signora la cui figlia lavora*
		the teacher combs the lay whose daughter works
	Filler	*Il gatto salta la corda e morde il panino col salame*
		The cat jumps the rope and bite a salami sandwich
21	**Oblique relatives**	*Il lupo guarda la bambina alla quale la nonna dona un fiore*
		The wolf looks at the girl to whom the grandmother gives a flower
	Filler	*Il papà guida la macchina e la cugina ascolta la musica*
		Daddy drives the car and the cousin listens to the music

The task was administered during a single session. Since the sentence repetition task allows a pause in the middle, the first part (sentences 1-25) was administered at the very beginning of the assessment session, the second part (sentences 26-49) was administered at the end of the assessment.
Before starting the sentence repetition task, the experimenter informed the participants not to pay much attention to the meaning of the sentences, but rather to focus on the intonation and the words uttered. To provide a fruitful example, the experimenter called the sentence repetition task the

'Parrot's game'. Indeed, as parrots repeat each sentence they ear, the participants were asked to do the same. Sentences were read aloud by the experimenter and participant could ask to ear the utterance no more than twice. Productions were audiotaped, then transcribed in an Excel file.

3.4.3. Participants

For this experiment, the results of part of the participants from both the experimental and the control group were considered. As brought forward in section 3.2., the experimental and the control groups do not have the same chronological age. Moreover, not all the participants completed all the tasks administered during the assessment part of this experiment.

The data related to thirteen children fitted with CIs were considered for this experiment. Participants ranged in age from 7;10 to 12;10 (mean age: 9;9). They were diagnosed and fitted with HAs between birth and the first year of life. They successively received a CI between 1;0 year and 9;8 years. All participants are bilateral stimulated; hence they have two CIs or a CI and a contralateral HA, except for VZ who resort only to a CI. Participants were from several regions of Italy and were selected and tested at the ENT Clinic. The following table resumes the main characteristics of the participants with CIs involved in this experiment.

Tab. 9: personal and clinical data of the participants with CIs at the sentence repetition task. (ID=identity; HL= hearing loss; CI= cochlear implant)

ID	Age	Sex	HL Type	Age of HA	Age of CI	Length of use of CI	Type of stimulation	Controlateral stimulation	Speech therapy	Area of provenance in Italy
SV	8;2	F	sensorineural	*	1;2	7;0	Bilateral	CI	Yes	North
RB	10;2	F	sensorineural	1;0	9;8	0;4	Bilateral	HA	Yes	North
MS	10;0	M	sensorineural	0;5	1;2	8;8	Bilateral	HA	Yes	North
VZ	7;10	F	sensorineural	0;2	1;6	6;4	Monolateral	/	Yes	North
GT	8;6	M	sensorineural	0;7	4;7	3;9	Bilateral	HA	Yes	North
MG	11;6	F	sensorineural	0;6	6;7	4;9	Bilateral	HA	No	North
MM	9;9	F	sensorineural	0;5	2;9	7;0	Bilateral	CI	Yes	North
DB	12;10	M	sensorineural	0;10	6;7	6;3	Bilateral	CI	No	North
CO	8;4	F	sensorineural	*	1;1	7;3	Bilateral	CI	No	North
AR	10;4	F	sensorineural	*	2;2	8;2	Bilateral	HA	Yes	North
AZ	10;5	M	sensorineural	0;6	2;3	8;2	Bilateral	CI	Yes	North
FZ (2)	10;5	F	sensorineural	0;6	7;3	3;2	Bilateral	HA	No	North
ER	8;6	F	sensorineural	0;6	1;0	7;6	Bilateral	CI	No	Centre

The performance of the experimental group was compared with the performance of a control group (TD group) composed of ten typically developing children with normal-hearing matched on similar chronological age. TD children ranged in age from 7;10 to 12;1 years (mean age: 9;6). Children came

from several regions of Italy. The following table summarizes the main information about the control group.

Tab. 10: main information about the control group. (ID=identity)

ID	Age	Sex	Area of Provenance in Italy
SA	10;11	F	North
AO	7;10	M	North
PN	9;5	M	North
MM	10;3	F	North
FED	12;1	M	Centre
EM	10;4	F	North
GD	9;7	F	Centre
AN	8;3	M	Centre
AP	8;8	F	North
GDA	8;1	F	North

3.4.4. Results

In this section, the data collected through the sentence repetition task are analysed.

Differently from previous studies done using the same sentence repetition task (Del Puppo et al. 2016; Carbonara 2017; Grasso 2017; Piccoli 2018), where were analysed as correct only responses that perfectly matched the experimental stimuli, in this experiment a wider range of sentences were considered. For example, in this experiment sentences with the substitution of a word or a preposition were considered, as well as sentences which displayed a different word order (as far as such order did not invalidate the target structure of the experimental items)[17].

Sentences were instead considered incorrect and scored as 0 when they presented one or more of the following errors: ungrammaticality or incompleteness, use of wrong prepositions[18], wrong number

[17] Most of the sentences containing a substitution in the word order concerned the adverb position in the sentence as shown in the examples (ii-vi) below.
Adverbs have a free distribution in the syntactic structure, hence they can be placed in each position of the sentence by only varying the prosody (Donati 2002):
(ii) *Il maestro ha deciso che **oggi** mangia la frutta*
'The teacher decided that **today** eats fruits'
(iii) *Il maestro **oggi** ha deciso che mangia la frutta*
'The teacher **today** decided to eat fruits'
(iv) *Il maestro ha deciso **oggi** che mangia la frutta*
'The teacher decided **today** to eat fruits'
(v) *Il maestro ha deciso che mangia **oggi** la frutta*
'The teacher decided that eats **today** fruits'
(vi) *Il maestro ha deciso che mangia la frutta **oggi***
'The teacher decided that eats fruits **today**'

[18] The substitution of a preposition was analysed as correct or incorrect depending on the grammaticality of the uttered sentence. Therefore, if the child produced the sentence *il gatto salta la corda e morde il panino al salame* 'the cat jumps the rope and bites the sandwich to the salami' instead of *il gatto salta la corda e morde il panino col salame* ' the cat jumps the rope and bites the sandwich with the salami' the sentence was considered as correct since the former strategy is grammatical in Italian. But if the child produced the sentence *il postino saluta la signora in cui il figlio disegna* 'the

and gender agreements, wrong prosody, substitution of a word giving rise to an ungrammatical sentence, substitution of the pronoun *quale* for *cui* and also the other way around, inversion of the head of the sentence, inversion of theta roles, production of sentences with an easier structure than the experimental sentences, and other strategies, such as the use of resumptive pronouns in relative clauses.

The CI group produced 493 correct sentences out of 637 items (77%), while the TD group produced 408 correct responses out of 490 items (83%). Table 11 offers a general overview of the correct responses given by the participants of both groups. The rest of the section will be devoted to a more detailed analysis of each type of sentence.

Tab. 11: Number(N), proportion, and standers deviation (SD) of the correct responses provided by the experimental and the control groups in the sentence repetition task. (SQ= subject questions; OQ=object question)

MACROTYPE	CI group			TD group		
	N	Proportion	SD	N	Proportion	SD
Left-dislocated	66/78	0.85	0.36	53/60	0.88	0.32
Cleft	51/78	0.65	0.48	56/60	0.93	0.25
Long-distance SQ	46/52	0.88	0.32	40/40	1.00	0
Long-distance OQ	87/104	0.84	0.37	77/80	0.96	0.19
Oblique/Genitive relatives	43/117	0.37	0.48	24/90	0.27	0.44
Filler	200/208	0.96	0.19	158/160	0.99	0.11
Total	**493/637**	**0.77**		**408/490**	**0.83**	

Following Dixon (2008) and Jaeger (2008), a repeated logistic regression analysis was carried out in order to analyse accuracy, using the statistical software R (R Development Core Team, 2018, R Version 3.5.0) [19]. The repeated logistic regression was chosen due to the categorical (dichotomic) nature of the collected data, which were analysed in a mixed model in which a model including the predictor is contrasted against a model without it using a χ^2-test (Jaeger, 2008). First, an analysis was carried out in which the independent fixed factors were group (CI vs. TD) and sentence macrotype (left-dislocated sentences, cleft sentences, long-distance subject *wh*-questions, long-distance object *wh*-questions, oblique/genitive relatives, filler sentences). The dependent variables were accuracy and

postman greets the lady in which the son draws' instead of *il postino saluta la signora il cui figlio disegna* 'the postman greets the lady whose child draws' the utterance was considered as incorrect since the former sentence is ungrammatical in Italian.

[19] Categorical data are usually analysed through ANOVAs. However, Dixon (2008) and (Jaeger (2008) suggested the use of mixed logit models since resorting to ANOVAs for categorical outcomes can lead to incorrect interpretations of results. The use of mixed logit models has two main advantages: (i) to overcome the problems arising from the use of accuracy data transformed into proportions, which causes a loss of information as for the number of observations that contribute to the proportion (Baayen 2008); (ii) random subject and item effects are included in the model (Baayen et al., 2008; Jaeger, 2008), thus allowing simultaneous analyses of both experimental fixed effects and individual and/or item (random) differences associated with them. Moreover, mixed models are robust against normality violations (Gelman & Hill 2007).

the several response strategies (lexical substitution, preposition substitution, word order substitution, production of uncomplete/ungrammatical sentences, wrong agreement, wrong prosody, substitution of the *wh*-element, head inversion, Theta-role inversion, production of simple sentences). Random factors were subjects and item. Overall, the two groups statistically differ in the use of correct prosody, namely TD children were more accurate than children with CIs (Wald Z=-2.049, p=.04). Furthermore, some marginally significances were found in the substitution of *quale* 'which' for *cui* 'who', which was more frequent in the TD group (Wald Z=1.932, p=.053), and in the higher frequency of simple SVO sentences in the CI group (Wald Z=-1.812, p=.07). Analysing the accuracy of the responses in the different sentence macrotypes, it was found that, within groups, filler sentences were repeated more accurately than the other sentence macrotypes, except for long-distance subject *wh*-questions (filler vs. cleft sentences: Wald Z=-5.764, p<.001; filler vs. left-dislocated sentences: Wald Z=-4.066, p=<.001; filler vs. long-distance object *wh*-questions: Wald Z=-3.559, p=.0003; filler vs. restrictive genitive relatives: Wald Z=-7.956, p<.001; filler vs. oblique relatives: Wald Z=-11.150, p<.001).

Furthermore, a statistical analysis was carried out comparing accuracy and clinical variables (age at HA, age a CI, length of se of CIs), but the outcomes did not highlight any significance.

After this first within groups analysis, a statistical analysis was conducted for each group within sentence macrotype to compare accurateness between experimental sentences and filler sentences. We also analysed whether a significance existed between the different structures contained in each macrotype. Also in this case a repeated logistic regression analysis was carried out.

Table 12 provides the results related to the correct responses in the repetition of left dislocated sentences containing clitic pronouns compared with the repetition of filler sentences of the same length (fourteen syllables). As the table shows, the control group had a better performance than the experimental group in the repetition of filler sentences and left-dislocated sentences containing a number match condition.

Tab. 12: Number and proportion of correct responses in sentences containing 14 syllables. (Left-disl=left-dislocation; dislM=left-dislocated sentence with number match condition; dislMM=left-dislocated sentences with number mismatch condition)

	CI-group		**TD-group**	
	N	**Proportion**	**N**	**Proportion**
LEFT-DISL	66/78	0.85	53/60	0.88
- **dislM**	42/52	0.87	38/40	0.95
- **dislMM**	21/26	0.81	15/20	0.75
FILLER (14 syllables)	38/39	0.97	30/30	1.00

For this piece of data, a statistical analysis was conducted between the experimental sentences and the filler sentences, and between the two conditions investigated within the experimental sentences,

namely the match and mismatch number conditions[20]. It was found that children with CIs had a better performance in the repetition of filler sentences than left-dislocated sentences (Wald Z=1.951, p=.05). A further significant difference was found in the CI group, hence left-dislocated sentences with number mismatch condition were repeated less accurately than filler sentences (Wald Z=2.085, p=.03). In the TD group, left-dislocated sentences with a match condition were significantly more accurate than left-dislocated sentences with a mismatch number condition (Wald Z=-2.073, p=.04). Table 13 shows the strategies adopted by children with CIs and children with TD when they repeated experimental sentences wrongly. As the table exemplify, children with CIs were the only participants to produce sentences with inverted theta roles or sentence with an easier structure than the experimental sentence uttered by the experimenter.

Tab. 13: strategies adopted by the participants when they repeated the wrong sentence

	CI group		**TD group**	
	N	**Proportion**	**N**	**Proportion**
Ungrammatical/incomplete				
La bambina, le signore salutano spesso	5/78	0.07	3/60	0.05
The girl, the ladies greets often				
Wrong agreement				
Il postino, il cane lo mordono ogni giorno	2/78	0.03	4/60	0.07
The postman, the dog him bite-pl everyday				
Theta inversion				
La bambina, il signore lo saluta spesso	1/78	0.01	---	---
The girl, the man him greets often				
Simple sentences				
La bambina saluta il signore spesso	3/78	0.04	---	---
The girl greets the man often				

The sentence repetition task investigates three types of cleft sentences, namely subject clefts with infinitival subordinate clause (Inf_Cleft), object clefts (Obj_Cleft), and passive clefts (Pass_Cleft). Both Inf_cleft and Obj_Cleft are twelve syllables long, while Pass_cleft are sixteen syllables long. Table 14 presents the results related to the repetition of cleft sentences compared with filler sentences. Also here the control group performed generally better than the experimental group. Noticeable is the difference between children with CIs and children with TD in the repetition of passive cleft sentences. Indeed, TD group were more accurate in the repetition of this structure than CI group.

[20] In the match number condition both the subject and the object of the sentence present the same number feature, for example they are both singular, while in the mismatch number condition the subject and the object present different number features.

Tab. 14: number (N) and proportion of correct repetition of cleft sentences. (Inf_cleft=infinitival cleft; Obj_Cleft=object cleft; Pass_Cleft=passive cleft)

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
CLEFT	38/52	0.73	38/40	0.95
- **Inf_Cleft (12 syllables)**	14/26	0.54	19/20	0.95
- **Obj_Cleft (12 syllables)**	24/26	0.92	19/20	0.95
FILLER (12 syllables)	26/26	1.00	20/20	1.00
Pass_Cleft (16 syllables)	13/26	0.50	18/20	0.90
FILLER (16 syllables)	88/91	0.97	68/70	0.97

The statistical analysis run out for these results pointed out some significance within the two groups. children with CIs were more accurate in the repetition of filler sentences than cleft sentences (filler vs. cleft (12 syllables): Wald Z=800.4, p<.001; filler vs. cleft (16 syllables): Wald Z=-4.785, p<.001). Moreover, the better performance in the repetition of Obj_Cleft over Inf_Cleft in the CI group was confirmed by the statistical analysis (Wald Z=-2.762, p=.005).

When children with CIs wrongly repeated experimental sentences, they produced ungrammatical or incomplete sentences, sentences without the typical prosody of cleft sentences, easier structures than the target one, or other strategies concerning, in this case, the production of sentences in which the non-finite verb was turned into a finite verb. These strategies were never found in the TD group, except for prosody errors.

Tab. 15: strategies adopted by the participants when they produced a sentence other than the target cleft sentence

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
Ungrammatical/incomplete				
È la mucca fermano i maiali	3/78	0.04	---	---
Is the cow stop the pigs				
Wrong prosody				
È la gallina che viene picchiata dalla pecora	18/78	0.23	4/60	0.07
Is the chicken that is beaten by the sheep				
Easier structure				
La gallina viene picchiata dalla pecora	1/78	0.01	---	---
The chicken is beaten by the sheep				
Other				
È la MUCCA che ferma il maiale!	5/78	0.06	---	---
Is the cow that stops the pig!				

In the repetition of long distance *wh*-questions, the performance of children with CIs was worse than that of their age peers with TD. Moreover, the experimental group showed the typical asymmetry between subject and object *wh*-questions, namely that the former are easier than the latter. The

following table shows the number and proportions of the correct responses given by the participants of both groups.

Tab. 26: number (N) and proportion of correct repetitions of long-distance wh-questions. (SQ=subject question; OQ=object questions; -SETRESTR=indefinite noun; +SETRESTR=definite noun)

	CI-group		TD-group	
	N	**Proportion**	**N**	**Propoprtion**
SQ (16 syllables)	46/52	0.88	40/40	1.00
- **SQ-SETRESTR**				
Quale persona hai detto che saluta i ragazzi?	24/26	0.92	20/20	1.00
Which person did you say that greets the boys?				
- **SQ+SETRESTR**				
Quale maiale hai detto che solleva i cavalli?	22/26	0.85	20/20	1.00
Which pig did you say that lifts the horses?				
OQ_Sprev (16 syllables)	87/104	0.84	77/80	0.96
- **OQ_SV-SETRESTR**				
Quale persona hai detto che i dottori curano?	22/26	0.85	17/20	0.85
Which person did you say that the doctors nurse?				
- **OQ_SV+SETRESTR**				
Quale leone hai detto che i maiali tirano?	21/26	0.81	20/20	1.00
Which lion did you say that the pigs pull?				
- **OQ_VS-SETRESTR**				
Quale persona hai detto che bagnano i gatti?	21/26	0.81	20/20	1.00
Which person did you say that the cats wet?				
- **OQ_VS+SETRESTR**				
Quale pulcino hai detto che fermano le giraffe?	23/26	0.88	20/20	1.00
Which chick did you say that the giraffes stop?				
FILLER (16 syllables)	88/91	0.97	68/70	0.97

The CI group was significantly more accurate in the repetition of filler sentences than long-distance subject *wh*-questions (Wald Z=-2.157, p=.03). In particular, filler sentences were more accurate than long-distance object *wh*-questions (Wald Z=-3.098, p=.002). The several typologies of long-distance subject and object *wh*-questions were compared with filler sentences and the outcomes showed that children with CIs are more accurate in the repetition of filler sentences than SQ+SETRESTR (Wald Z=-2.454, p=0.01); OQ_SV-SETRESTR (Wald Z=-2.454, p=.01); OQ_SV+SETRESTR (Wald Z=-2.923, p=.003); OQ_VS-SETRESTR (Wald Z=-2.923, p=.003); OQ_VS+SETRESTR (Wald Z=-1.873, p=.06). In the TD group, a marginally significant difference was found between filler sentences and OQ_SV-SETRESTR (Wald Z=-1.895, p=.06), the former being more accurate than the latter.

When children with CIs were asked to repeat long-distance *wh*-question, they resorted to several strategies in order to avoid this complex structure. Strategies found in the experimental group were never or rarely found in the performance of children with TD of the same chronological age. The

strategies used by the CI group are sentences with an easier structure than the target one; sentences in which the theta roles were inverted (i.e. the production of a subject question instead of a target object question); ungrammatical or incomplete sentences; sentences with wrong number and/or gender agreement; sentences in which the lexical substitution give rise to an ungrammatical sentence. The table below provide some examples of the strategies when the target sentence was not correctly repeated.

Tab. 37: strategies used when the long-distance wh-question was not correctly repeated.

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
LONG-DISTANCE SUBJECT QUESTIONS				
Theta inversion				
Quale maiale hai detto che sollevano i cavalli?	2/52	0.04	---	---
Which pig did you say that the horses lift?				
Easier structure				
Quale gallina saluta le pecore?	4/52	0.08	---	---
Which chicken greets the sheep?				
LONG-DISTANCE OBJECT QUESTIONS				
Ungrammatical/incomplete				
Quali leoni hai detto che tirano?	3/104	0.03	2/80	0.03
Which lions did you say that pull?				
Wrong agreement				
Quale persona hai detto che il dottore curano?	1/104	0.01	---	---
Which person did you say that the doctor look-pl after?				
Lexical substitution				
Quale gallina hai detto che scrivono le papere?	4/104	0.04	---	---
Which chicken did you say write the ducks?				
Theta inversion				
Quale animale hai detto che bagna i gatti?	1/104	0.01	---	---
Which animal did you say that wets the cats?				
Easier structure				
Quale pulcino ha detto che ferma le giraffe?	7/104	0.07	---	---
Which chick said that stops the giraffes?				

The last structures assessed by the sentence repetition task are genitive and oblique relative clauses. Genitive relatives are nineteen syllables long, while oblique relatives are twenty-one syllables long. The task investigates three types of oblique relative clauses, namely oblique relatives introduced by the pronoun *cui*, oblique relatives introduced by the pronoun *quale*, and oblique genitive relative clauses. As table 18 shows, these structures were the most difficult for both the experimental and the control groups. Moreover, the control group performed lower than the experimental group, who had a slightly better performance than their age peers with TD.

Tab. 18: number and rate of correct responses in the repetition of relative clauses (Gen_rel=genitive restrictive relative clauses; Obl_rel=oblique restrictive relative clauses; Obl_rel_CUI=oblique relative clauses introduced by cui; Obl_rel_QUALE=oblique relative clauses introduced by quale; Obl_rel_GEN=genitive oblique relative clauses)

	CI-group		TD-group	
	N	**Proportion**	**N**	**Proportion**
GEN_REL (19 syllables)	11/26	0.42	7/20	0.35
FILLER (19 syllables)	12/13	0.92	10/10	1.00
OBL_REL (21 syllables)	32/91	0.34	17/70	0.24
- **Obl_rel_CUI**	8/13	0.62	5/10	0.50
- **Obl_rel_QUALE**	18/52	0.35	5/40	0.13
- **Obl_rel_GEN**	6/26	0.23	7/20	0.35
FILLER (21 syllables)	34/39	0.87	30/30	1.00

The statistical analysis carried out for this piece of data showed a significance in the accurateness of filler sentences compared to genitive restrictive relative clauses (CI group: Wald Z=-2.017, p=.04; TD: Wald Z=-2.029, p=.04). A further significance was found between filler and oblique relative clauses (CI group: Wald Z= -4.375, p<.001; TD group: Wald Z=-3.813, p<.001). The statistical analysis evidenced also a significance in the accuracy of the repetition of filler sentences compared to the other typologies of oblique relatives in both the experimental and the control groups (CI group: filler vs. Obl_rel_CUI: Wald Z= -2.596, p<.001; filler vs. Obl_rel_QUALE: Wald Z=-4.843, p<.001; filler vs. Obl_rel_GEN: Wald Z=-4.940, p<.001; TD group: filler vs. Obl_rel_CUI: Wald Z=2.728, p=.006; filler vs. Obl_rel_QUALE: Wald Z=-5.245, p<.001; filler vs. Obl_rel_GEN: Wald Z=-3.748, p<.001). The outcomes also showed that for both CI group and TD group the repetition of Obl_rel_CUI sentences was more accurate than that of Obl_rel_QUALE (CI group: WaldZ=-1.957, p=.05; TD group: Wald Z=-2.454, p=.01). Furthermore, the statistical analysis pointed out better performance of Obl_rel_CUI than Obl_rel_GEN in the CI group: Wald Z=-2.528, p=.01), and the better performance of Obl_rel_GEN than Obl_rel_QUALE in the TD group (Wald Z=-1.982, p=.04). Both CI and TD children resorted to several strategies in order to avoid the repetition of genitive and oblique relative clauses. The high rates of errors are related to the production of a wrong preposition. Both the experimental and the control groups produced a high percentage of ungrammatical sentences. Children from both groups also substituted the pronoun *quale* for the pronoun *cui* and the other way around. In this last case, it is worth mentioning that, even though children with TD replace the pronoun *quale* with *cui*, most of them still produced grammatical sentences. A further strategy used especially by children with CIs is the production of sentences with an easier structure.

Tab. 19: strategies used during the repetition of relative clauses

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
GENITIVE RELATIVES				
Ungrammatical/incomplete				
La signora saluta il bambino il postino il cui bambino disegna	3/26	0.12	3/20	0.15
The lady greets the boy the postman whose the boy paints				
Wrong preposition				0.45
Il maestro pettina la signora in cui la figlia disegna	10/26	0.38	9/20	
The teacher combs the lady in whose the daughter paints				
Cui>quale				
Il maestro pettina la signora il quale la figlia lavora	1/26	0.04	---	---
The teacher combs the lady which daughter works				
Easier structure				
Il maestro pettina la signora e la figlia lavora	1/26	0.04	---	---
The teacher combs the lady and the daughter works				
Other				
Il maestro pettina la signora la quale lavora	---	---	1/20	0.03
The teacher combs the lady who works				
OBLIQUE RELATIVES				
Ungrammatical/incomplete				
La mamma bacia la bambina in cui gli piacciono le tigri	20/91	0.22	10/70	0.14
The mommy kisses the girl in who him likes the tigers				
Wrong preposition				
La bambina lava il cane con cui il padrone gli dà i biscotti	14/91	0.15	15/70	0.21
The girl washes the dog with which the owner gives him the cookies				
Wrong agreement				
la mamma bacia la bambina al cui fratelli piacciono le tigri	5/91	0.5	4/70	0.06
the mommy kisses the girl whose brothers likes the tigers				
quale>cui				
Il topo tocca il ragazzo in cui il papà ha portato un gioco	14/91	0.15	20/70	0.29
The mouse touches the boy in which the daddy brought a toy				
cui>quale				
La bambina lava il cane il quale padrone dà i biscotti	2/91	0.02	1/70	0.01
The girl washes the dog which owner gives the cookies				
Easier structure				
Il lupo guarda la bambina e la donna dona un fiore	3/91	0.03	1/70	0.01
The wolf looks at the girl and the lady gives a flower				
Other				
Il topo tocca il ragazzo al quale il papà gli porta un regalo	1/91	0.01	1/70	0.01
The mouse touches the boy to whom the daddy brings a present to him				

3.4.5. Discussion

In this section, we analyse the data collected in the sentence repetition task (Del Puppo et al. 2016) administered to two groups: The experimental group composed of thirteen children with a hearing impairment and fitted with a CI (CI group) and a control group composed of ten children with normal hearing and typical development (TD group) matched on chronological age.

The sentence repetition task allows the examination of several syntactic structures using one and the same task. Repetition is not an automated task since it implies both comprehension and production of sentences whose structures have already been acquired (Friedmann & Szterman 2011; Szterman & Friedmann 2015; Del Puppo et al. 2016). The task used for this experiment analyses several sentences: left-dislocated sentences containing resumptive clitic pronouns, cleft sentences, long-distance subject and object *wh*-questions, genitive and oblique relative clauses. The task was divided into two parts: the first (sentences 1-25) was administered at the beginning of the assessment session, the second part (sentences 26-49) was administered at the very end of the same session.

Taking into account that the task is very demanding for both children with CIs and TD, and that it was administered together with other three tasks, it was decided to count as correct, giving a score equal to 1, not only perfectly repeated sentences, but also those utterances in which the target syntactic structure was not changed but the participant changed a word, a preposition[21] or inverted the position of a word, usually an adverb.

Overall, the TD group performed better than the CI group in the repetition of all the structures investigated by the sentence repetition task. The most problematic structures for children with CIs were cleft sentences and long-distance *wh*-questions, in which the rate of correctness was notably lower than their TD age peers (i.e. cleft sentences CI: 62%, TD: 95%; long-distance *wh*-questions CI: 86%, TD: 98%). Both groups showed many difficulties in the repetition of restrictive genitive and oblique relative clauses.

We will now analyse each structure in turn. In left-dislocated sentences containing resumptive clitic pronouns, the general performance of children with CIs was lower than the performance of their TD controls (CI: 85%, TD: 88%). When children did not correctly repeat the experimental sentences, they made several errors, such as ungrammatical or incomplete sentences, sentences with wrong number and gender agreement, sentences in which the theta roles were inverted, and sentences with an easier syntactic structure (e.g. SVO simple sentences). The difficulties related to the repetition of this structure may be ascribed to the two movements involved in the structure. The first concerns object, which is moved to the left periphery of the sentence. The second movement is the cliticization

[21] As said before, the substitution of a preposition was counted as correct when the participant uttered a grammatical sentence. On the contrary, the substitution of the preposition was scored as 0 if the result was an ungrammatical sentence.

process which, assuming Belletti (1999) follows two steps: (i) a phrasal movement involving the DP whose head is the DO clitic pronoun, and (ii) a head movement incorporating the clitic pronoun into the relevant inflectional head. These two movements prevent the correct interpretation of left-dislocated sentences containing clitic pronouns. The difficulties in the repetition of these sentences are not ascribable to an impairment of memory since filler sentences of the same length are correctly repeated.

As said before, cleft sentences represented one of the most impaired structures for children with CIs. The task investigates three types of cleft sentences, namely subject clefts with infinitival subordinate clause, object clefts, and passive clefts. The most problematic structures for the participants with CIs were cleft sentences with infinitival subordinate clauses and passive clefts. Even though infinitival clefts are sometimes preferred to finite ones, since they avoid redundancy effects (Del Puppo 2016), they were found particularly problematic in the repetition by children with CIs. This result is probably due to the fact that clefts with infinitival are structures typical of the formal register. Indeed, among the strategies used by children with CIs in order to avoid the repetition of infinitival clefts, we find substitution of the infinitival verb for a finite verb (subject cleft with *che*+finite verb). The difficulties in the repetition of passive clefts may be related to the presence of two movements: (i) the A movement involved in the derivation of the passive sentence, and (ii) the A' movement of the subject to a position in the left periphery of the sentence. Errors may also be explained by the fact that children produced an easier structure only with A movement involved in the derivation of passive sentences. Moreover, the problem in the repetition of cleft sentences with passive cannot be ascribed to a difficulty in the derivation of the passive form, since filler sentences containing passive verbs are correctly repeated by all participants. Therefore, also in this case it is possible to hypothesize that the difficulties in the repetition of passive clefts are ascribable to the complexity derived by the combination of the passive voice and the cleft structure. Finally, it is possible to assume that problems related to the repetition of cleft sentences are not caused by the presence of a cleft structure, since children with CIs correctly repeated object clefts.

Like cleft sentences, long-distance *wh*-questions resulted to be more impaired in the performance of CI children. This result is probably due to the complex structure of long-distance *wh*-questions in which the *wh*-element is generated in a subordinate clause that is not adjacent to the main clause, so the *wh*-item and the position where it was generated are separated by a variable number of clauses. For this reason, the element undergoes cyclic movement through the CP nodes of each embedded clause when it moves from its base position to a new position in the main clause (de Villiers et al. 1994). Assuming the Derivational Complexity Hypothesis (DCH) proposed by Jakubowicz (2004,

2005), children acquire less complex structures first. Complexity is measured by the Derivational Complexity Metric (DCM, Jakubowicz 2005):

- Merging α n times gives rise to a less complex derivation than merging α (n+1) times.
- Internal merge of α gives rise to a less complex derivation than internal merge of α+β.

In deriving *wh*-questions, the child is sensitive to the number of times that a copy of the *wh*-element is merged to satisfy a computational requirement and to the number of constituents that may (or must) undergo internal merge. If, as proposed by the DCH and according to the first clause of the DCM, children acquire less complex derivations first, it is expected that *wh*-questions involving no internal merge of the *wh*-element, or a smaller number of internal merges will emerge before other structures containing a higher number of movements. Furthermore, according to the second clause of DCM, children will initially prefer structures where only one constituent undergoes internal merge in the left periphery of the clause. This hypothesis is supported by the strategies adopted by children with CIs to avoid the repetition of long-distance *wh*-questions, namely they produced sentences with an easier structure such as simple *wh*-questions (*Quale gallina colpisce i pulcini?* 'Which chicken hits the chicks?' instead of *Quale gallina hai detto che colpisce i pulcini?* 'Which chicken did you say that hits the chicks?'). Moreover, children from both the experimental and the control groups showed a better performance in the repetition of long-distance subject *wh*-questions than long-distance object *wh*-questions. This result is in line with previous studies focused on the production and comprehension of simple *wh*-questions which demonstrated that *wh*-questions involving the movement of the subject are easier to process than *wh*-questions involving the movement of the object.

The last structures assessed by the sentence repetition task are restrictive genitive and oblique relative clauses. These structures were problematic for all the participants in this experiment. It is possible to suggest that the difficulty relies on the double movement that characterises the structure. Indeed, following Kayne (1994) and Bianchi (1999), pied-piping relatives are realized through two steps: (i) the relative DP or the pied-piped PP move to Spec, CP; successively (ii) the NP contained in the relative D° moves out of the complement position and reaches the highest specifier position within the relative clause in order to asymmetrically c-command everything else within the relative CP. As a support to this hypothesis it is possible to recall some of the strategies used by children from both the experimental and the control groups who produced sentences with an easier structure than repeating genitive or oblique relative clauses. These structures also presented a high rate of ungrammatical or incomplete sentences. Interestingly, children also replaced the relative pronoun

quale with the relative pronoun *cui*. This strategy was largely found in TD children's performances. It is possible to assume that this type of substitution is due to the fact that the relative pronoun *cui* is more economic than *quale* since it does not involve number and gender agreement with its antecedent. Concluding this section, the outcomes of this experiment are in line with previous studies analysing the repetition of complex syntactic structures in populations with typical development and language impairments (Friedmann & Szterman 2011; Szterman & Friedmann 2015; Del Puppo et al. 2016). Indeed, the experimental group showed a lower performance than the control group. Moreover, the length of sentences has not been found problematic in either group since filler sentences are correctly repeated. Experimental structures have been shown to be problematic since they involve double movement of constituents, thus involving a heavier computational work for children with CIs.
We conclude that the sentence repetition task has been useful to highlight differences in the response strategies between children with CIs and children with TD: production of shorter *wh*-questions; omission of the complementizer *che*; production of a finite verb instead of a finite one; production of simple SVO sentences instead of long-distance dependency structures.

3.5. THE ELICITATION AND THE COMPREHENSION OF SUBJECT AND OBJECT RELATIVE CLAUSES

This section reports data collected with two tests, namely the preference task and the character selection task. Each task respectively assesses the production and the comprehension of subject and object restrictive relative clauses. Both tasks were developed by Volpato (2010). Since the two tasks focus on the same structures, it was decided to unify the analysis in the same section. Italian restrictive subject and object relative clauses will be described in section 3.5.1. Section 3.5.2 is dedicated to the description of the task used to elicit the production of relative clauses. Then, in section 3.5.3, the participants in this experiment and the data collected will be presented. Section 3.5.4 presents the results of the preference task. Section 3.5.5 is devoted to the description of the agent selection task, while the participants involved in this experiment are presented in section 3.5.6. Then the data collected will be presented in section 3.5.7. A general discussion concludes the analysis of the production and comprehension of restrictive subject and object relative clauses in CI and TD children matched on the same chronological age.

3.5.1. Structures analysed

As mentioned in section 3.4.1.4 above, relative clauses are subordinate clauses which modify a nominal element known as antecedent of the relative clause. In restrictive relative clauses, the antecedent is modified limiting the number of referents for it. Restrictive subject and object relative clauses are introduced by the complementizer *che* 'that'.

Relative clauses are derived by A' movement or *wh*-movement, namely the movement of a NP towards a non-argument position in Spec, CP (Kayne 1994; Bianchi 1999)

In this section, we focus on subject and object relative clauses, in which the modified element is merged in subject or object position where it leaves a gap when it moves to the left periphery of the sentence. Since Italian is a *pro-drop* language, namely preverbal subjects can be omitted in finite sentences and optionally included postverbally (Rizzi 1982), two types of object relative clauses can be derived: Object relative clauses with preverbal subject (43) or postverbal subject (44). The examples below present the three types of restrictive relative clauses investigated by the preference and the character selection tasks.

(42) La mamma che <la mamma> abbraccia le figlie (Subject relative)
the mommy that <the mommy> hugs the daughters
'The mommy that hugs the daughters.'

(43) Le figlie che la mamma abbraccia <le figlie > (Object relative, preverbal subject)
the daughters that the mommy hugs <the daughters>
'The daughters that the mommy hugs.'

(44) Le figlie che abbraccia la mamma <le figlie> (Object relative, postverbal subject)
the daughters that hugs the mommy <the daughters>
'the daughters that the mommy hugs.'

In the spoken language of some varieties of Italian and dialects of Italy, restrictive object relatives may be realized with a resumptive clitic pronoun rather than a gap within the relative clause (Cinque 1988; Guasti & Cardinaletti 2003). The reason why only object relatives and not subject relatives may contain a resumptive clitic pronoun is due to absence of subject clitic pronouns in Italian. The resumptive clitic agrees in gender and number with the relative head, as example (45) shows.

(45) Le figlie che la mamma le abbraccia
the daughters that the mommy DO-CL_{3PF} hugs
'The daughters that the mommy hugs.'

Resorting to resumption may be analysed under different viewpoints. On the one hand, resorting to resumption suggests a derivation involving movement (Friedmann & Costa 2011). On the other hand, resumptive relatives may involve a doubling-type derivation, in which the relative head and the clitic

are merged within the same 'big-DP' where the relative head first moves to its dedicated left peripheral position within the CP, and the clitic pronoun is stranded inside the relative clause (Cecchetto 2000; Kayne 2005; Belletti 2005).

All in all, restrictive relative clauses involve the creation of a long-distance movement-dependency between the relative 'head' filling a dedicated position in Spec, CP and the corresponding gap in the relative clause; while the dependency of resumptive relatives holds between the relative head and the corresponding clitic pronoun.

Relative clauses are acquired at a later stage of language acquisition, as pointed out by several studies in different languages (Tavakolian 1981; Mc Kee 1998; Håkansson & Hansson 2000; Friedmann & Novogrodsky 2004). Subject relative clauses are acquired earlier and with no difficulties already around the age of 3;6 years. Conversely, object relative clauses are acquired later, at about 5 years. This asymmetry is long-lasting, since even adults experience the same asymmetry in analysing relative clauses (Utzeri 2007; Volpato 2010, 2012). Moreover, this asymmetry has been shown in individuals with an atypical language development, such as children with SLI; children with a hearing impairment, patients with agrammatic aphasia (Garraffa & Grillo 2008). The asymmetry between subject and object relative clauses can be explained in terms of intervention.

RM principle affirms that a local relation between two elements, X and Y, cannot hold if there is a third element, namely Z, that intervenes in this relation and can also be a potential candidate for it since it shares some features with X.

Grillo (2008) resorted for the first time to the RM hypothesis in order to explain the subject/object asymmetry in aphasic agrammatic patients. Assuming Grillo, agrammatic aphasics cannot correctly compute sentences derived by object movement since these individuals have limited processing resources that make it difficult to activate, select, maintain, and manipulate the full array of morphosyntactic features required to distinguish the intervening subject from the moved object.

Following Grillo's (2008) hypothesis, Friedmann et al. (2009) claimed that the difficulties in the processing of object relative clauses are caused by a [+NP] feature (which indicates the presence of a lexical restriction) being the source of intervention effects. Therefore, children cannot establish a correct relation between the moved constituent and the first merge position because of the presence of an interfering [+NP] feature in the embedded subject position, as shown in the example in (46).

(46)	Mi	piacciono	i bambini	che	il papà	pettina	<i bambini>.
	to-me.CL	like.3PL	the children	that	the father	comb.3SG	<the children>.
			R +NP		+NP		R +NP

'I like the children that the father combs.'

Conversely, when the head in the main clause and its copy in the embedded position display a lexically unrestricted *wh*-pronoun, as for example *chi* 'who' in (47), children's performance accuracy increases, since the head (*who*) and the intervener (*the boy*) do not share any feature specification.

(47) Mostrami chi il bambino abbraccia <chi>
Show-to-me.CL who the boy hug.3SG <who>
+R +NP +R
'Show me who the boy hugs.'

Applying their principle to language development, Friedmann et al. (2009) found that sentences containing object extraction are problematic for young children, since they cannot establish a correct relation between the moved element and the position from which it has been moved because the intervener and the moved head share a subset of features that children are not able to disjoin.
Later, Volpato (2010, 2012) reconsidered Friedmann et al.'s (2009) hypothesis claiming that also number features may influence the successful computation of a relative clause. Indeed, if both the subject and the object of the sentence share the same number features, namely they are both singular (48) or both plural (49), the computation of the sentence is compromised, since the number features act as interveners on the coindexed chain between the moved element and its copy in the position where it is generated.

(48) La gallina che il pulcino becca <la gallina>
[-pl] [-pl] [-pl]
the chicken that the chick pecks <the chicken>
'The chicken that the chick pecks.'

(49) Le galline che i pulcini beccano <le galline>
[+pl] [+pl] [+pl]
the chickens that the chicks peck <the chickens>
'The chickens that the chicks peck.'

On the other side, if the subject and the object present a number mismatch condition, namely the subject is singular and the object is plural (50) and the other way around (51), the computation of the sentence is easier since the number feature of the subject is different from the number feature of the object; therefore the subject does not represent an intervener in the relation between the moved element and its copy in the first merge position.

(50) Le galline che il pulcino becca <le galline>
[+pl] [-pl] [+pl]
the chickens that the chick pecks <the chickens>
'The chickens that the chick pecks.'

(51) La gallina che i pulcini beccano <la gallina>
[-pl] [+pl] [-pl]
the chicken that the chicks peck <the chicken>
'The chicken that the chicks peck.'

When the subject or the object present the number features [+pl], a dedicated projection activates in the syntactic structure (Ferrari 2005). The activation of the number projection facilitates children's computation of object relatives. Volpato (2012) also found that children with hearing impairment performed better when the relative head does not contain number features, hence the noun is singular. This condition was found helpful for the comprehension of sentences with number match and mismatch conditions.

In conclusion, children find the production and the comprehension of object relative clauses problematic because of the intervention effect of the subject on the chain built between the moved object and its copy in the first merge position.

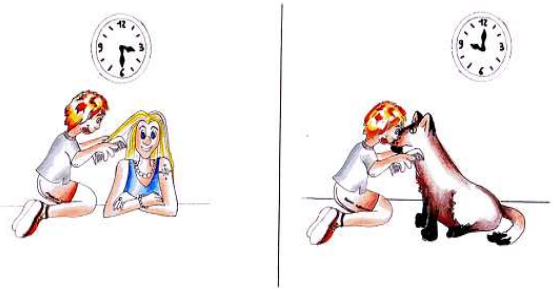
3.5.2. The preference task

The analysis of children's production of a certain structure may help to investigate which syntactic representation individuals assign to that structure. Arguably, by the time children are producing a specific structure, they have already acquired it. One of the most used techniques to assess the production of complex structures that seldom occur in spontaneous speech is the elicitation technique that also controls the meaning that is to be associated with the targeted utterance (McKee et al. 1998). The preference task developed by Volpato (2010) was used for this experiment. Volpato followed the approach by Friedmann and Szterman (2006) to test Hebrew-speaking children with hearing impairment. Moreover, following the hypothesis on elicited conditions pointed out by Hamburger and Crain (1982), all stimuli present two options for the head of the sentence to allow children a better performance on relative clauses. Finally, the preference task stimulates the child's interest, because he/she can identify himself/herself in the picture he/she prefers. Although some choices might appear unusual to the child, he/she was asked to anyway express a preference for one or both options.

For this study, a shortened version of the preference task[22] developed by Volpato (2010) was used (APPENDIX B). This decision was necessary to respect the time limit imposed by the ENT Clinic. The preference task was reduced to a shorten version unanimously with Volpato. The experimental stimuli were six subject relative clauses and six object relative clauses. Half of the experimental stimuli presented the head DPs with singular number features, while the other half of the head DPs had plural number features. Experimental sentences are semantically reversible, namely they contained verbs whose thematic roles can be compatible with both DPs in the clause, preventing the child from deriving the meaning of the sentence by relying on semantic or pragmatic cues. All verbs are transitive used in the present tense, in order to avoid difficulties related to the presence of auxiliaries and past participle morphology, which are often problematic for hearing-impaired children and may increase the difficulty of the task (Chesi 2006). The verbs used in the cut version of the preference task are: *accarezzare* 'caress', *baciare* 'kiss', *colpire* 'hit', *guardare* 'watch', *inseguire* 'follow', *lavare* 'wash', *mordere* 'bite', *pettinare* 'comb', *premiare* 'reward', *rincorrere* 'run after', *salutare* 'greet', *seguire* 'follow', *sgridare* 'scold', *tirare* 'pull'. In addition to experimental stimuli also six filler sentences were left in the task. The items eliciting filler sentences are very easy questions which require the production of simple SV or SVO word order sentences. Indeed, the random introduction of filler sentences helps to keep the tested participant focused to the task by diverting his/her attention from the real aim of the investigation. Moreover, the use of filler sentences also helps to encourage the participant during the assessment since the required answer is very easy. APPENDIX B shows the order in which trials were administered.

The task consists in showing two pictures to the participant, then he/she was asked to express a preference between the two options so as to force the child to produce a relative clause. The following pictures present examples of the elicitation of a subject relative clause and an object relative clause:

[22] The full version of the preference task elaborated by Volpato (2010) was composed of thirty-six stimuli, twelve eliciting a subject relative, twelve eliciting an object relative, and twelve filler sentences. The verb used in the full version were: *accarezzare* 'caress', *baciare* 'kiss', *colpire* 'hit', *fermare* 'stop', *guardare* 'watch', *inseguire* 'follow', *lavare* 'wash', *mordere* 'bite', *pettinare* 'comb', *premiare* 'reward', *rincorrere* 'run after', *salutare* 'greet', *seguire* 'follow', *sgridare* 'scold', *sporcare* 'dirt', *tirare* 'pull'.



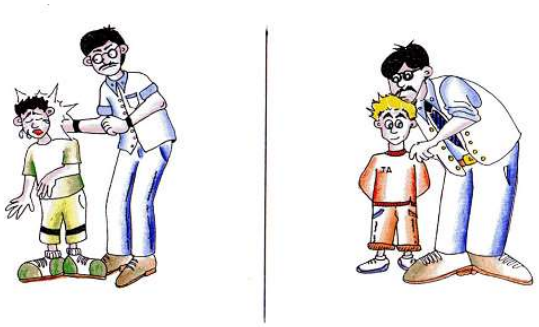
(Fig. 11) **Elicitation of a subject relative clause:**

Ci sono due disegni. Nel primo il bambino pettina la mamma, nel secondo il bambino pettina il cane. Quale bambino ti piace di più? Inizia la frase con mi piace il bambino…

Target: Mi piace il bambino che pettina la mamma/il cane.

There are two pictures. In the former the child combs the mother, in the latter the child combs the dog. Which child do you like? Start with I like the child...

Target: I like the child that combs the mother/the dog.



(Fig.12) **Elicitation of an object relative clause*:***

Ci sono due immagini. Nella prima il papà colpisce il bambino, nella seconda il papà bacia il bambino. Quale immagine ti piace di più? Inizia con Mi piace il bambino...

Target: Mi piace il bambino che il papà bacia.

There are two pictures. In the former the father hits the child, in the latter the father kisses the child. Which child do you like? Start with I like the child...

Target: I like the child that the father kisses.

The task was administered to all participants after the first half of the sentence repetition task and before the character selection task. Children were audiotaped; the responses were transcribed by the experimenter in an Excel file.

3.5.3. Participants

The results of some participants of both groups were considered for this experiment. As said in section 3.2, the experimental and the control groups do not have the same chronological age. Moreover, not all the participants completed all the tasks administered during the assessment part of this research. The data from fourteen children with CIs are considered for this experiment. Participants ranged in age from 7;8 to 12;7 years (mean age: 9;6). They were diagnosed and fitted with a HA between birth and 4;6 years (mean age of first HA fitting: 1;1). They successively received a CI between 1;0 year and 12;1 years (mean age of CI fitting: 4;4). The length of CI thus use varies from 0;4 months and 8;8 years (mean duration of CI use: 5;1). All the participants are bilateral stimulated; they either have two CIs or a CI and a contralateral HA, except for VZ who only resorts to a CI. Participants were from several regions of Italy and were selected and tested at the ENT Clinic. The following table resumes the main characteristics of the participants with CIs involved in this experiment

*Tab. 20: personal and clinical data of the CI participant at the sentence repetition task (ID= identity; HL= hearing loss; CI= cochlear implant; *=some data are missing)*

ID	Age	Sex	HL Type	Age of HA	Age of CI	Length of use of CI	Type of stimulation	Controlateral stimulation	Speech therapy	Area of provenance in Italy
SV	8;2	F	sensorineural	*	1;2	7;0	Bilateral	CI	Yes	North
FZ	11;1	M	mixed	3;0	6;7	4;4	Bilateral	HA	No	Centre
RB	10;2	F	sensorineural	1;0	9;8	0;4	Bilateral	HA	Yes	North
MS	10;0	M	sensorineural	0;5	1;2	8;8	Bilateral	HA	Yes	North
VZ	7;10	F	sensorineural	0;2	1;6	6;4	Monolateral	/	Yes	North
GT	8;6	M	sensorineural	0;7	4;7	3;9	Bilateral	HA	Yes	North
AM	12;8	M	sensorineural	4;6	12;1	0;7	Bilateral	HA	Yes	North
MM	9;9	F	sensorineural	0;5	2;9	7;0	Bilateral	CI	Yes	North
NV	8;1	M	sensorineural	0;4	1;7	6;4	Bilateral	CI	Yes	North
AT	9;0	M	sensorineural	0;3	7;10	1;2	Bilateral	HA	Yes	North
CO	8;4	F	sensorineural	*	1;1	7;3	Bilateral	CI	No	North
AR	10;4	F	sensorineural	*	2;2	8;2	Bilateral	HA	Yes	North
FZ (2)	10;5	F	sensorineural	0;6	7;3	3;2	Bilateral	HA	No	North
ER	8;6	F	sensorineural	0;6	1;0	7;6	Bilateral	CI	No	Centre

The performance of the experimental group was compared with the performance of a control group (TD group) composed of fourteen normal-hearing TD children matched on similar chronological age. TD children ranged in age from 7;0 to 12;1 years (mean age: 9;2). Children are from several regions of Italy. The following table resumes the main information about the control group

Tab. 21: main information about the control group (ID= identity)

ID	Age	Sex	Area of Provenance in Italy
GM	9;6	F	South
CL	7;0	F	North
SA	10;11	F	North
AO	7;10	M	North
PN	9;5	M	North
MM	10;3	F	North
FIL	8;8	M	Centre
FED	12;1	M	Centre
EM	10;4	F	North
GD	9;7	F	Centre
AN	8;3	M	Centre
GG	8;0	F	North
AP	8;8	F	North
GD	8;1	F	North

3.5.4. Results of the preference task

This subsection reports the results of the preference task (Volpato 2010).

The correctness of the responses was analysed in two distinct ways. The first analysis considered as correct only responses that perfectly matched with the target sentence, while other responses, even though they were syntactically correct but did not fill the task, were scored 0. During the second analysis, all the structures that are licit in Italian, even if they did not fill the task, were considered as correct and scored with 1. The strategies that were considered as correct, following Volpato and Vernice (2014), were resumptive relatives and passive relatives. Before analysing the results of the preference task, the aforementioned strategies will be briefly presented.

Resumptive relative clauses are common structures used in the spoken language of some varieties of Italian and dialects of Italy (Cinque 1988; Guasti & Cardinaletti 2003). This strategy involves the realization of an object relative clause with a resumptive clitic pronoun rather than a gap within the relative clause.

The production of a passive relative instead of an object relative clause was considered a correct strategy since several studies on language acquisition have pointed out that the use of passive relative clauses increases as children grow older and they are the preferred strategy by adolescents and adults when an object relative is elicited (Utzeri 2007; Contemori & Belletti 2014; Volpato & Vernice 2014). As pointed out by Manetti and Belletti (2013), young children approach the production of passive relatives resorting to a '*si fa*'-causative passive (52a), while adults produce reduced passives (52c)

instead. Therefore, it is possible to identify three different types of passive relatives in order to avoid the production of object relative clauses (Contemori & Belletti 2014; Belletti & Guasti 2015):

(52) a. *si-fa* causative: Il bambino che si fa accarezzare dall'orso
the child SI-CL/himself is made cuddled by the bear
'The child had himself cuddled by the bear.'

b. copular: Il bambino che è accarezzato dall'orso
'The child that is cuddled by the bear.'

c. reduced: Il bambino accarezzato dall'orso
'The child cuddled by the bear.'

Passive relatives are largely preferred to object relative clauses since they avoid the violation of locality principles. Assuming Collins's (2005) approach, the derivation of passive is stepwise. The first movement involves the chunk of the verb phrase containing at least the lexical verb and the direct object and is triggered by the passive voice, realized by the preposition *da* 'by'. In the second movement, that Collins called *smuggling*, the internal argument moves from the specifier of the passive voice into the subject position of the clause with no violation of locality, as the external argument does not intervene anymore in the path of this movement from the higher position (53).

Movement of internal argument/object DP

(53) [$_{TP}$ …T… [$_{Passive\ Voice}$ [$_{VP}$ V DP/IA] [*by*] [$_{vP}$ DP/EA v <[$_{VP}$ V DP/IA]>]]]

Movement of verbal chunk/*smuggling*

[$_{TP}$ il bambino [$_{Passive\ Voice}$ [$_{VP}$ accarezzato il bambino] [da] [$_{vP}$ l'orso <[VP accarezza il bambino]>]]]

Si-fa causative passives are largely found in the production of 6;0-year-old TD children (Re 2010). The crucial property of the *si-fa* causative passive is that a Romance-type causative structure, so called *fare-da*, is used in combination with reflexive clitic *si*. In *fare-da* causatives, the external argument of the infinitival complement of the functional causative verb *fare* is introduced through preposition *da*/by. Differently from *fare-da* causatives, in *si-fa* causatives the reflexive clitic *si* occurs instead of the external argument of the functional verb *fare*. The presence of the reflexive clitic has

the same effect as the passive voice in that movement of the object of the embedded infinitival verb into the matrix subject position occurs. The syntactic derivation of a *si-fa* causative is illustrated in (54).

(54) Il bambino si è fatto accarezzare dall'orso
The child SI-CL/himself is made cuddled by the bear
'The child had himself cuddled by the bear.'

(55) Il bambino SI-cl è [$_{vP}$ <SI-cl> fatto [$_{VP}$ accarezzare <il bambino>] [dall'[$_{vP}$ orso <VP>]]]

Strategies that are considered as incorrect are: ungrammatical or incomplete sentences; sentences with reversed Theta-roles; sentences in which the target embedded subject became the relative head of the matrix clause, so as to turn an object relative into a subject relative; object relative clauses with resumptive full-DPs; simple SVO sentences.

In the following tables, an overview of the results obtained in the elicitation of restrictive relative clauses is presented.

Table 22 shows the number and rate of correct responses that perfectly matched the experimental sentence given by the children with CIs and TD involved in this experiment. In both the experimental and the control groups, results show the typical subject/object asymmetry in the production of relative clauses, namely subject relatives are easier to produce than object relatives. In addition to this, the control group performed almost 100% in the production of subject relatives, while their age peers fitted with CIs had a lower performance. A slightly higher rate of object relative clauses was found in the experimental group. However, looking at table 23, the general performance of the control group when an object relative was elicited was higher than the CI group.

Tab.22: number (N), proportion, and standard deviation (SD) of target responses given by the CI and TD children (SR= subject relatives; OR= object relatives)

	CI group			**TD group**		
	N	**Proportion**	**SD**	**N**	**Proportion**	**SD**
SR	66/84	0.79	0.41	81/84	0.96	0.19
OR	7/84	0.08	0.28	3/84	0.04	0.19
Total	**73/168**	**0.43**		**84/168**	**0.50**	

Considering resumptive pronouns and passive sentences as correct, TD children's performance is critically higher than their CI age peers.

Tab. 23: number (N), proportion, and standard deviation (SD) of right responses given by the CI and TD children (SR= subject relative; OR= object relative)

	CI group			TD group		
	N	**Proportion**	**SD**	**N**	**Proportion**	**SD**
SR	66/84	0.79	0.41	82/84	0.98	0.15
OR	42/84	0.50	0.5	67/84	0.80	0.39
Total	**108/168**	**0.64**		**149/168**	**0.89**	

Table 24 shows the strategies used to avoid the production of subject relative clauses, while table 25 shows the strategies used instead of producing a target object relative clause.

Tab. 24: number and proportion of the wrong strategies used when a subject relative clause was elicited

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
CORRECT				
Mi piacciono i bambini che salutano l'amico	66/84	0.79	82/84	0.98
I like the children that greet the friend				
WRONG	18/84	0.21	2/84	0.02
Ungrammatical/incomplete				
Mi piacciono i bambini salutano l'amico	12/84	0.14	2/84	0.02
I like the children greet the friend				
Simple SVO				
I bambini salutano l'amico	3/84	0.04	---	---
The children greet the friend				
Other				
Mi piacciono i bambini e i bambini salutano l'amico	3/84	0.04	---	---
I like the children and the children greet the friend				

Children with CIs avoided the production of a subject relative clause more frequently than their normal hearing TD age peers. They produced a high rate of ungrammatical sentences. In addition to this, children with CIs produced some simple SVO sentences which do not involve the syntactic movement of the subject to the Spec, CP. Finally, the children from both groups resorted to other strategies, namely children with CIs produced coordinate sentences, while one participant of the TD group use the clitic pronoun to replace the direct object (*Mi piacciono i bambini che lo accarezzano* 'I like the children that cuddle him' instead of *Mi piacciono i bambini che accarezzano il gatto* 'I like the children that cuddle the cat').

Table 25 shows the correct and incorrect strategies used by the children from both groups in order to avoid the production of an object relative clause. Overall, children with TD showed better performance than their age peers fitted with CIs. Indeed, even though they do not produce a high rate of object relative clauses with a gap, they resorted to licit strategies for the Italian language. The most

used strategy by both groups was the production of copular passive sentences. TD children resorted to strategies that were rarely found in the CI group, such as the production of object relative clauses with resumptive clitic pronouns or the production of reduced passives. Moreover, children with TD produced *si-fa* causative sentences which were never found in the production of children with CIs. On the other side, children with CIs showed higher rate in the production of wrong sentences instead of target or licit sentences. The most used strategies were the production of sentences in which the target embedded subject became the relative head of the matrix clause, so as to turn an object relative into a subject relative, sentences in which the thematic roles were inverted, or the production of simple SVO sentences, this strategy was never found in the production of TD children. Both groups produced a low number of ungrammatical or incomplete sentences, sentences with a resumptive full-DP, and they rarely resorted also to other strategies. In this last case, children produced mostly coordinate sentences.

Tab. 25: number (N) and proportion of the correct and incorrect strategies used by CI and TD children to avoid the production of an object relative clause

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
CORRECT	42/84	0.50	68/84	0.81
Object relative with a gap				
Mi piace il bambino che l'orso accarezza	7/84	0.08	3/84	0.04
I like the child that the bear cuddles				
Resumptive clitic				
Mi piace il bambino che l'orso lo accarezza	1/84	0.01	13/84	0.15
I like the child that the bear cuddles him				
Reduced passive				
Mi piace il bambino accarezzato dall'orso	5/84	0.06	10/84	0.12
I like the child cuddled by the bear				
Copular passive				
Mi piace il bambino che è accarezzato dall'orso	29/84	0.35	37/84	0.44
I like the child that is cuddled by the bear				
***si-fa* causative**				
Mi piace il bambino che si fa acarezzare dall'orso	---	---	5/84	0.06
I like the child that makes himself cuddle by the bear				
WRONG	42/84	0.50	16/84	0.19
Ungrammatical				
Mi piace l'orso accarezza il bambino	7/84	0.08	5/84	0.06
I like the bear cuddles the child				
Resumptive full-DP				
Mi piace il bambino che l'orso accarezza il bambino	2/84	0.02	1/84	0.01
I like the child that the bear cuddles the child				
Head inversion				
Mi piace l'orso che accarezza il bambino	12/84	0.14	2/84	0.02
I like the bear that cuddles the child				
Theta inversion				
Mi piace il bambino che accarezza l'orso	8/84	0.10	7/84	0.08
I like the child that cuddles the bear				
SVO sentences				
L'orso accarezza il bambino	8/84	0.10	---	---
The bear cuddles the child				
Other				
L'orso dà una carezza al bambino	4/84	0.05	1/84	0.01
The bear gives a cuddle to the child				

The data collected through the preference task were analysed using a repeated logistic regression analysis. First, an analysis was carried out in which the independent fixed factors were group (CI vs. TD), sentence type (subject relatives, object relatives). The dependent variables were accuracy and the several response strategies (wrong sentences, sentences containing a resumptive full DP, sentences containing a resumptive clitic pronoun, ungrammatical sentences, passive sentences,

passive relatives, passive causative sentences, sentences with head inversion, sentences with Theta-inversion, simple SVO sentences). Random factors were subjects and item. The statistical analysis conducted between groups highlighted a significance in the production of correct subject and object relatives, namely the TD group had a better performance than the CI group (Wald Z=3.008, p=.003). Moreover, the TD group produced a significant higher number of passive relatives than CI group (Wald Z=1.972, p=.05). The high production of ungrammatical sentences by children with CIs was marginally significant (Wald Z=1.893, p=.05) in comparison to the TD group. Secondly, we conducted a further analysis in which the independent fixed factor was sentence type, the dependent variable was accuracy, and random factors were subjects and item. The outcome of this second analysis showed that both groups were significantly more accurate in the production of subject relatives over object relatives (Wald Z=4.537, p<.001). Focusing only on the CI group, we found that also for this group the production of subject relatives was more accurate than the production of object relatives (Wald Z=4.105, p<.001).

3.5.5. The character selection task

Since the types of comprehension errors make it possible to infer the nature of children's morphosyntactic underlying representations, the comprehension of relative clauses was tested through a character selection task developed by Volpato (2010). The task by Volpato follows the approach by Arnon (2005), who modified the picture matching task by Friedmann and Novogrodsky (2004). What differentiates these two task typologies is that the former implies the choice between four characters (Arnon 2005), and the latter implies the choice between two pictures (Friedmann & Novogrodsky 2004). In this last case, presenting children with two pictures on each trial would set chance performance at 50%, but it would reduce the processing load deriving from keeping in mind a long sentence and detecting the correct response. On the other hand, presenting children with four pictures on each trial would offer some statistical advantages since chance performance is 25%, thus increasing the experimenter's ability to detect non-random behaviour.

In the character selection task developed by Volpato (2010), the participant listens to a sentence and has to select a referent from a set of characters, performing an action in two different pictures, choosing the one that correctly matches the sentence. For each stimulus, two different scenarios were presented to the participant: in the first scenario, some characters perform an action (e.g. the mice hit the rabbit), and in the second scenario, the action is the same, but the Theta-roles are reversed (e.g. the rabbit hits the mice). The picture that follows present an example of one of the stimuli presented during the task.

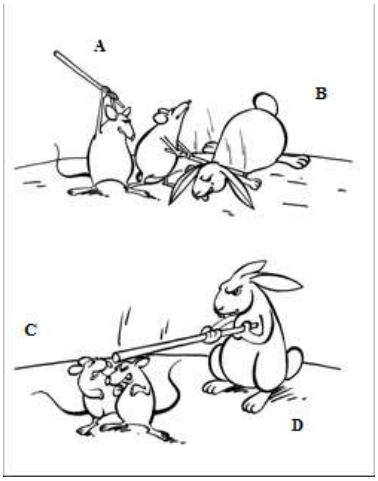


Fig. 13: one of the stimuli of the character selection task.

The presentation of four referents made it possible to obtain from the child one out of four responses, thus being able to gain a representation as detailed as possible of his/her underlying grammar. The answer possibilities varied according to the type of sentence proposed.
For subject relatives (SVO order – *Tocca il coniglio che colpisce i topi* 'Touch the rabbit that hits the mice'), it was possible to obtain the following answers (see Fig. 13):

- the correct answer: referent D
- the reversed answer: referent B
- other error: referent A - C

For object relatives (OSV – *Tocca il coniglio che i topi colpiscono* 'Touch the rabbit that the mice hit' and OVS order – *Tocca il coniglio che colpiscono i topi* 'Touch the rabbit that hit the mice' meaning again 'Touch the rabbit that the mice hit'), still considering figure 12, it was possible to obtain the following answers:

- the correct answer: referent B
- the reversed answer: referent D
- the agent error (selection of the agent instead of the head): referent A
- other error: referent C

The reversal error suggests that individuals are able to understand that the relative clause modifies a referent. However, they are unable to correctly assign the thematic role to the head DP. The agent

error suggests that children are not able to process the whole sentence correctly and to detect the modifying nature of the relative clause, namely that the subordinate sentence adds information on the head DP.

For ambiguous sentences, such as *Tocca la pecora che lava il cavallo* 'Touch the sheep that washes the horse', it was possible to obtain only two answers. Indeed, the child could select whether the child the sheep doing the action or the sheep experiencing the action, and in both cases he/she would provide the correct answers.

Only animate nouns were used in the experimental trials. All verbs were transitive and in the present tense, in order to avoid troubles deriving from the presence of auxiliaries and past participle morphology, which are often source of difficulty for hearing impaired children. The verbs used in the experimental task are: *baciare* 'kiss', *beccare* 'peck', *guardare* 'watch', *colpire* 'hit', *fermare* 'stop', *inseguire* 'follow', *lavare* 'wash', *mordere* 'bite', *pettinare* 'comb', *portare* 'bring', *salutare* 'greet', *seguire* 'follow', *spaventare* 'scare', *spingere* 'push', *tirare* 'pull', *toccare* 'touch'. All sentences were semantically reversible.

Some pictures were presented twice but the children were instructed to listen carefully to the experimental sentence. Before beginning the task, children were familiarized with the lexicon presented in the task. The experimental part was preceded by a training part, giving the possibility to children to familiarize with the items and the experimental setting, and to make sure that the instructions were correctly understood. The task is composed of fifty-nine items, forty-eight experimental trials, and eleven filler sentences, which were put every four items[23]. The task began with two sentences in order to make the participant familiar with the task. Each trial began with the request "*Tocca…*" 'touch' and then the experimental sentence was uttered by the experimenter. Even though sentences were registered on a paper sheet, children were audiotaped since the task was administered in the middle of two elicitation tasks, namely the preference task and the elicitation of *wh*-questions. The responses were reported on an Excel file. The list of the stimuli of the character selection task is provided in APPENDIX C.

[23] The full version of the character selection task (Volpato 2010) consists of eighty items: sixty experimental trials and twenty filler sentences. The experimental trials were ten different sentence conditions, each including six items. The experimental trials assess subject relatives, object relatives with embedded preverbal subject, and object relatives with embedded postverbal subject. For this study, in order to make the task compatible to the time limit given by the ENT Clinic, ambiguous trials and some of the filler sentences were removed from the task.

Tab. 26: all the conditions investigated by the character selection task (SR= subject relatives; OR= object relatives with preverbal embedded subject; ORp= object relatives with postverbal embedded subject; SG= singular; PL= plural)

Sentence Type	Condition	Item
SRs	SR_SG_PL	*la mucca che spinge gli elefanti*
		The cow that pulls the elephants
	SR_PL_SG	*Le mucche che spingono l'elefante*
		The cows that pull the elephant
ORs	OR_SG_SG	*L'elefante che la mucca spinge*
		The elephant that the cow pulls
	OR_PL_PL	*Gli elefanti che le mucche spingono*
		The elephants that the cows pull
	OR_SG_PL	*L'elefante che le mucche spingono*
		The elephant that the cows pull
	OR_PL_SG	*Gli elefanti che la mucca spinge*
		The elephants that the cow pulls
ORps	ORp_SG_PL	*L'elefante che spingono le mucche*
		The elephant that pull the cows
	ORp_PL_SG	*Gli elefanti che spinge la mucca*
		The elephants that pulls the cow

3.5.6. Participants

For the comprehension of restrictive subject and object relative clauses, the performance of thirty-three children, seventeen children with CIs and sixteen children with TD, were considered.

The seventeen children with CIs selected for this experiment ranged in age from 7;5 to 12;10 years (mean age: 9;7). They were diagnosed and fitted with a HA between birth and 3;0 years (mean age of first HA fitting: 0;11 months). They successively received a CI between 0;7 months and 12;1 years (mean age of CI fitting: 4;4). The length of CI use varies between 0;8 months and 8;10 years (mean duration of CI use: 5;5 years). All the participants are bilateral stimulated; they have two CIs or a CI and a contralateral HA, except for VZ who only resorts to a CI. Participants come mostly from the northern regions of Italy, only ER is from Centre Italy, and were selected and tested at the ENT Clinic. The following table resumes the main characteristics of the CI participants involved in this experiment

Tab. 27: personal and clinical data of the CI participants in the character selection task

ID	Age	Sex	HL type	Age of HA	Age of CI	Length of use of CI	Type of stimulation	Controlateral stimulation	Speech Therapy	Area of provenece in Italy
SV	7;8	F	sensorineural	*	1;2	6;6	bilateral	CI	1	North
DB	12;10	M	sensorineural	0;10	6;7	6;3	bilateral	CI	0	North
RB	9;10	F	sensorineural	*	7;8	1;3	bilateral	HA	0	North
MS	10;00	M	sensorineural	0;5	1;2	8;10	bilateral	HA	1	North
VZ	7;10	F	sensorineural	0;2	1;6	6;4	monolateral	*	0	North
GT	8;7	M	sensorineural	1;0	4;7	4;0	bilateral	HA	1	North
AM	12;8	M	sensorineural	3;0	12;1	0;7	bilateral	HA	1	North
MM	9;9	F	sensorineural	0;6	2;8	7;1	bilateral	CI	1	North
NV	8;1	M	sensorineural	0;4	2;7	5;6	bilateral	CI	1	North
AT	9;0	M	sensorineural	3;6	6;10	1;2	bilateral	HA	1	North
CO	8;4	F	sensorineural	*	1;1	7;3	bilateral	CI	0	North
AR	10;4	F	sensorineural	*	2;2	8;2	bilateral	HA	1	North
AZ	10;5	M	sensorineural	0;6	2;3	8;3	bilateral	CI	1	North
ER	8;6	F	sensorineural	0;6	0;11	6;5	bilateral	CI	0	Centre
EN	7;5	F	sensorineural	birth	0;7	6;10	bilateral	CI	1	North
MG	11;6	F	sensorineural	0;6	6;7	4;9	bilateral	HA	0	North
FZ2	10;5	F	sensorineural	0;6	7;3	3;2	bilateral	HA	0	North

The performance of the experimental group was compared with the performance of a control group (TD group) composed of sixteen normal-hearing TD children matched on similar chronological age. TD children ranged in age from 7;2 to 13;3 years (mean age: 9;5). Children are from several regions of Italy. The following table resumes the main information about the control group.

Tab. 28: personal data of the participant of the control group in the character selection task

ID	Age	Area of provenance in Italy
AR	7;2	North
SA	10;11	North
AP	8;8	North
GD	9;7	Centre
SB	13;3	Centre
FV	7;10	Centre
GD1	8;1	North
FED	12;1	Centre
GM	9;6	South
GG	8;0	North
PN	9;5	North
AN	8;3	Centre
MM	10;3	North
EM	10;4	North
MM1	8;1	North
FIL	8;8	Centre

3.5.7. Results of the character selection task

Table 29 shows the number and proportion of correct responses. As the table shows, both groups performed quite at the same level, the mean rate of correctness in the CI group is 81%, while the TD group showed a mean rate of 83%. Both groups showed the typical subject/object asymmetry, namely subject relative clauses were comprehended more accurately (CI: 88%; TD: 94%) than object relative clauses with preverbal subjects (CI: 83%; TD: 81%) and object relative clauses with postverbal subjects (CI: 65%; TD: 76%). Both groups performed at ceiling in the comprehension of filler sentences.

Tab. 29: number (N), proportion and standard deviation (SD) of correct responses of CI and TD children during the character selection task.

	CI group			TD group		
	N	**Proportion**	**SD**	**N**	**Proportion**	**SD**
SVO_SG_PL	94/102	0.92	0.27	92/96	0.92	0.20
SVO_PL_SG	86/102	0.84	0.36	88/96	0.96	0.28
OSV_SG_SG	81/102	0.79	0.40	72/96	0.75	0.43
OSV_SG_PL	91/102	0.89	0.31	86/96	0.90	0.31
OSV_PL_PL	83/102	0.81	0.39	75/96	0.78	0.41
OSV_PL_SG	85/102	0.83	0.37	78/96	0.81	0.39
OVS_SG_PL	71/102	0.70	0.46	81/96	0.84	0.36
OVS_PL_SG	67/102	0.60	0.47	65/96	0.68	0.47
Total	658/816	0.81		637/768	0.83	

Focusing on incorrect responses, the reverse character was chosen by the children with CIs especially when a subject relative or an object relative with postverbal subjects were presented. Conversely, children with TD resorted to this strategy mostly when they were presented an object relative with preverbal subject.

Tab. 30: number (N) and proportion in CI and TD children when the reverse character was selected.

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
SVO_SG_PL	3/102	0.03	---	---
SVO_PL_SG	7/102	0.07	1/96	0.01
OSV_SG_SG	13/102	0.13	15/96	0.16
OSV_SG_PL	4/102	0.04	6/96	0.06
OSV_PL_PL	11/102	0.11	12/96	0.13
OSV_PL_SG	9/102	0.09	7/96	0.07
OVS_SG_PL	24/102	0.24	6/96	0.06
OVS_PL_SG	29/102	0.28	20/96	0.21

The strategy selecting the agent of the uttered sentence was found both groups when object relatives were presented. The following table offers an overview of the use of this strategy in all the object relatives analysed in this task.

Tab. 31: Number (N) and proportion in CI and TD children when the agent character was selected.

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
SVO_SG_PL	---	---	---	---
SVO_PL_SG	---	---	---	---
OSV_SG_SG	7/102	0.07	8/96	0.08
OSV_SG_PL	7/102	0.07	1/96	0.01
OSV_PL_PL	5/102	0.05	8/96	0.08
OSV_PL_SG	8/102	0.08	10/96	0.10
OVS_SG_PL	5/102	0.05	8/96	0.08
OVS_PL_SG	3/102	0.03	10/96	0.10

Finally, the selection of the option standing for other errors was mostly used by CI children but was also found in the TD group.

Tab. 32: Number (N) and proportion of CI and TD children's resort of the character standing for "other error".

	CI group		TD group	
	N	**Proportion**	**N**	**Proportion**
SVO_SG_PL	5/102	0.05	4/96	0.04
SVO_PL_SG	9/102	0.09	7/96	0.07
OSV_SG_SG	1/102	0.01	1/96	0.01
OSV_SG_PL	---	---	3/96	0.03
OSV_PL_PL	3/102	0.03	1/96	0.01
OSV_PL_SG	---	---	1/96	0.01
OVS_SG_PL	5/102	0.05	1/96	0.01
OVS_PL_SG	9/102	0.09	1/96	0.01

The statistical analysis did not detect any significant difference either between-groups or within-groups.

3.5.8. Discussion

This section was devoted to production and comprehension of restrictive subject and object relative clauses. CI and TD children's competence in these structures was assessed with two different tests developed by Volpato (2010). The production was analysed with a preference task which helps the experimenter to elicit the production of restrictive relative clauses, while the comprehension of relative clauses was assessed through a character selection task. Since both tests analyse the same structures, the preference task was administered before the character selection task in order not to influence children's responses. Moreover, as aforementioned in the introduction of this section, children were administered two reduced versions of these tasks. This decision was made necessary by the ENT Clinic time regulation; hence children must have been tested within forty-five minutes so as not to further tire children with CIs during their follow-up medical examinations. The tests were reduced under the supervision of Francesca Volpato.

In this experiment, a subject/object asymmetry was found both in the production and comprehension tasks. This finding is in line with previous studies on the acquisition of *wh*-movement in both *wh*-questions and relative clauses in children with typical or atypical language acquisition (Goodluck & Tavakolian 1982; de Villiers et al. 1994; Corrêa 1995; Avrutin 2000; Friedmann & Novogrodsky 2004; Arnon 2005, 2010; Friedmann & Szterman 2006; Volpato & Adani 2009; Adani et al. 2010; Volpato 2010, 2012; Adani 2011; Arosio et al. 2011; Costa et al. 2011; Volpato & Vernice 2014; Bentea et al. 2015; Szterman & Friedmann 2015; Bentea & Durrleman 2016, 2017; Volpato & D'Ortenzio 2017) and in individuals with an acquired language disorder, such as agrammatism (Avrutin 2000; Grillo 2008; Garraffa & Grillo 2008).

Common to these studies is the assumption that the asymmetry between subject and object relative clauses may be explained in terms of interventions effects due to moving the object across a subject sharing morphosyntactic features (Friedmann et al. 2009), along the lines of the locality principle of Relativized Minimality (RM) operative in adult grammar (Rizzi 1990, 2004; Starke 2001). The RM principle states that a local relation between two elements, X and Y, can be interrupted by a third element, namely Z, that shares some features with X becoming a potential candidate for the relation with it, thus intervening in the relation between X and Y.

Assuming Grillo (2008), individuals with limited processing resources (i.e. patients with agrammatic aphasia) cannot correctly compute sentences derived by object movement since they find difficult to activate, select, maintain, and manipulate the full array of morphosyntactic features required to distinguish the intervening subject from the moved object.

Friedmann et al. (2009) follow the hypothesis by Grillo (2008) and assume that children cannot process object relative clauses, since they are not able to establish a correct relation between the moved constituent and the first merge position because of the presence of an interfering [+NP] feature in the embedded subject position.

Later, Volpato (2010, 2012) reconsidered Friedmann et al.'s (2009) hypothesis claiming that also number features may influence the successful computation of a relative clause. Indeed, if both the subject and the object of the sentence share the same number features, namely they are both singular or both plural, the computation of the sentence is compromised, since the number features act as interveners on the coindexed chain between the moved element and its copy in the position where it is generated. On the other side, if the subject and the object present a number mismatch condition, namely the subject is singular and the object is plural and the other way around, the computation of the sentence is easier since the number feature of the subject is different from the number feature of the object, thus it does not represent an intervener in the relation between the moved element and its copy in the first merge position. Volpato (2010, 2012), following the suggestion by Ferrari (2005), claims that when the subject or the object present the number features [+pl], a dedicated projection activates in the syntactic structure, thus facilitating children's computation of object relatives. Volpato (2012) also found that children with hearing impairment performed better when the relative head does not contain number features, hence the noun is singular. This condition was found helpful for the comprehension of sentences with number match and mismatch conditions.

In conclusion, it is possible to suggest that children find the production and the comprehension of object relative clauses problematic because of the intervention effect of the subject on the chain built between the moved object and its copy in the first merge position.

Focusing on object relative clauses, a further asymmetry was found, namely object relative clauses with preverbal subjects were found less problematic than object relative clauses with postverbal subjects. This asymmetry can be addressed in the following way: in object relative clauses with preverbal subjects, subject-verb agreement is checked twice by AGREE[24] and Spec-Head agreement[25]; in object relative clauses with postverbal subjects, the relation between the subject and the verb is checked only once through AGREE. This only checking makes the structure more fragile than object relative clauses with preverbal subjects.

During the preference task, participants resorted to several strategies in order to avoid the production of a target object relative clause. Some of these strategies are licit in Italian. Some participants, from both the experimental and the control groups, produced object relatives with resumptive clitic pronouns. This strategy was found in some varieties of Italian and in some dialects of Italy (Cinque 1995, Guasti & Cardinaletti 2003). On the one hand, the resort of resumption is the signature of a derivation not involving derivation (Friedmann & Costa 2011). On the other hand, resumptive relatives can be assumed to involve a doubling-type derivation, in which the relative head and the clitic pronoun are merged within the same 'big-DP' (Cecchetto 2000; Kayne 2005; Belletti 2005).

Other children often produce passive relative clauses instead of object relatives. Passive relatives are largely attested in adults' and adolescents' elicited productions (Utzeri 2007; Volpato 2010). According to Belletti (2009), older children produce passive relatives because these are easier to compute as they do not involve intervention, thanks to the smuggling operation occurring in their derivation. As said above in section 3.5.4., Smuggling (Collins 2005) allow the movement of the VP chunk containing the verb and the direct object to a position above the subject.

The use of passive relatives is considered as a marker of proper language acquisition. This means that in spite of the delayed exposure to the linguistic input during the sensitive period, it was possible for the children with CIs to attain language competence comparable to age peers.

Therefore, children with CIs producing passive relatives show that they are acquiring language properly, since they resort to adult-like strategies.

The production of causative constructions, found in TD children, is not found in children with CI. In causative constructions, the presence of the functional verb *fare* 'to make', which assigns an additional thematic role, is problematic for children with hearing impairment (Volpato 2010; Volpato & Vernice 2014). Among the answers produced by CI and TD children, there are some which do not represent context adequate strategies, namely sentences containing head inversion and Theta-role

[24] AGREE checks if the verb contains the same number and gender features of the subject, when the subject is still in its first merge position (Chomsky 1995, 2000).

[25] Spec-Head agreement checks if the subject and the verb occur in one and the same phrase, namely TP.

inversion, ungrammatical sentences, and simple SVO sentences. Ungrammatical sentences distinguish the CI group from the TD group, especially as far as object relatives are concerned, replicating previous findings that participants with a hearing impairment are more likely to produce ungrammatical sentences than hearing children (Chesi 2006; Delage 2008; Friedmann & Szterman 2006; Volpato 2010; Volpato & Vernice 2014). The use of these sentences in children with CIs can be considered as a consequence of the language impairment caused by hearing impairment. Very common in the production of the CI group are subject relatives containing head inversion instead of the production of the 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 THEME to the arguments of the relative clause but avoid the production of an object relative clause (Volpato 2010; Volpato & Vernice, 2014). Moreover, the production of simple SVO sentences was never found in the performances of TD children, but it was found in the performances of children with CIs, probably because they find it difficult to compute *wh*-movement and, in order to avoid it, produce easier sentences which are not derived by syntactic movement.

Concluding, some differences were found in the production and comprehension of relative clauses between the experimental and the control groups. This may lead to the hypothesis that the delay in language exposure may cause later difficulties with some complex syntactic structures even though children are early diagnosed and received a CI.

3.6. THE ELICITATION OF *WH*-QUESTIONS[26]

Questions are necessary in daily life. To survive, people make requests: They ask for water if they are thirsty, they invite to turn the heat up if they are cold, people beg for help if they are in danger. It would be probably for this reason that children start producing questions since very young age.

It has been pointed out that Italian-speaking children master *wh*-questions introduced by *cosa* 'what' or subject *chi* 'who' starting from the age of 2;0 (Guasti 1996; De Vincenzi 1999). TD English-speaking children show a good master of questions introduced by *who* at the age of 4 (Yoshinaga 1996), and the same behaviour is displayed by Hebrew-speaking children (Friedmann et al. 2009). Greek-speaking children fully master subject and object *wh*-questions in the age between 3;4 and 5;2

[26] The data discussed in this section were presented during the 5th Bucharest Colloquium of Language Acquisition, BUCLA, Bucharest (Romania), 24th November 2017. The proceedings of the 5th BUCLA conference will be published in the Bucharest Working Papers in Linguistics by the end of 2018. Preliminary results were presented at VI International Conference on Fundamental and Applied Aspects of Speech and Language, Belgrade (Serbia), 27th-29th October 2017. Part of this data were presented also during the Mallorca Lectures on Neurolinguistics, Eivissa (Spain), 14th-15th June 2018, and during the 17th International Clinical Phonetics and Linguistics Association Conference, ICPLA, Malta, 23rd-25th October 2018.

years (Stavrakaki 2006). Also German-speaking children show good behaviour with *wh*-questions in an age comprised between 2;0 and 4;0 years (Clahsen et al. 1996; Siegmüller et al. 2005).
However, within the age of 11;0, children still present an asymmetry in the production and comprehension of subject and object *wh*-questions, namely the former are easier to handle than the latter (De Vincenzi et al. 1999; Guasti 2002; Guasti et al. 2012, 2015; Del Puppo et al. 2016). This asymmetry has also been found in children with hearing impairment fitted with HAs or CIs (Friedmann & Szterman 2006, 2011, 2014; Friedmann & Haddad-Hanna 2014; Volpato & D'Ortenzio 2017).
In the wake of these previous researches, the aim of this study is to analyse the production of subject and object *who* and *which+NP* questions, so as to investigate whether a difference exists between children with CIs and TD children.

3.6.1. Structures analysed

Questions are speech acts through which the speaker makes a request to his/her listener/s. Questions can be distinguished in two different groups depending on the type of expected answer: Polar questions as in example (56) and X-type questions as in (57).

(56) Giovanni ascolta la musica?
Giovanni listens the music?
'Does Giovanni listen to music?'

(57) Quale musica ascolta Giovanni?
which music listens Giovanni?
'Which music does Giovanni listen to?'

Polar questions present a choice between two possibilities, the first confirms the content of the question, while the other states the contrary (Fava 1988).
In Italian, polar questions and affirmative sentences share the same word order, namely Subject-Verb-Object (SVO). They however differ in the intonation: polar questions present an ascendant intonation, while affirmative sentences are characterised by a descendant intonation.
X-type questions are introduced by a *wh*-element which is usually an interrogative pronoun such as *who*, *which*, *what*, *where*, *why*, *when*. This is due to the fact that in X-type questions, the X is a function containing several variables, and the speaker tries to understand what X stands for (Fava 1988).

In Italian *wh*-questions, the verb always follows the *wh*-element, as displayed in (58). This property has been stated by Rizzi (1996) as a well-formedness constraint on question formation, namely the *Wh*-Criterion. According to Rizzi, (i) each *wh*-element must be in a Spec-head relation with a head carrying the *wh*-feature, and (ii) each head carrying a *wh*-feature must be in a Spec-Head relation with the *wh*-element.

(58) a. Chi lava la macchina?
'Who washes the car?'

b. Cosa ha mangiato Maria?
what has eaten-S Maria
'What has Maria eaten?'

c. Chi guardano i gatti?
who watch-3PL the cats
'Who do the cats watch?'

d. Quale maglia lava Gianni?
which sweater washes Gianni
'Which sweater does Gianni wash?'

Because of *Wh*-Criterion, object *wh*-questions present a non-canonical order of constituents, as examples (58 b-d) above show, namely the subject is located in a post-verbal position and pronounced without any stress. While in subject *wh*-questions the canonical SVO order of constituents is maintained (58 a), in object *wh*-questions the canonical word order is violated, and the object precedes both the verb and the subject (58 b-d).

The subject is taken to be marginalized (Antinucci & Cinque 1977; Guasti 1996) in the merge position (Cardinaletti 2001, 2002, 2007) or a low topic position (Belletti 2004).

As relative clauses, also *wh*-questions present a subject-object asymmetry (De Vincenzi 1991; De Vincenzi et al. 1999; Guasti et al. 2012; Del Puppo et al. 2016) depending on the interpretation of the *wh*-element, which can be interpreted either as the subject (59a-60a) or the object (59b-60b) of the sentence, depending on the subject-verb agreement. Sentences like (59a-60a) are subject questions in which the singular verb agrees with the *wh*-operator and the NP in post-verbal position is plural. The sentences in (59b-60b) are object questions, in which the plural verb agrees with the plural post-verbal subject. Since, in subject *wh*-questions the canonical word order is not violated (Subject-Verb-

Object), their interpretation will be easier than that of object *wh*-questions, which present a non-canonical word order (Object-Verb-Subject).

(59) a. Chi lava i cani?
'Who washes the dogs?'

b. Chi lavano i cani?
who wash-3P-pl the dogs?
'Whom do the dogs wash?'

(60) a. Quale cuoco saluta i calciatori?
'Which chef greets the football players?'

b. Quale cuoco salutano i calciatori?
which chef greet-3P-pl the football players?
'Which chef do the football players greet?'

Wh-questions are characterised by a dependency between the *wh*-element in sentence initial position and a gap in the position from which the operator has moved and in which it is interpreted. The landing site of the moved *wh*-element is taken to be Spec, CP or Spec, FocusP in the more articulated structure proposed by Rizzi (1997). In subject questions (61a-62a), the subject undergoes vacuous movement, as it does not alter the Italian canonical word order (SVO). In object questions (61b-62b), the object leaves a gap in a post-verbal position that follows the subject.

(61) a. [$_{CP}$ Chi <chi> lava i cani?]
who <who> is washing the dogs?

b. [$_{CP}$ Chi lavano i cani <lavano> <chi>?]
whom are washing the dogs <are washing> <whom>?
'Whom do the dogs wash?'

(62) a. [$_{CP}$ Quale cuoco <quale cuoco> saluta i calciatori?]
which chef <which chef> greets the football players?

b. [$_{CP}$ Quale cuoco salutano i calciatori <salutano> <quale cuoco>?]
which chef greet the football players <greet> <which chef>?
'Which chef do the football players greet?'

As the examples above show, this dependency is short in subject questions (61a-62a) and is longer in object questions (61b-62b).

Note that *who*-questions where the subject and the object share the same number features and the verb is reversible are ambiguous. Indeed, subject and object *wh*-questions in Italian present the same order *Wh V SN* as shown by the following examples[27]:

(63) Chi ha attaccato la leonessa?
Who has the lioness attacked?
Interpretation 1: 'Who attacked the lioness?'
Interpretation 2: 'Who did the lioness attack?'

Taken out of context, the question in (63) has two interpretations, it is either a subject or an object *wh*-question. In other words, the *wh*-element *chi* 'who' can be interpreted as the subject or the object of the verb. However, the question in (63) can be disambiguated by resorting to the linguistic-pragmatic context, as shown by examples (64 a-b).

(64) a. Chi ha attaccato la leonessa, per difendere il turista? (Subject)
'Who has attacked the lioness, to defend the tourist?'

b. Chi ha attaccato la leonessa, per difendere i cuccioli? (Object)
who has attacked the lioness, to defend the little lions?
'Whom did the lioness attacked, to defend the little lions?'

(64a) is interpreted as a subject question, because a lioness may attack a tourist during a safari, and (64b) is an object question, because the lioness protects her puppies.

Ambiguity effects can also be prevented when the *wh*-element and the post-verbal NP have different number features. This is more evident with *which*-phrases in Italian, because they can be either singular or plural, as the following examples show:

(65) a. Quale leone tira i bambini? (Subject)
which-3SG M lion pull-3SG the children?
'Which lion pulls the children?'

[27] Examples are taken and adapted from De Vincenzi (1991).

b. Quale leone tirano i bambini? (Object)
which-3SG M lion pull-3PL the children?
'Which lion do the children pull?'

In Italian, several strategies are available when a *wh*-question must be produced. Sometimes, the subject can be found in a left dislocated position before the *wh*-element (66). Prosodically, this question is pronounced with a short pause between the subject and the *wh*-element, which is represented by a comma in written texts. Thus, the subject forms a prosodic unit (Guasti et al. 2012 2015; Belletti & Guasti 2015)[28]:

(66) I cani, chi lavano?
the dogs, who wash-3PL?
'Who do the dogs wash?'

Since Italian is a *pro-drop* language[29], it is possible to utter a *wh*-question with a null subject (*pro*) if the pragmatic conditions are met (67a). Moreover, it is obligatory to resort to a null subject with first and second person (67b):

(67) a. Chi lavano (i gatti)?
who wash-3PL (the cats)?
'Whom are the cats washing?'

b. Chi guardi *pro*?
who watch-2SG *pro*?
'Who are you looking at?'

Colloquial Italian also allows the possibility to express a *wh*-question by resorting to a cleft structure as in (68)[30]. In this structure, the subject can occur in either pre-verbal or post-verbal position. This last word order is considered more natural (Belletti & Guasti 2015).

[28] Differently from other languages (such as English), in Italian object questions, the DP subject cannot occur between the *wh*- operator and the verb:
(vii) a. *chi i cani lavano?
who the dogs wash.PL
'Whom are the dogs washing?'

[29] *Pro* subjects are found in certain languages, since they are not universal properties. In Italian the use of a *pro* subject is allowed by the richness of the verb inflection, through which it is possible to identify an empty category in the subject position (Rizzi 1982).

[30] Poletto (1993) observes that in standard Italian the cleft structure is limited to certain pragmatic contexts (e.g. when the interrogation is on a well-known set of objects or in echo contexts). However, in the northern variety of Italian, the cleft structure does not require any presupposition and is commonly used in spoken language.

(68) Chi è che (i cani) lavano (i cani)?

who is (it) that (the dogs) are washing (the dogs)

'Whom are the dogs washing?'

3.6.2. The task

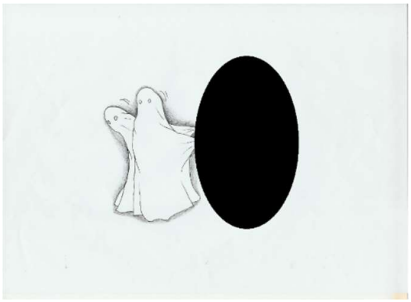
The production of subject and object *wh*-questions introduced by *who* and *which* was assessed through the elicited production task developed by Guasti et al. (2012). The test includes 24 items, investigating four conditions: subject *who* questions, object *who* questions, subject *which* questions, and object *which* questions. The four conditions are summarised in the following table.

Tab.32: experimental design: conditions

Question type	***Wh*-element**	**Test sentences**
Subject	Who	*Chi acchiappa gli gnomi?*
		Who catches the gnomes?
	Which	*Quale gatto lava le scimmie?*
		Which cat washes the apes?
Object	Who	*Chi sporcano gli elefanti?*
		Who the elephants dirty?
	Which	*Quale cane leccano i gatti?*
		Which dog do the cats lick?

The task was presented on a Power Point presentation displayed on a laptop computer screen. *Who* questions are elicited with the help of a single picture in which some characters are performing an action, but one or two characters, whether the subject or the object of the sentence, are hidden. To elicit a *which* question, the picture that provides the stimulus is preceded by a slide in which the characters are introduced. After the introduction of the stimuli, the participants are requested to ask a question to their parents, who did not know the correct answer, and have to guess pretending to be magicians.

Who-subject questions always feature a singular verb (Fig. 14), and *who*-object questions employ a plural verb (Fig. 15). Half of the items eliciting a *which* question have singular verbs (Fig. 16 and Fig. 18), the other half contain plural verbs (Fig. 17 and Fig. 19).



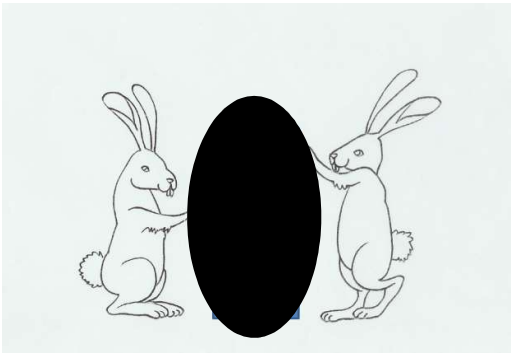
(Fig. 14) **Elicitation of a subject *who* question:**

Experimenter: *Qualcuno acchiappa i fantasmi. Chiedi alla mamma/al papà chi.*

'Someone catches the ghosts. Ask your mom/dad who.'

Target: *Chi acchiappa i fantasmi?*

'Who catches the ghosts?'



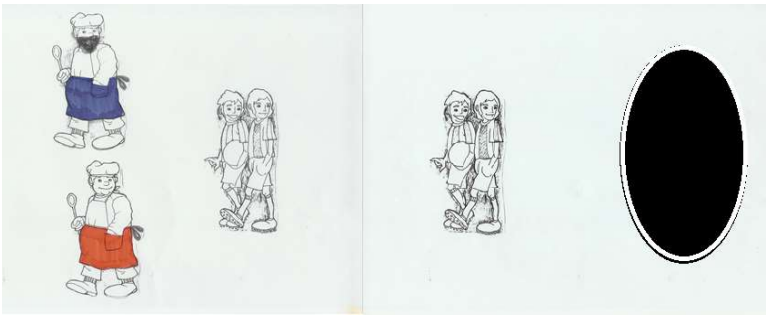
(Fig. 15) **Elicitation of an object *who* question:**

Experimenter: *I conigli accarezzano qualcuno. Chiedi alla mamma/al papà chi.*

'The bunnies carress someone. Ask your mom/dad who.'

Participant: *Chi accarezzano i conigli?*

'Whom do the bunnies caress?'



(Fig. 16) **Elicitation of a subject *which* question with a singular verb:**

Experimenter: *Ci sono un cuoco con un grembiule blu, un cuoco con un grembiule rosso e due calciatori.*

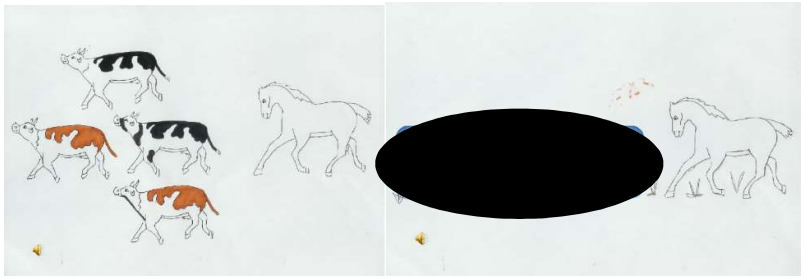
'There are a cook with a blue apron, a cook with a red one, and two football players.'

Uno dei cuochi saluta i calciatori. Chiedi alla mamma/al papa quale cuoco.

'One of the cooks greets the football players. Ask your mom/dad which cook.'

Participant: *Quale cuoco saluta i calciatori?*

'Which cook greets the football players?'



(Fig. 17) **Elicitation of an object *which* question with a singular verb:**

Experimenter: *Ci sono due mucche a macchie nere, due mucche a macchie marroni e un cavallo.*

'There are two cows with black spots, two cows with brown spots, and a horse.'

Il cavallo insegue due delle mucche. Chiedi alla mamma/al papà quali mucche.

'The horse follows two of the cows. Ask your mom/dad which cows.'

Participant: *Quali mucche insegue il cavallo?*

'Which cows does the horse follow?'

(Fig. 18) **Elicitation of a subject *which* question with a plural verb:**

Experimenter: *Ci sono due streghe con la scopa, due streghe senza scopa ed un signore.*

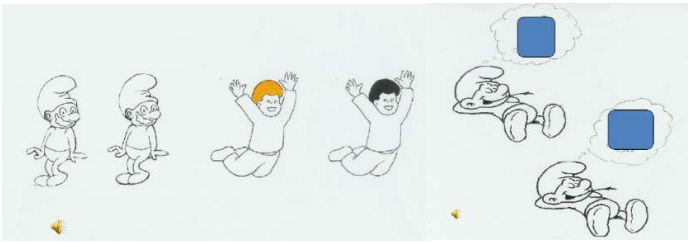
'There are two witches with a broom, two witches without a broom, and a man.'

Due delle streghe bagnano il signore. Chiedi alla mamma/al papà quali streghe.

'Two of the witches wet the man. Ask your mom/dad which witches.'

Participant: *Quali streghe bagnano il signore?*

'Which witches wet the man?'



(Fig. 19) **Elicitation of an object *which* question with a plural verb:**

Experimenter: *Ci sono due puffi, un bambino biondo e un bambino con i capelli neri.*

'There are two smurfs, a boy with blond hair, and a boy with black hair.'

I puffi sognano uno dei bambini. Chiedi alla mamma/al papà quale bambino.

'The smurfs dream of one of the children. Ask your mom/dad which child.'

Participant: *Quale bambino sognano i puffi?*

'Which child do the smurfs dream of?'

For this task, 18 transitive reversible verbs were used*:* *accarezzare* 'caress', *acchiappare* 'catch', *bagnare* 'wet', *catturare* 'catch', *colpire* 'hit', *inseguire* 'follow', *lavare* 'wash, *leccare* 'lick', *legare* 'tie', *mordere* 'bite', *rincorrere* 'run after', *salutare* 'greet', *spingere* 'push', *sognare* 'dream', *spaventare* 'scare', *sporcare* 'dirt', *svegliare* 'wake up', *tirare* 'pull'. The use of transitive reversible verbs prevents the child to derive the meaning of the sentence by relying on semantic or pragmatic cues, since being semantically reversible, these verbs can be compatible with both nouns as agents and patients.

While in Guasti et al. (2012, 2015), the participants heard the stimuli by a recorded voice and then they were asked to ask a question to a puppet, for this study all participants received the stimuli

directly from the experimenter. In this way, hearing impaired children could also rely on lip reading. The questions produced by the participants were audiotaped and transcribed by one of the experimenters on an Excel file.

3.6.3. Participants

For this experiment, we consider the data collected from twenty-six children: thirteen children with CIs and thirteen children with TD.

Children with CIs ranged in age between 7;5 and 13;10 years (mean age: 9;4). Twelve children suffer from sensorineural hearing loss, while one child suffers from mixed hearing loss. They were diagnosed and received the first HA in a period comprised between birth and 3;6 years (mean age of first HA fitting: 1;3 year)[31]. They were prothesized between 0;7 months and 7;8 years (mean age of CI fitting: 4;1). The use of the CI varies between 1;2 and 10;9 years (mean years of CI use: 5;10). Twelve children benefit of a binaural stimulation, namely they are fitted with two CIs or with a CI and a contralateral HA, while one child resort only to the CI. Seven children still follow a speech therapy, while six are no more followed by a speech therapist. Children came from different regions of Italy, mostly from Northern Italy.

Tab. 33: personal and clinical data of the CI children involved in the elicitation task of wh-questions. (=lack of information; ID=identity; HL=hearing loss; HA=hearing aid; CI=cochlear implant)*

ID	Age	HL type	Age of HA	Age of CI	Length of use of CI	Type of stimulation	Controlateral stimulation	Speech therapy	Area of provenance in Italy
EN	7;5	Sensorineural	birth	0;7	6;10	Bilateral	CI	No	North
CO	8;4	Sensorineural	*	1;1	7;3	Bilateral	CI	No	North
AT	9;0	Sensorineural	3;6	6;10	1;2	Bilateral	HA	Yes	North
MM	9;9	Sensorineural	0;6	2;8	7;1	Bilateral	CI	Yes	North
FZ	10;10	Mixed	2;6	5;7	5;3	Bilateral	HA	No	Central
RB	9;10	Sensorineural	*	7;8	2;2	Bilateral	HA	No	North
SV	7;8	Sensorineural	*	1;2	6;6	Bilateral	CI	Yes	North
VZ	7;10	Sensorineural	0;2	1;6	6;4	Monolateral	No	No	North
MS	10;0	Sensorineural	0;5	1;2	8;10	Bilateral	HA	Yes	North
NV	8;1	Sensorineural	0;4	2;7	5;6	Bilateeral	CI	Yes	North
FP	13;10	Sensorineural	*	3;1	10;9	Bilateral	CI	Yes	Central
ER	8;6	Sensorineural	0;6	0;11	7;7	Bilateral	CI	No	Central
AM	12;8	Sensorineural	3;0	11;11	0;8	Monolateral	No	Yes	North

The control group (TD group) was composed of thirteen Italian-speaking children with TD ranged in age between 7;0 and 13;3 years (mean age: 9;3). Some of them were tested at the ENT Clinic, while

[31] For some participants (CO, RB, SV, FP, AR) the data related to their diagnosis and first HA fitting are not available since they changed Hospital and some of the data are shield in their previous Hospitals.

their siblings underwent post CI fitting follow-up examinations. The rest of the participants were tested at their houses. TD children came from several regions of Italy.

Tab. 34: personal data of the TD children who took part at the elicited production task for wh-questions.

ID	Age	Area of provenance in Italy
GM	9;6	South
CL	7;0	North
SA	10;11	North
AO	7;10	North
AR	7;2	North
PN	9;5	North
NL	7;1	North
AL	9,11	North
GD	13;3	Central
AD	8;3	Central
FV	9;7	Central
SB	7;10	Central
FS	12;1	Central

3.6.4. Results

In this subsection, the data collected are presented.

Responses considered as correct were scored with 1. Following Guasti et al.'s previous studies, I considered as correct the following sentences: *wh*-questions with final NP; *wh*-questions with subject topicalization; cleft *wh*-questions; *wh*-questions with the use of passive; *wh*-questions with implicit argument; substitution of *quale* 'which' pronoun for *che* 'that'. The following examples give an overview of the structures considered as correct.

(69) *Final NP* a. Chi acchiappa i fantasmi? (Subject question)
'Who catches the ghosts?'

b. Chi colpiscono i bambini? (Object question)
who are hitting the children
'Who are the children hitting?'

c. Quale gatto lava le scimmie? (Subject question)
'Which cat washes the children?'

d. Quale bambino sognano i puffi? (Object question)
which child dream the smurfs?
'Which child do the smurfs dream of?'

(70) *Topicalized* Gli orsi, chi lavano? (Object question)
the bears, who wash?
'Who do the bears wash?'

(71) *Cleft* Chi è che acchiappa i fantasmi? (Subject question)
who is that chases the ghosts?
'Who is chasing the ghosts?'

(72) *Passive* Quali bambini vengono tirati dalla fatina? (Object question)
which children come pulled by the fairy?
'Which children are pulled by the fairy?'

(73) *Implicit argument* Chi mordono? (Object question)
who bite-PL?
'Who do the horses bite?'

(74) *che instead of quale* Che bambini tira la fatina? (Object questions)
that children pull the fairy?
'Which children do the fairy pull?'

Sentences analysed as incorrect were scored 0. Some sentences were considered as errors even though they were grammatically correct, but pragmatically infelicitous, as for instance sentences targeting a *which*-questions, but introduced by the element *who* (75) or questions with thematic roles inversion (76):

(75) I gatti, chi leccano?
'The cats, who (they) lick?'
TARGET: Quale cane leccano i gatti?
'Which dog do the cats lick?'

(76) Che cuoco salutano i calciatori?
which cook greet-3pl the football players
'Which cook do the football players greet?'

TARGET: Quale cuoco saluta i calciatori?

'Which cook greets the football players?'

Other strategies that were coded as incorrect included *in situ wh*-questions (77) and *wh*-questions containing resumptive clitic pronouns (78):

(77) La fatina tira quali bambini?
the fairy pulls which children
'Which children does the fairy pull?'

(78) Quale cane i gatti lo stanno leccando?
which dog the cats him.CL are licking
'Which dog do the cats lick?'

Some children also produced incomplete or ungrammatical sentences (*quale cuoco?* 'which cook?'). This category includes structures that are not grammatically correct (79), questions containing only the (complex) *wh*-element (80), incomplete sentences (81), and sentences that consist in the repetition of the last part of the stimulus read by the experimenter (82).

(79) Quali cavalli insegue i leoni?
'Which horses follow-3P-sg the lions?'

(80) Quale cuoco?
'Which cook?'

(81) Un bambino fa qualcosa …
'A child makes something …'

(82) Qualcuno acchiappa i fantasmi, chi è?
'Someone catches the ghosts, who is (it)?'

For each group 288 responses were collected. The CI group provided 218 correct responses (76%), while the TD group responded correctly to 245 items (85%). Therefore, children with CIs performed lower than their age peers with TD. Like relative clauses, *wh*-questions also present the typical subject-object asymmetry, namely subject *wh*-questions are easier than object *wh*-questions. A further asymmetry was detected, namely between questions introduced by *who* and questions introduced by *which+NP*. Indeed, the first structure is easier to compute than the second one. General results are

showed in the following table.

Tab. 35: Number (N), proportion and standard deviation (SD) of correct responses in the CI group and TD group

		CI group			TD group		
		N	**Proportion**	**SD**	**N**	**Proportion**	**SD**
WHO	subject	61/72	0.85	0.36	67/72	0.93	0.26
	object	58/72	0.81	0.40	59/72	0.82	0.39
WHICH	subject	55/72	0.76	0.43	63/72	0.88	0.33
	object	44/72	0.61	0.49	56/72	0.78	0.42
TOTAL		**218/288**	**0.76**		**245/288**	**0.85**	

Data were analysed using the repeated-measure logistic regression analysis. The first analysis carried out considered as independent fixed factors sentence type (subject questions vs. object questions), and *wh*-operator (*who* vs. *which+NP*). Response accuracy was the dependent variable. The data analysis showed that both groups display the same pattern of performance in the production of *wh*-questions. *Who* questions are more preserved than *which+NP* questions (Wald Z=3.207, p=.001), and subject *wh*-questions are easier to produce than object *wh*-questions (Wald Z=3.413, p<.001). However, no significant difference is observed between the two groups, even though in each question type, a lower level of accuracy is observed in the CI group compared to the TD group. The same analysis was than conducted within each group. In the CI group a significance was found between *who* and *which+NP* questions, namely the former are easier than the latter (Wald Z=2.908, p=.004), while the asymmetry between subject and object questions was found marginally significant (Wald Z=1.918, p=.055). On the contrary, the TD group was significantly more accurate in the production of subject questions instead of object questions (Wald Z=2.545, p=.011). The second analysis conducted, investigated the sentence condition factor (subject *who*-questions, object *who*-questions, subject *which+NP*-questions, object *which+NP*-questions). Overall it was found that the production of subject *who*-questions was more accurate than object *who*-questions (Wald Z=-2.057, p=.04), and subject *who*-questions were more accurate also than subject *which+NP*-questions (Wald Z=-4.418, p<.001). Subject *which+NP*-questions were easier to produce than object *which+NP*-questions (Wald Z=2.792, p=.005), and object *who*-questions were statistically less problematic than object *which+NP*-questions (Wald Z=2.629, p=.009). The same analysis was conducted within the different groups. Within the CI group, significant differences were found between subject and object *which+NP*-questions (Wald Z=2.201, p=0.028), and between object *who*- and *which+NP*-questions (Wald Z=2.817, p=0.049), but not between subject and object *who*-questions (Wald Z=0.726, p=0.47). Within the TD group, a significant difference was only found between subject and object *who*-questions (Wald Z=2.191, p=0.028), but not when contrasting the other conditions (object *who*

vs. object *which+NP*, Wald Z=0.670, p=0.502; subject *which+NP* vs. object *which+NP*, Wald Z= 1.677, p=0.093).

When a *wh*-question was elicited, participants from both the experimental and the control group resorted to several strategies in order to give an answer. Some strategies were grammatical and appropriate in the context, while some others were considered incorrect, because they were syntactically wrong or pragmatically inappropriate.

The strategy with the highest percentage of occurrence is the production of a question with a final NP, namely a *Wh* V NP word order question. The trend is the same for both groups: subject questions show higher percentages than object questions. The condition with the lowest percentage of occurrence is the object *which+NP*-question, for both groups. As expected, topicalized questions were more employed when an object *wh*-question was elicited. Topicalization of the subject was more adopted by CI children (mean percentage 15%), while children with TD used it in 8% of their productions. For both groups, this strategy is mainly used with *who*-questions. Cleft sentences are produced at lower percentages than *wh*- questions with a final NP by both groups (mean: 6% for CI group, and 6% for TD group). While this strategy is used by CI children when both *who*- and *which+NP*-questions were targeted, TD children used it only with items eliciting *who*-questions.

The production of *wh*-questions with the omission of one argument, namely the subject, was found more in TD children's responses than in CI children's answers (CI group: 1%; TD group 3%).

The strategy involving the presence of the passive voice is preferred in the case of *which+NP*-questions by both groups (9% in CI group, 11% in TD group). In a very low percentage of items both groups replaced the target forms *who* and *which* with the form *che*+NP '*what*+NP' (CI group: 4%; TD group: 5%).

Table 36 summarizes the data analysed as correct.

Tab. 46: Number (N) and proportion (P) of use of the different correct strategies in each group for each question type (SQ= subject question; OQ= object question)

	CI group								**TD group**							
	WHO				**WHICH**				**WHO**				**WHICH**			
	SQ		**OQ**		**SQ**		**OQ**		**SQ**		**OQ**		**SQ**		**OQ**	
	N	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**
Wh V NP	49/72	0.68	32/72	0.44	45/72	0.63	18/72	0.25	53/72	0.74	40/72	0.56	54/72	0.75	33/72	0.46
Topicalized	---	---	16/72	0.22	---	---	6/72	0.08	---	---	9/72	0.13	---	---	2/72	0.03
Cleft	11/72	0.15	2/72	0.03	1/72	0.01	2/72	0.03	12/72	0.18	4/72	0.06	---	---	---	---
No subject	---	---	3/72	0.04	---	---	1/72	0.01	---	---	4/72	0.06	2/72	0.03	1/72	0.01
Passives	---	---	3/72	0.04	---	---	10/72	0.14	---	---	2/72	0.03	---	---	13/72	0.18
Che+NP	---	---	1/72	0.01	4/72	0.06	6/72	0.8	---	---	---	---	6/72	0.08	7/72	0.10
Other Right	1/72	0.01	1/72	0.01	5/72	0.07	1/72	0.1	1/72	0.1	---	---	1/72	0.01	---	---

Focusing on incorrect strategies, the most frequent in the CI group is the production of

ungrammatical/incomplete sentences. These productions were significantly higher with items eliciting *which+NP* questions than *who* questions. An incorrect strategy that differentiates the two groups is the use of Theta-roles inversion. Even though the percentages of occurrence are very low in both groups (mean: 3% in the CI group and 1% in the TD group), in the TD group this strategy is found only with object questions, while in the CI group, it is found especially with items eliciting subject *wh*-questions and to a lower extent in object questions. An incorrect strategy consists in the production of *wh*-elements different from the target ones. While children with CIs resorted to this strategy only when a *which+NP* question was elicited (*Chi tira l'ape?* 'Who pulls the bee?' instead of *Quali grilli tirano l'ape?* 'Which crickets pull the bee'?), in TD children this strategy was found also when a *who* question was elicited (*Quale persona è stata accarezzata dei conigli?* 'Which person was caressed by the bunnies?' instead of *Chi accarezzano i conigli?* 'Whom do the bunnies caress?'). A strategy that was found only in the CI group was the production of in situ *wh*-questions (mean: 1% in the CI group) (L*e streghe spaventano quale fantasma?* 'The witches scare which ghost?' instead of *Quale fantasma spaventano le streghe?* 'Which ghost do the witches scare?'). Finally, a strategy only found in the production of children with CIs is the utterance of *wh*-questions with resumptive clitic pronouns (*Quale cane i gatti lo stanno leccando?* Which dog the cats are licking it?' instead of *Quale cane i gatti leccano?* 'Which dog do the cats lick?').

Table 38 summarizes the percentages related to the production of syntactically or pragmatically incorrect *wh*-questions.

Tab.37: Number (N) and proportion (P) of use of the different incorrect strategies in each group for each question type (SQ= subject question; OQ= object question)

	CI-Group								**TD-group**							
	WHO				**WHICH**				**WHO**				**WHICH**			
	SQ		**OQ**		**SQ**		**OQ**		**SQ**		**OQ**		**SQ**		**OQ**	
	N	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**
other wh-	---	---	---	---	1/72	0.01	7/72	0.08	4/72	0.06	5/72	0.07	5/72	0.07	8/72	0.11
ungrammatical / incomplete	3/72	0.04	3/72	0.04	9/72	0.13	13/72	0.18	1/72	0.01	5/72	0.07	4/72	0.06	4/72	0.06
Theta inversion	3/72	0.04	1/72	0.01	4/72	0.06	1/72	0.01	---	---	2/72	0.03	---	---	2/72	0.03
In situ	---	---	---	0%	---	---	1/72	0.01	---	---	---	---	---	---	---	---
Clitic pronoun	---	---	---	0%	---	---	1/72	0.01	---	---	---	---	---	---	---	---
other strategies	5/72	0.07	10/72	0.14	3/72	0.04	6/72	0.08	---	---	1/72	0.01	---	---	2/72	0.03

3.6.5. Discussion

In this experiment, we analysed the production of *wh*-questions by thirteen children with CIs and thirteen children with TD matched on chronological age. As in the previous experiments, the aim of

the experiment was to investigate whether a difference in the production of *wh*-questions exists between the two groups.

In a previous study by Volpato and D'Ortenzio (2017), no significant difference was observed between a group of eight children with CIs and a control group of eight normal hearing TD age peers. In this experiment, in which a larger number of children was included in both the experimental and the control samples, only small differences were found between the two groups, namely children with CIs show lower percentages of accuracy than children with TDs in all sentence conditions.

Differently from previous studies on the comprehension and production of *wh*-questions in which a significant difference was found between experimental and control samples (Friedmann & Szterman 2011; Friedmann & Haddad-Hanna 2014; Tuller & Delage 2014; Ruigendijk & Friedmann 2017; Penke & Wimmer 2018), the results of this experiment only show some differences in the percentages of accuracy of the two groups. Differently from the previous studies, in which the experimental samples were heterogeneous as far as the type of device used (HA or CI), the present study exclusively includes children fitted with CIs. Therefore, it seems that the use of CIs increases accuracy in the production of *wh*-questions and reduces the gap between hearing impaired and normal hearing children.

Focusing on the types of constructions included in the elicitation test, two typical asymmetries were identified: (i) between subject and object *wh*-questions, the former being easier than the latter, and (ii) between *who* and *which+NP* questions, the former being less demanding than the latter.

The outcomes of this experiment confirm two asymmetries found also in previous studies on the comprehension and the production of *wh*-questions in populations with typical and atypical language development (TD-children and adults: De Vincenzi 1991, 1999; Friedmann et al. 2009; Guasti et al. 2012; Belletti & Guasti 2015; children with developmental dyslexia: Guasti et al. 2015, Del Puppo et al. 2016; patients with agrammatic aphasia: Garraffa & Grillo 2008; children with hearing impairment: Quigley et al. 1974; Friedmann & Szterman 2011; Friedmann & Haddad-Hanna 2014; Ruigendijk & Friedmann 2017; Volpato & D'Ortenzio 2017; Penke & Wimmer 2018).

The asymmetries found in the production of *wh*-questions can be explained by considering two hypotheses present in the literature, namely the Minimal Chain Principle (MCP, De Vincenzi 1991), and the Agree Interference Approach (AIA, Guasti et al. 2012).

Following De Vincenzi's MCP (1991, 1999), children's misinterpretation of object *wh*-questions is due to economy reasons. Taking into consideration the dependency between the *wh*-element and the position from which it has been moved, either the subject or the object position, the parser avoids keeping in memory the moved element for a long time by promptly interpreting it. Therefore, subject *wh*-questions are easier because the dependency between the *wh*-element and its copy in subject

position is shorter than the dependency in object *wh*-questions, where the *wh*-element moves from the object position. Long dependencies, like those found in object questions, increase the computational load necessary to produce these sentences. Since the first element met by the parser, namely the *wh*-element with the object function, does not agree with the verb, the initial analysis of the parser is not confirmed by new incoming material and a new analysis must be done in order to reassign new grammatical function, thematic role, and case to the object chain. This hypothesis is supported by one of the errors made by the children, namely the production of a subject *wh*-question (*Chi lava i cani?* 'Who washes the dogs?') instead of an object *wh*-question (*Chi lavano i cani?* 'Who wash.PL the dogs.SUBJ.?'). In a nutshell, De Vincenzi et al. (1999) assume that Italian-speaking children misinterpret object *wh*-questions, because they posit a gap in the subject position and, obeying the MCP, fail to revise the initial incorrect analysis.

However, although the MCP explains the subject/object asymmetry in the comprehension and production of *wh*-questions, it does not explain the reason why, especially with object *wh*-questions, children resort to several strategies in order to facilitate their production. Guasti et al. (2012) faced this question proposing the AIA, which was built on the proposal by Guasti and Rizzi (2002), and Franck et al. (2006). The AIA hypothesis was grounded on the subject-verb agreement relation, since agreement is crucial to decide whether a subject or an object question is meant in Italian. Agreement usually occurs in two steps: AGREE and Spec-Head agreement. Through AGREE the subject in the specifier of the vP checks its person and number features against the inflectional node AgrS, under c-command and in a local configuration. Spec-Head agreement is an optional operation that takes place only when the subject moves from Spec, vP to Spec, AgrS, and through which it is possible to verify whether the subject and the verb share the same features. The movement of the object to the left-periphery involves a movement to an intermediate projection (AgrOP) before landing in the CP. Considering AGREE, when AgrS checks its features in its c-commanding domain, it first finds the object or its copy in Spec, AgrOP, which can be mistaken for AgrS and transfer its features to it. Therefore, the object intervenes in the AGREE relation between the thematic subject in Spec, vP and AgrS and induces attraction errors, since it is possible for the object to be valued as AgrS. In VS sentences, agreement is checked only once, allowing interpreting errors. For this reason, children resorted to other strategies when an object *wh*-question was elicited (Guasti et al. 2012). In production, several strategies of asking a question are available to children (Belletti & Guasti 2015; Del Puppo et al. 2016).

One of the strategies in support of this hypothesis is the recourse to passive by older children (in both the experimental and the control groups). Passive sentences allow to bypass the interference effect in the AGREE relation, since in passive structures the logical object becomes the subject and the logical

subject is demoted to an adjunct status. This means that AgrS checks the agreement relation with the internal argument, allowing the production of a passive subject *wh*-question instead of an object *wh*-question.

According to Guasti et al. (2012, 2015) and Belletti and Guasti (2015), the asymmetry between *who* and *which+NP* questions is due to several processes involved in the derivation of *which*+NP questions. On the one hand, movement of the *which*-phrase involves pied-piping of the nominal element. This hypothesis is supported by the several errors made by both CI and TD children, for example, when children produce questions in which the *wh*-operator and the nominal element are separated (*Il cuoco, quale sta salutando dei calciatori?* 'The cook, which is greeting of the football players?'), or simplify the *which+NP* into *who* (C*hi lava le scimmie?* 'Who washes the monkeys?' instead of *Quale gatto lava le scimmie?* 'Which cat washes the monkeys?'). The avoidance of *which+NP* questions when pragmatically required is a strategy that makes it possible for children to reduce the complexity of this kind of sentence. On the other hand, agreement relations also condition the right interpretation of *which+NP* questions, since both the subject and the object display agreement features and must agree. Moreover, in subject *wh*-questions, it is the *which*-phrase that agrees with the verb. This latter hypothesis is confirmed when children leave the *which+NP* in its original position, namely they produced an in-situ question (*La fatina tira quali bambini?* 'The fairy pulls which children?'). However, agreement may not be a problem per se, since Italian-speaking children can already master agreement at 2-3 years, but it becomes a problem when it occurs with pied-piping, which is much demanding for children's computational system (Belletti & Guasti 2015).

The asymmetry between *who* and *which*+NP questions may also be explained assuming the Derivational Complexity Hypothesis (Jackubowicz 2004, 2005) which assumes that children acquire structures with a less complex derivation before more complex structures. Indeed, the child is sensitive to the number of times a copy of the *wh*-element must move (i.e. cyclic movement in long distance *wh*-questions) and to the number of constituents that may or must undergo internal movement (e.g. the pied-piping of the *wh*-element plus the NP). Therefore, children find *which+NP* questions more difficult than *who* questions because of the number of the constituents that must move to the Spec, CP.

As pointed out above, comparing the performance of the two groups, the data analysis showed lower percentages of correct sentences in the CI group as opposed to the TD one for all sentence conditions. In this experiment, children with CIs resorted to a large number of strategies when both subject and object questions were targeted. The most frequent (incorrect) strategy was the production of ungrammatical sentences. In addition, most children with CIs replaced the *wh*- element with another one that was context inappropriate (for example, they used *chi* 'who' instead of *which+NP*). This

strategy was observed in many children, regardless of their age. In some cases, children produced *wh*-questions with reversed thematic roles. However, some other children fitted with CIs who did not produce the target sentence used some strategies that were nonetheless pragmatically correct, such as topicalised sentences, cleft *wh*-questions, and sentences in which the *which+NP* element was replaced with *che+NP* '*what+NP*'. This last strategy is largely used in some regional varieties of Italian and was considered as correct because both *wh*-elements involve pied-piping. However, *what+NP* pragmatically differs from the target *which+NP* since it is used to refer to a non-rigid domain, which does not imply the choice between two distinct options (Fava 1988).

In conclusion, confirming what has been shown by previous studies in the comprehension and production of *wh*-questions in hearing impaired children (Friedmann & Szterman 2006; Szterman & Friedmann 2014; Tuller & Delage 2014; Ruigendijk & Friedmann 2017; Volpato & D'Ortenzio 2017; Penke & Wimmer 2018) the children with CIs who produced correct and appropriate sentences displayed to have good competence of Italian and use response strategies also found in TD children; other children with CIs, who produce ungrammatical sentences, showed an atypical behaviour that is evidence of the linguistic deficit associated to hearing impairment.

3.7. General Discussion

This third chapter was devoted to the analysis of data collected in four different experiments. First, the performance of CI and TD children in a sentence repetition task was analysed in section 3.4. (Del Puppo et al. 2016). Then, data related to two tests on the production and comprehension of relative clauses were presented in section 3.5. (Volpato 2010). Finally, the data collected by means of a task eliciting *wh*-questions were analysed in section 3.6. (Guasti et al. 2012, 2015). Each task investigates syntactically complex structures derived by syntactic movement. The sentence repetition task analyses the repetition of left dislocated sentences containing resumptive clitic pronouns, cleft sentences, long-distance subject and object *wh*-questions, and restrictive genitive and oblique relative clauses. The preference task assesses the production of restrictive subject and object relative clauses. The character selection task evaluates the comprehension of subject relative clauses, object relative clauses with preverbal and postverbal subjects. Finally, the elicited production of *wh*-questions investigates the production of *who* and *which+NP* subject and object questions.

Tests were administered in one meeting not exceeding the time limit imposed by the ENT Clinic (i.e. 45 minutes). This limit was decided by mutual agreement with the speech therapists of the ENT Clinic in order to assess children during their follow up medical examinations for the periodic checking of CIs. The same time limit was maintained with the participants of the control group. However, as was previously explained, some difficulties existed during this part of the research. The first concerned

the participants with CIs, since not all of them accomplished the assessment of the syntactically complex structures due to the high levels of tiredness reached during the medical examinations. The second concerned TD children for the reason that they were not selected through a rigorous random sampling procedure (i.e. school collaboration) but it presents a convenience sample, namely, TD participants were selected among CI children's siblings, known children and the members of Lisabilità. Some participants were selected via email, contacting some author's colleagues, or using social media by posting a communication of collaboration for the research. Moreover, some participants of the control group were selected and tested by a MA student for the essay she wrote at the end of the course of Linguistics for deafness and hearing impairments. Unfortunately, the participants of the control group were in a lower number than children with CIs. Furthermore, most of the TD children were younger than the children fitted with CIs, thus invalidating the construction of a bigger group of controls. For these two reasons, each experiment present different experimental and control groups in order to always have two groups, one composed of children fitted with CIs and the other composed of TD children matched on chronological age.

In total, fifty-five children were assessed: thirty children and adolescents with hearing impairment and fitted with CIs (CI group), and twenty-five normal hearing TD children and adolescents. Children with CIs ranged in age between 7;3 and 14;5 (mean age: 10;3). They were diagnosed and received their first HAs between birth (Neonatal hearing screening) and 6;2 years. Participants received their first CI in an age comprised between 0;7 months and 12;1 years. Twenty-six participants benefit from bilateral stimulation, namely they are fitted with two CIs (fourteen participants) or by a CI and a contralateral HA (twelve participants). Four participants are monolaterally stimulated, i.e. they benefit of the only use of a CI. Fifteen participants follow a speech therapy, the other half has concluded the rehabilitation programme. TD children ranged in age between 5;2 and 13;3 years (mean age: 8;9).

The tests were administered in the same order to all participants. The assessment started with the first half of the sentence repetition task (sentences 1-25), continued with the preference task, followed by the character selection task, then children were administered the task for the elicited production of *wh*-questions, and finally the children were administered the second half of the sentence repetition task (sentences 26-49). Some children of the experimental group did not finish some tasks since they found them difficult or, maybe, they had problems in the production of some sentences. Sometimes, they refused to continue since they were too tired. Overall, the author noticed that it was much easier testing children with CIs than their TD age peers. This may be due to the fact that children with CIs attend speech therapies since a very young age and are accustomed maintaining attention to the tasks for a longer time than TD children.

The intent of this general discussion on the assessment of syntactically complex structures is to compare the several structures investigated through the four tests administered to CI and TD children. The sentence repetition task allows the examination of several syntactic structures using one and the same task. Several studies have pointed out that repetition is not an automated task since it implies both the comprehension and the production of sentences whose structures have presumably already been acquired (Friedmann & Szterman 2011; Szterman & Friedmann 2015; Del Puppo et al. 2016).The sentence repetition task developed by Del Puppo et al. (2016) investigates left-dislocated sentences containing resumptive clitic pronouns, cleft sentences, long-distance subject and object *wh*-questions, genitive and oblique relative clauses. For this experiment, the data of thirteen children with CIs were compared with the outcomes of ten normal hearing TD children matched on chronological age.

All in all, TD children performed better than their CI age peers in the repetition of all the structures investigated. The most problematic structures for the participants of the experimental group were cleft sentences and long-distance *wh*-questions, in which the rate of correctness was notably lower than the rate of correctness of their TD age peers. Interestingly, both groups showed many difficulties in the repetition of restrictive genitive and oblique relative clauses.

Since filler sentences, which are matched to experimental sentences on the same number of syllables, were correctly produced, it is possible to reject the hypothesis whereby children with CIs show a problematic computation of movement-derived sentences because of problems with memory. We suggest that children fitted with a CI, and in some cases also TD children, find some structures difficult to process because of the number of syntactic movements involved in their derivation. Considering the structures analysed, they all involve more than one syntactic movement.

Left-dislocated sentences containing resumptive pronouns are characterised by two movements. First, the object moves to the left periphery of the sentence; second, the pronoun cliticizes. Argument movement and clitic movement make the correct interpretation of left-dislocated sentences containing clitic pronouns particularly difficult.

Cleft sentences are particularly demanding when they involve an infinitival and a passive subordinate clause. In the former case, this result may be due to the fact that clefts with infinitivals are formal structures. Indeed, looking at the strategies used by the experimental group in order to avoid the repetition of infinitival clefts, we observe the substitution of the infinitival verb for a finite verb (subject cleft with *che*+finite verb). The difficulties in the repetition of passive clefts may be related to the presence of two movements: (i) the A movement involved in the derivation of the passive clause, and (ii) the *wh*-movement of the subject to a position in the left periphery of the sentence. Since filler sentences containing passive verbs were correctly repeated by all participants, it is possible to hypothesize that the difficulties in the repetition of passive clefts are ascribable to the

complexity derived by the combination of two different movements, the first related to the passive voice and the second involved in the derivation of the cleft structure.

The difficulties in the processing of long-distance subject and object *wh*-questions is due to the cyclic movement through the CP node of the embedded sentence underwent by the moved constituent (de Villiers et al. 1994). Indeed, long-distance *wh*-questions present a dependency between the *wh*-element in the main clause, the gap in the CP of the subordinate clause, and the gap inside the subordinate clause. Moreover, both CI and TD children showed a better performance in the repetition of long-distance subject *wh*-questions than long-distance object *wh*-questions. This result is in line with previous studies focused on the production and comprehension of simple *wh*-questions which showed that *wh*-questions involving the movement of the subject are easier to process than *wh*-questions involving the movement of the object.

Finally, both CI and TD children show a problematic repetition of restrictive oblique and genitive sentences. The complexity of the structure is caused by the double movement that allow the derivation of oblique and genitive relatives. Indeed, following Kayne (1994) and Bianchi (1999), pied-piping relatives are realized through two steps: (i) the relative DP or the pied-piped PP moves to Spec, CP; and (ii) the NP moves out of the complement position of the relative D°, and it reaches the highest specifier position of the relative clause that asymmetrically c-commands everything else within the relative CP.

The production and the comprehension of restrictive subject and object relative clauses have been analysed simultaneously since both tasks investigate the same type of structures. The common outcome to the CI and TD groups was the subject-object asymmetry both in the production and in comprehension of restrictive relative clauses. A further asymmetry was found between object relative clauses with preverbal and postverbal subjects. Following previous studies on the production and comprehension of structures involving object dependencies (Friedmann et al. 2009; Bentea et al. 2016; Bentea & Durrleman 2017, 2018), the subject-object asymmetry may be explained as a violation of a locality principle, namely Relativized Minimality (Rizzi 1990, 2004), which is not completely mastered by children. The subject of the relative clause functions as an intervener blocking the relation between the moved object and its copy in the first merge position. Friedmann et al. (2009) claimed that the relation between the object and its copy is blocked by the subject if they present a lexical restriction [+NP]. This theory was modified by Volpato (2010) assuming that the violation of the locality principle may be caused by the concurrence of number features in the subject and in the object. Therefore, the correct interpretation of an object relative clause may be helped by the presence of a number mismatch condition, namely the subject is singular, and the object is plural, or the other way around. However, if these hypotheses may explain the subject-object asymmetry,

they cannot explain the reason why object relative clauses with preverbal subjects are less demanding than object relative clauses with postverbal subjects. Following previous studies focused on the comprehension of relative clauses (Volpato & Adani 2009; Volpato 2010), the asymmetry can be analysed resorting to the minimalist theory of Agreement (Chomsky 1995, 2000, 2001; Guasti & Rizzi 2002; Franck et al. 2006) which assumes that agreement is a two-step process, namely AGREE and Spec-Head checking. AGREE is the relationship established between the subject within the VP and the relevant functional projection in IP. AGREE allows the copy of the subject number and person features onto I. Spec-Head agreement takes place when the subject has moved to Spec, IP allowing a local checking of subject and verb features. Structures containing both types of subject-verb agreement must be considered robust, because agreement is double-checked. Structures involving only one of these checking procedures, namely AGREE, are to be considered fragile. Under this viewpoint, relative clauses with postverbal subjects are more difficult to interpret since their structure is more fragile than the structure of object relative clauses with preverbal subjects (Volpato & Adani 2009; Volpato 2010).

Data collected in the elicited production of *wh*-questions showed two asymmetries: the first, common to relative clauses, is the typical subject-object asymmetry. The second is between *who* and *which*+NP questions, namely the former are easier to produce than the latter. These asymmetries can be explained by resorting to three different hypotheses: De Vincenzi's Minimal Chain Principle (De Vincenzi 1991; De Vincenzi et al. 1999); Guasti et al.'s Agree Inference Approach (Guasti et al. 2012); Friedmann et al.' Lexical Restriction (Friedmann et al. 2009).

Assuming De Vincenzi's approach, CI and TD children find the production of object *wh*-questions problematic because of the long movement of the object from its base position to a new position in the left periphery. Indeed, long dependencies, like those found in object questions, increase the computational load necessary to produce these sentences. During the analysis of the moved object, the children's parser finds difficult to keep in memory the moved element for a long time by promptly interpreting it. Therefore, in object *wh*-questions the initial analysis of the parser is not confirmed by new incoming material and a new analysis must be done so as to reassign new grammatical function, thematic role, and case to the object chain which was not correctly analysed because the first element met by the parser, namely the moved object, does not agree with the verb. However, although the MCP explains the subject/object asymmetry in the comprehension and production of *wh*-questions, it does not explain why, especially with object *wh*-questions, children resort to several strategies in order to facilitate production. Guasti et al. (2012) faced this question proposing the Agree Interference Approach grounded on Guasti and Rizzi (2002), and Franck et al. (2006). This hypothesis focuses on the fact that agreement is crucial to decide whether a subject or an object question is meant in Italian.

As aforementioned, agreement usually occurs in two steps: AGREE and Spec-Head agreement. In VS sentences agreement is checked only once, allowing interpreting errors. For this reason, children resorted to other strategies when an object *wh*-question was elicited (Belletti & Guasti 2015; Del Puppo et al. 2016).

The subject-object asymmetry can also be interpreted in terms of lexical restriction (Friedmann et al. 2009) since, especially in *which+NP* questions, a [+NP] feature intervenes in the relation between the moved object and its copy in the first merge position. Lexical Restriction may also explain the reason why object *who*-questions are less problematic than object *which+NP*-questions. In object *which*-questions the *wh*-element contains NP and is thus similar to the subject DP which thus intervenes on the coindexed chain between the moved object and its trace. To further explain this asymmetry between *who* and *which+NP* questions it is also possible to recall the Derivational Complexity Hypothesis (Jackubowicz 2004, 2005) which assumes that children acquire structures with a less complex derivation before more complex structures. Indeed, the child is sensitive to the number of times a copy of the *wh*-element must move (i.e. cyclic movement in long distance *wh*-questions) and to the number of constituents that may or must undergo internal movement (e.g. the pied-piping of the *wh*-element plus the NP). Therefore, children find *which+NP* questions more difficult than *who* questions because of the number of the constituents that must move to the Spec, CP: movement of the *which*-phrase involves pied-piping of the nominal element (Belletti & Guasti 2015).

We now compare the results on structures which were investigated by resorting to different tasks, namely simple and long-distance *wh*-questions, and restrictive relative clauses.

Simple *wh*-questions were analysed by means of an elicited production task, while long-distance *wh*-questions were investigated with a sentence repetition task. Since this latter task investigated long-distance questions introduced by *which+NP*, only this structure of the elicited production task will be considered. Comparing the results of these structures in both experimental and control groups, CI and TD children showed a better performance in the repetition of more complex structures than in the production of simple *wh*-questions. This may lead to the hypothesis that children find the processing of pied-piping the NP with the *wh*-element to the beginning of the sentence more difficult because the subject NP intervenes on the coindexed chain between the moved object and its copy.

While restrictive subject and object relative clauses were analysed by using an elicited production and a comprehension task, genitive and oblique relative clauses were analysed with a sentence repetition task. In this case, CI and TD children showed a better performance in subject and object relatives than oblique and genitive relatives. The difficulty in processing more complex relative clauses can be caused by the pied piping of the PP to Spec, CP. In addition to this, genitive and oblique restrictive relatives present a further movement of the NP to the complement position of the

relative D° (Kayne 1994; Bianchi 1999). Observe that in oblique relative clauses, the moved PP contains an NP; the subject NP thus intervenes in the chain between the moved element and its copy. CI children show a deficient competence in the processing of syntactically complex structures derived by syntactic movement, both argumental and *wh*-movements. This confirms previous studies comparing the syntactic competence of CI children with normal hearing TD children (Friedmann & Szterman 2006, 2011; Friedmann et al. 2008; Volpato & Adani 2009; Volpato 2010, 2012; Friedmann & Haddad-Hanna 2014; Guasti et al. 2014; Volpato & Vernice 2014; Szterman & Friedmann 2015; Ruigendijk & Friedmann 2017; Volpato & D'Ortenzio 2017; Penke & Wimmer 2018). However, the causes of the poor performance of children with CIs in processing syntactically complex structures derived by syntactic movement is still open. Indeed, as pointed out by Penke and Wimmer (2018), there are two main lines of thought: on the one hand the worse performance of children with CIs is ascribed to a deficit that persists into adolescent (Delage & Tuller 2010; Tuller & Delage 2014), on the other hand their performance is caused by a delay in language acquisition (Penke & Wimmer 2018). But on this last point more longitudinal studies are needed.

Moreover, the data collected showed a major impairment in those structures derived by more than one movement, in line with the Derivational Complexity Hypothesis (Jackubowicz 2004, 2005). Children find it more difficult to process structures that are characterised by a higher number of syntactic derivations. In addition to this, children also find the processing of movement involving more than one constituent demanding. For example, children perform better in the production of *who* questions than in the production of *which+NP* questions since this latter structure involves the pied piping of the NP with the *wh*-element.

4. PREVIOUS STUDIES ON THE TREATMENT OF MOVEMENT-DERIVED STRUCTURES

4.1. INTRODUCTION

This chapter presents an overview of previous studies on the treatment of syntactically complex structures derived by movement based on the explicit teaching of syntactic rules.

During the last thirty years, the intervention on movement-derived sentences was grounded in the methodology of the explicit teaching of syntactic rules, which has been revealed to be an effective technique for (re)habilitation. The efficacy of this methodology is due to: (i) the participant's reflection on his/her language, hence s/he is conscious to have learned something and can retell what s/he has learned (Ellis 2009); (ii) the good results reached with very young children, individuals affected by brain, sensory, or linguistic impairment, i.e. individuals with hearing impairment and fitted with a CI, children with Specific Language Impairment (SLI) and agrammatic aphasic patients and with bilinguals and L2 speakers.

The chapter is organised as follows. Section 4.2. describes the treatment carried out by Roth (1984) to improve and accelerate very young children's acquisition of relative clauses. Section 4.3. presents the treatment of restrictive relative clauses in a child with hearing impairment and fitted with a CI (D'Ortenzio 2015). In section 4.4. the syntactic treatment given to a syntactic SLI child will be described (Levy and Friedmann 2009). Section 4.5. presents the syntactic intervention administered to an adolescent with dyslexia (Piccoli 2018). Section 4.6. presents an overview of the immense work done by Thompson and her research group on the treatment of agrammatic aphasic patients. Section 4.7. is devoted to the training of bilingual and L2 Italian-speaking individuals (Bozzolan 2016, Volpato & Bozzolan 2017; De Nichilo 2017).

4.2. IMPROVEMENT AND ACCELERATION OF CHILDREN'S ACQUISITION OF RELATIVE CLAUSES

Children start to properly produce relative clauses near the age of 3 (Crain et al. 1990; McKee et al. 1998; Pérez-Leroux 1995; Varlokosta & Armon-Lotem 1998; Guasti 2002). The comprehension of these structures appears later, at around 6 years (Sheldon 1974; de Villiers et al. 1979; Tavakolian 1981; Goodluck & Tavakolian 1982; Håkansson & Hansson 2000; Guasti 2002).

Having these results in mind, Roth (1984) tried to accelerate and improve very young children's comprehension of relative clauses by resorting to explicit teaching of movement-derived structures. The experiment had a twofold purpose: (i) to verify whether it was possible to accelerate children's

language acquisition of relative clauses by explicitly teaching them their underlying syntactic rules; (ii) to analyse if a relation exists between linguistic abilities and cognitive development. The success of the explicit syntactic training does not imply the use of other forms of human cognition.

The study was carried out with a group of 18 very young English-speaking children aged between 3;6 and 4;6. None of the participants had any neurological, linguistic, or sensorial impairment.

This study was focused on relative clauses, since they are considered substantive universal, i.e., their processing is difficult for both children and adults. Moreover, having knowledge of children's language acquisition, relative clauses provide an interesting point of view for the observation of the strategies used by children to understand these structures. Indeed, the comprehension of relative clauses seem to be acquired at a later stage than their production.

The study was organised as follows. Firstly, the experimenter defined three phases, namely a pre-test session, an intervention, and a post-test session. Secondly, children were randomly associated to a training condition. Roth distinguished three different training conditions in order to analyse the efficacy effects of different training methods. The list below supplies a description of each training condition.

- During the *explicit training condition,* the child was told how discontinuous non-interrupted elements, such as those in sentence (83), could combine into a sentence formed by continuous and interrupted elements such as (84):

  (83) The lion follows the zebra and the lion watches the elephant.

  (84) The lion that follows the zebra watches the elephant.

- During the *implicit training condition*, only sentences formed by interrupted elements as in (84) were presented to the child, so as to test his/her inductive capacities;
- During the *control condition*, the child was exposed only to conjoined structures as in (83), in order to analyse if the performance on the post-test phase could be attributed to factors other than training.

All interventions were accomplished by resorting to an Act-out task. Indeed, children manipulate toy objects to figure out the sentences they were exposed to. Children were tested twice during the post-test session: the first soon after the end of the intervention, and the second some months later.

Results showed an improvement in both post-test conditions, namely the treatment effects have been maintained also several months after the end of the treatment; a significant improvement has been found in children who have followed the *explicit* and the *implicit training conditions*, while children

from the *control training condition* did not show any improvement. A further interesting outcome consisted in generalization effects to sentence word order, which draw attention to children's preference for sentences in which the canonical order of the constituents was maintained. This hypothesis is supported by the children's *first noun* and *SVO* errors[32] to process relative clauses. The former strategy consisted in children's interpretation of the first-heard noun as the subject of both the main and the subordinate clauses, whereas SVO errors indicate that children basically rely on word order to process complex structures.

4.3. TREATMENT OF RESTRICTIVE RELATIVE CLAUSES IN A CHILD FITTED WITH A COCHLEAR IMPLANT

The participant in this experiment is LB, an 8;5-year-old boy, who was first diagnosed with hearing impairment at the age of 2 and promptly received his first conventional HAs. He received a CI at the age of 2;7. At the time of treatment, LB had gained an experience of CI use of 5;10 years. LB received speech-language therapy once a week. He was followed by two assistant teachers for 5 hours a day at school, and by a communication assistant for 12 hours a week. LB was selected for the treatment experiment because he displayed an impaired production of object relatives.

Before treatment, LB was assessed on the production and comprehension of relative clauses using the tests developed by Volpato (2010). Results before treatment showed the typical asymmetry between subject relatives and the two types of object relatives allowed by Italian in both production and comprehension. In the production test, he showed a preserved production of subject relatives and a problematic production of object relatives, i.e. he avoided the target structure and produced ungrammatical sentences, such as *Mi piace il bambino che fa il diritto al cane di seguirlo* 'I like the child that makes the right to the dog to follow him'. However, LB showed a good performance in the comprehension test, even better than the control group.

Since LB showed the typical asymmetry in the production and comprehension of relative clauses and a zero production of object relatives, he was chosen for the experiment. The aim of the study was to analyse whether training on relative clauses would improve the participant's performance in the production and comprehension of these structures and whether the effects of treatment would be maintained over time. The intervention was carried out over three months and consisted of six sessions, each lasting 75 minutes. During each session, comprehension and production exercises were administered in both written and oral modalities. Each session included a teaching and a training part.

[32] The first noun errors consisted in children's interpretation of the first-heard noun as the subject of both the main and the subordinate clauses, whereas SVO errors indicate that children basically rely on word order to process complex structures.

The sessions were distributed into three phases, and only after it was clear that LB was able to deal with a certain structure, another structure was presented.

- *Verb argument structure and Theta criterion*. This phase was accomplished in two sessions. Following Levy and Friedmann (2009), the main aim of this stage was to turn LB's implicit knowledge into explicit knowledge, which could be used as a support during the explanation of *wh*-movement. During this phase, intransitive verbs, reversible, and non-reversible transitive verbs, and ditransitive verbs were used. Verb argument structure was explained through several exercises highlighting that a verb needs a specific number of arguments to make the sentence correct. When LB could explain verb argument structure, the Theta criterion was introduced by explaining the relation between the verb and its arguments and using the terms AGENT and THEME. Indirect objects were introduced without focusing on the different thematic roles the verb can assign. To summarize verb argument structure and Theta criterion, the experimenter resorted to the metaphor described by Levy and Friedmann (2009), namely the verb is like an officer who can control a variable number of soldiers/arguments depending on his rank. Soldiers do not have the same task, and the verb-officer decides which roles its argument-soldiers must play.
- *Wh-movement*. The second phase of the treatment comprised three sessions and was entirely dedicated to *wh*-movement. As in Levy and Friedmann (2009), the sentences in which the participant performed above chance even before treatment, hence SRs, were trained first. During these sessions, only non-reversible and reversible transitive verbs were used as target. Each type of relative clause was first introduced without semantic reversibility to enable the reliance on non-syntactic cues. A semantically reversible version of each structure was introduced only after *wh*-movement was clear to LB. During this stage, a card game was used to teach *wh*-movement. The card game comprised: noun-cards; verb-cards; VP-cards, complementizer-cards, and trace-cards. To explain syntactic movement, each sentence was presented on cards to show LB that sentences may be created by the movement of a constituent from one position to another in the sentence. A chain establishes a connection between the original position and the final one. LB was taught that the argument that moves does not lose its right to receive a thematic role, although it is no longer in the place where the verb usually assigns it a thematic role. To receive a thematic role, the argument that moves leaves a trace behind, the verb assigns the trace the thematic role, and the role is transferred from the trace to the argument via a chain. A metaphor was used to reinforce the concepts of traces and chains. In this case, the trace is compared to a postman, who brings a letter from the verb to the moved constituent; the thematic role assigned by the verb is written on

the letter. After the theoretical part, LB was given some comprehension and production exercises, which were always administered with the card game.

- *Review*. The last session represented the third and last phase of the intervention. During this session, the topics taught during the previous sessions were reviewed, starting from the verb argument structure, then the Theta criterion was examined, and finally *wh*-movement was reviewed. Both the oral and written modalities were used during the review, and both comprehension and production exercises were administered for the learning of syntactic movement. At the end of this session, LB draw all the necessary movements that occur in each type of relative clauses starting from the easiest structure, i.e. subject relative clauses.

The results collected soon after the end of the treatment showed that LB performed at ceiling in each task and in each structure and did not show any asymmetry in the production and comprehension of relative clauses. LB was also tested five months after the end of the treatment, and his performance showed no regression, he still performed at ceiling in all structures except for an error in the production of object relatives with embedded preverbal subject and an error in the comprehension of object relatives with embedded postverbal subject. It is worth mentioning that in the assessment after five months from the end of treatment, LB resorted to different strategies to produce object relatives, namely, he produced object relatives with resumptive clitic pronouns (*Mi piace il bambino che l'orso lo morde* 'I like the child that the bear bites him'). This strategy may be due to an influence caused by a simultaneous acquisition of clitic pronouns.

4.4. TREATMENT OF SYNTACTIC MOVEMENT IN SYNTACTIC SLI

SLI affects from 3% to 10% of the children population aged between 2 and 6 years (Pozzan 2006) and is more frequent in boys. It may have genetic origins, more than 22% of the SLI population has an individual in his/her family showing the same impairment (Rice et al. 1998). SLI is a specific impairment of children's linguistic skills, which occurs in the absence of other developmental deficits (Reilly et al. 2014), its symptoms do not concern auditory, phono-articulatory and neurological systems. To be diagnosed with SLI, a child must present more than 2 SD below the mean in his/her language skills, and at least 1 SD below in his/her non-verbal skills (WHO 2010). Children affected by SLI show a delayed language acquisition in relation to their typically developing peers, and, moreover, they show a deviant pattern.

The linguistic system is organised in independent modules (syntax, phonology, pragmatics, semantics, and lexicon). Friedmann and Novogrodsky (2008) showed the selectivity of SLI, i.e. only one of the language components could be impaired, while the others are unimpaired. After they

assessed individuals with SLI's linguistic profiles, they identified different SLI's subgroups: Syntactic SLI (SySLI), Lexical SLI (LeSLI), Phonological SLI (PhoSLI), Semantic SLI (SemSLI), and Pragmatic SLI (PraSLI). Children affected by SySLI show significantly worse performance if compared not only to typically developing age peers, but also to younger children. Their deepest difficulties concern comprehension and production of movement-derived structures and in the processing of free inflectional morphology (for example, clitic pronoun and determiners). More specifically, the deficit involves sentences with a non-canonical order of constituents. The same difficulties in the processing of movement-derived structures with a non-canonical word order was found also in several studies on Italian-speaking children with SLI (Bottari et al. 1998; Jakubowicz et al. 1998; Tsimpli & Stavrakaki 1999; Guasti 2002; Pozzan 2006; Friedmann & Novogrodsky 2007, 2008; Adani et al. 2009; Contemori & Garraffa 2010; Guasti et al. 2014). For instance, considering that the canonical word order in Italian is SVO (Subject-Verb-Object), Italian-speaking children with SLI misprocess sentences presenting OSV (Object-Subject-Verb) order such as object relatives, object *wh*-questions, and sentences containing clitic pronouns.

Intervention studies on SySLI children were introduced by Ebbels and her collaborators (Ebbels & van der Lely 2001; Ebbels et al. 2007). These studies have a significant impact on the field of research concerning the treatment of moved-derived sentences in children with SLI, since they describe a new methodology known as *shape coding therapy* (Ebbels 2007), which resort to visual cues to make the structure of language explicit. It uses combinations of shapes, colours, and arrows to indicate phrases, parts of speech, and morphology. The shape coding therapy focuses on the explicit teaching of the links between the syntactic structures and meaning, which are explained in terms of verb argument structure.

This finding has influenced Levy and Friedmann's work (2009) with a Hebrew-speaking boy with SySLI. Levy and Friedmann (2009) gave a treatment based on syntactic rules to Gal, a Hebrew-speaking SySLI boy aged 12;2. Gal was tested before, during and after treatment on sentences derived by *wh*-movement and sentences containing verb movement. The results collected before treatment showed: an impaired production and comprehension of movement-derived structures, such as object relative clauses, *wh*-questions, focalization sentences, and sentences containing verb movement, but an adequate competence of sentences in which the canonical constituent order was preserved, as for example subject relative clauses. Interestingly, Gal's competence on verb argument structure was intact. Therefore, Levy and Friedmann (2009) grounded their treatment on Gal's intact competence of verb argument structure.

The treatment was carried out over six months. It consisted of 16 sessions lasting between 20 to 60 minutes. Each session was divided into three parts: explanation, training, and testing. Gal was given written and oral exercises. Levy and Friedmann divided Gal's treatment into three phases:

- *Verb argument structure*. During this phase the experimenters explained the difference between intransitive, transitive and ditransitive verbs, hence the fact that verbs need a different number of arguments to make sense in the sentence. To pursue the goal of this phase, the experimenters used a metaphor: verbs were compared to officers who, according to their grade, could exercise their command upon the soldiers, which represented the arguments. It was very important to take advantage of the patient's interests, in order to make the therapy less demanding and more agreeable.
- *Theta criterion*. To explain this rule, the experimenters resorted to the metaphor of the verb-officer and the soldiers-arguments. Verbs are like officers who, depending on their ranks, can command a precise number of soldiers. For example, transitive officers can command two soldiers-arguments. Moreover, the verb-officer, after he has chosen its arguments-soldiers, tells them which tasks they must accomplish, namely the verb assigns thematic roles to its arguments.
- *Syntactic movement*. The experimenters faced the problem how to teach syntactic movement to a child by using a card game, which allows a clear and tangible explanation of movement. Through the card game, it was possible to show to Gal how the constituents of a sentence move to form a new and more difficult sentence. Chains and traces were explained to the patient by using colours. After this part, characterized by high tangibility, a more abstract phase including oral tasks began. The experimenters treated two types of movement: *wh*-movement (focus, object and subject RCs) and verb movement. *Wh*-questions, despite having been included in the pre-treatment phase, were not explicitly treated on purpose. Indeed, the authors aimed at analysing generalization effects to untrained structures. Hence, they verified whether the performance on *wh*-questions would improve after treatment focused on focus sentences, and subject and object RCs.

As said before, Gal was tested during and after treatment. Results showed an improvement in both trained and untrained structures and in almost all the tasks assessed with a percentage of accuracy at ceiling. Other tasks, such as the paraphrasing task and the repetition task, showed lower percentages of correctness. Indeed, Gal scored 80% in the object relatives paraphrasing task, 75% in the repetition of object relatives and 88% in the repetition of subordinate clauses without movement.

It is worth mentioning a U-band pattern in the production of some structures, such as the elicitation of subject relatives. During the pre-treatment phase, Gal did not show any difficulties in the

production of subject relatives. However, in the assessment during treatment, he scored 0% of accuracy. His errors consisted in the use of resumptive pronouns in the production of subject relatives, a strategy which is ungrammatical in Hebrew. This error was never found in Gal's performance at the end of treatment. The authors have put forward the hypothesis that this U-band performance was analogous to what happens during children's spontaneous language acquisition. When children start to produce verbs, they do not resort to any non-target pattern, also producing irregular verbs. However, during a later stage, children start elaborating their own grammar and producing the so-called generalization errors, giving rise to words such as English *goed* and *comed*. This phenomenon could explain Gal's case, too. Before treatment, he was able to produce subject relatives spontaneously, but, when he was taught that Hebrew allows the use of resumptive pronouns only in object relatives, he overgeneralised this rule and produced ungrammatical sentences by also introducing resumptive pronouns in subject relatives. This overgeneralization demonstrates that a process of linguistic acquisition was indeed having place. Moreover, resumptive pronouns started being used in the majority of object relatives, after treatment, while, before that, they were never attested.

Finally, it was possible to verify that the treatment focused on *wh*-movement-derived structures had positive effects in the comprehension and production of *wh*-questions, even if these constructions have not been treated directly.

4.5. Syntactic intervention administered to an Italian-speaking adolescent with dyslexia

Specific learning disorders (SLD) are neurodevelopmental disorders that manifest themselves during school-age. SLD refers to ongoing problems in one or more of three areas, reading, writing and math, which are foundational to one's ability to learn, thus compromising children's school adjustment and limiting one's everyday activities (Italian Law 170/2010). Taking into account the damaged areas, it is possible to identify four types of SLD: dyslexia, dysorthographia, dysgraphia, and dyscalculia (Consensus Conference 2007). SLD affects children with normal cognitive abilities, normal IQ, without neurological pathologies and/or sensory deficits, without emotional or relational disorders, and without socio-cultural disadvantages. In many cases, students with a diagnosis of SLD also present an impairment in working memory, in procedural memory, and show attentional problems (Italian Law 170/2010; Piccoli 2018). In particular, the selective and divided attention are significantly impaired, thus causing scarce motivation, anger, resignation, and low self-esteem in the students (Italian Law 170/2010, Piccoli 2018).

In Italy, the rate of children suffering from SLD varies from 3 to 4%.

Of all the deficits categorised as SLD, dyslexia is the most studied. (Developmental) Dyslexia is a life-long disorder that consists in an impaired ability of learning how to read accurately and fluently. It may have genetic origins, indeed children with dyslexia may have individuals in their family showing the same impairment. Between 5% and 7% of school-aged children suffer from dyslexia (Guasti et al. 2015). Dyslexia is identified as a language disorder ascribable to phonological and phonology processes (Castle & Coltheart 2004). In addition to this, much recent research shows that this population may also have an impaired oral language. However, these problems are difficult to detect since they easily escape standardized testing (Guasti et al. 2015).

Several studies have analysed the syntactic competence of Italian individuals with dyslexia (Vender & Delfitto 2010; Guasti 2013; Zachou et al. 2013; Cardinaletti 2014; Pivi 2014; Pivi & Del Puppo 2014; Cardinaletti & Volpato 2015; Guasti et al. 2015; Arosio et al., 2016; Pivi et al. 2016; Arosio et al., 2017). Cardinaletti and Volpato (2015) carried out a study on the production and comprehension of object relative clauses and passive sentences in a group of Italian-speaking university students with dyslexia. The results show that the students with dyslexia are less accurate than their controls in the production of object relative clauses. Cardinaletti and Volpato state that the difficulty in the processing of object relatives is due to the syntactic complexity of this structure.

Taking these results into consideration, Piccoli (2018) administered a syntactic intervention to an Italian-speaking adolescent with dyslexia (DS1). The treatment lasted two months and comprised eleven sessions each lasting 90 minutes. Each session was split in four parts: a review of the previous topics; introduction and presentation of the aims of the session; explicit teaching; reinforcement activities. Each session presented written and oral exercises. The treatment carried out by Piccoli was divided in four stages described in the following list:

- *Explicit teaching of verb argument structure and Theta Criterion*. This first phase lasted two sessions. During the first session the difference between zero argument, monovalent, divalent and trivalent verbs[33] was explained to the participant. The experimenter asked DS1 to paraphrase the definitions of the four verb typologies and then to find them in given examples. Then, the participant was asked to analyse the other elements of a sentence and to highlight them with different colours. Resorting to some metaphors (Haegeman 1996; Levy and Friedmann 2009), the participant was explained the Verb argument structure and the Theta Criterion.
- *Explicit teaching of syntactic movement and relative clauses*. This second phase comprised seven sessions. During this phase, the experimenter taught the participant wh-movement in several

[33] This topic will be exhaustively explained in chapter 5, section 5.2.

typologies of relative clauses starting from the less impaired. Therefore, the participant was given some exercises on subject relative clauses, object relative clauses (with preverbal embedded subject, and with postverbal embedded subject), and oblique relative clauses (dative, locative, genitive). This phase of the syntactic intervention was carried out through a card game designed specifically for this treatment.

- *Review*. All the topics at the core of treatment were reviewed during a single session.
- *Final assessment*. The participant was re-assessed with a sentence repetition task (Del Puppo et al. 2016) and a task for the elicitation of relative clauses adapted from Mulas (2000).

After treatment, the participant showed an improvement in the production and repetition of subject and object restrictive relative clauses, and oblique relative clauses (dative, locative, and genitive). The improvement was observed in untreated sentences as well, namely cleft and interrogative sentences. Therefore, it is possible to confirm the validity of the treatment based on the explicit teaching of syntactic rules also for individuals with dyslexia.

4.6. TRAINING SENTENCE PRODUCTION IN AGRAMMATISM

Aphasia is a neurological condition caused by an injury to the portions of the brain in the left hemisphere responsible for language by which an individual can acquire an impairment in the production and comprehension of oral and written language (Basso 2003; Basso & Macis 2011; Luzzatti 2011).

Assuming that language is processed in several areas of the left hemisphere, and in some cases also in certain areas of the right hemisphere, it is possible to classify distinct types of aphasia depending on the area in the brain affected by it (Fig. 20); these types of aphasia can be ascribed to two main groups depending on the quality of the patient's oral production (Basso 2003, 2005; Denes 2009; Luzzatti 2011). On the one hand, *fluent aphasia* is characterised by an abundant spontaneous speech lacking prosodic or articulatory deficits. The patient's production presents long sentences with complex syntactic structures, which can be characterised by interruptions, failed agreements, and errors with function words. The types of aphasia ascribed in this group are: Wernicke's aphasia, conduction aphasia, anomic aphasia, and transcortical sensory aphasia. On the other hand, *non-fluent* aphasia is defined by insufficient spontaneous speech. The patient produces words with effort and is not able to assign the right prosody to speech. Sentences are short with simple syntactic structure, as in telegraphic messages. Broca's aphasia, Global aphasia, mixed transcortical aphasia, and transcortical motor aphasia are included in this group (Basso 2003, 2005; Denes 2009; Luzzatti 2011).

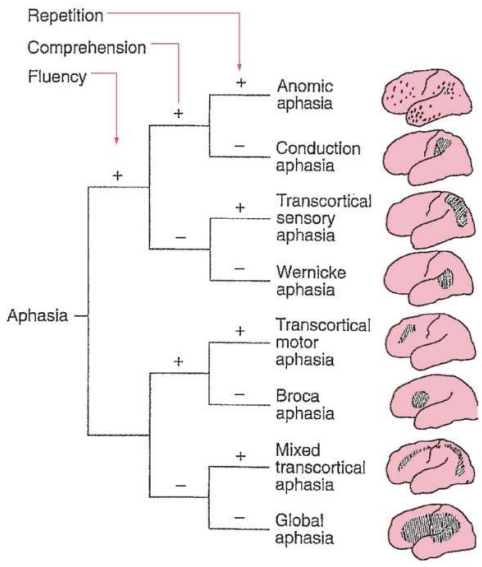


Fig. 20: types of aphasia and related damaged areas, neupsykey.com/approach-to-the-patient-with-aphasia-2/, 27th September 2018.

One of the deficits that mostly strikes non-fluent aphasic patients is *agrammatism*, which is a language-specific morphosyntactic deficit presenting with a unique speech pattern known as *telegraphic speech*, which is characterised by sentences built as telegraphic messages. Utterances contain content words and lack functional words. They may also display errors with verb inflection. Many intervention studies on Broca's patients have been carried out, which can be divided into two main branches depending on the treatment approach embraced: (i) the Mapping Therapy (Schwartz et al. 1994; Haedinges et al. 1996; Rochon et al. 2005); (ii) the Treatment of Underlying Forms (TUF, Thompson & Shapiro 2005). Both approaches are grounded on Theta criterion (Chomsky 1981) and syntactic properties of sentences. While Mapping Therapy focuses on simple sentences, TUF is focused on syntactically complex structures. Furthermore, TUF follows the so-called *complexity effect*, namely the treatment is grounded on more complex structures (e.g. cleft sentences) in order to help generalization effects to simpler untrained structures derived by the same syntactic movement. Indeed, it is possible to achieve generalization effects to *wh*-questions after a training focused on cleft sentences or object relative clauses, but not the other way around (Thompson et al. 1998; Thompson et al. 2003). TUF is the result of a large amount of previous studies which originated from Grodzinsky's[34] proposal (1990) to explain Broca's aphasics impaired production and comprehension of complex structures resorting to Government and Binding Theory (GB: Chomsky 1986; Chomsky & Lasnik 1991).

[34] Grodzinsky (1990) claims that the agrammatics' difficulty with the comprehension of sentences with a non-canonical order of constituents, such as object relative clauses, is due to the position in which the moved constituent leaves its 'trace' or 'gap'. Indeed, sentences involving the movement of the subject are correctly comprehended by this population.

Since their first experiments in the treatment of syntactic deficits, Thompson and Shapiro (1995) included in their training some aspects of Chomsky's Principles and Parameters approach to GB theory (Chomsky 1986; Chomsky & Lasnik 1991). Moreover, some findings from psycholinguistic and neurolinguistic literature provided a basis for selecting sentences used during the intervention. In a nutshell, the aim of Thompson and Shapiro's studies is to link linguistic and psycholinguistic issues with a proper research design in order to investigate whether the effects of the training generalize to untrained forms.

Since one of their first studies (1995), Thompson and Shapiro's treatments are usually divided in four phases:

- *Identification of the verb argument structure in simple active sentences*. This first phase relies on the normal access to verb and thematic information of Broca's patients (Shapiro & Levine 1990; Shapiro et al. 1993; Tyler 1994; Kegl 1994);
- *Movement of the proper sentence constituent to formulate new sentences* (such as *wh*-questions). Starting from the hypothesis that training complex sentences helps generalization to untrained structures derived by the same syntactic movement, Thompson and Shapiro focused their treatment on sentences formed applying the rule "move-alpha" in which moved constituents leave behind a 'trace' or 'gap' in their original position. This kind of training emphasizes the lexical and syntactic properties of target sentences, by training aphasics patients to produce non-canonical sentences working through the thematic roles of NPs; the movement of NPs required to derive the s-structure of complex sentences, and the insertion of grammatical elements in the surface sentence string. Training complex sentences helps generalization to untrained sentences derived by the same type of movement. For example: training *wh*-questions introduced by *what* allow an improvement also to *wh*-questions introduced by *who*, even though this structure was not used during training. This hypothesis helped Thompson and Shapiro to delineate the Complexity Account of Treatment Efficacy (CATE): "*training complex structures results in generalization to less complex structures when untreated structures encompass process relevant to (i.e., are in a subset relation to) treated ones*" (Thompson et al. 2003: 602).
- *Production of the surface form of the targeted structure.*
- *Comprehension and production of sentences with a non-canonical order of constituents*.

The results of their studies show that treatment improves production and comprehension of the sentence types entered into treatment. The generalization to untrained structures is possible only to

those that are syntactically similar to the trained structures. In addition to this, generalization effects are enhanced when the direction of treatment is from more complex to less complex structures. Moreover, it appears that treatment affects the processing of trained sentences in real time. A further outcome is the positive effects of the treatment in the increase of the Mean Length of Utterance (MLU) of grammatical sentences, the production of a greater number of VP; the improvement in verb argument structure processing, which consists also in a more correct use of thematic roles. Additionally, positive outcomes were attested in adjuncts production. Finally, in a study by Dickey and Thompson's (2004), it is also demonstrated that meta-linguistic competence, namely the ability to reflect upon language to make judgements on structures, significantly improved on treated patients, differently from non-treated ones.

4.7. TRAINING OF BILINGUAL AND L2 ITALIAN-SPEAKING INDIVIDUALS

The term bilingualism indicates the capacity to use more than one language regularly (Sorace 2011). In fact, it is quite impossible to have the same control of two or more languages. This can be explained by several reasons: (i) the heterogeneity of type and the amount of input, for example when the parents speak two different languages and the child is exposed to them alternatively; (ii) one of the languages is always dominant in relation to the other(s); (iii) interaction or separation between the linguistic systems (i.e. code mixing and code switching); (iv) socio-psychological factors can push an individual to use a language more than the others, as in the case of migrant people (Bathia & Ritchie 1999). Therefore, the acquisition of a second language is heavily conditioned by several factors that can be *internal* (personality, motivation, attitude in learning languages, cognitive maturity, etc.) and *external* (quantity and quality of L1 and L2 input, language used in the social milieu, etc.) (Paradis 2004).
Despite this, bilingualism provides to individuals a series of advantages from social, linguistic, and cognitive perspectives.
According to several studies, it is possible to identify two types of bilingualism depending on the age of onset of each linguistic system:

- In *simultaneous bilingualism*, the age of onset is comprised between the birth and 3 years of life (McLaughlin 1978). However, the early age of onset alone cannot be a sufficient condition to reach a native-like competence in a L2 (Scovel 1988). Native-like proficiency in a L2 with early age of onset is indeed less common than it was assumed to be.
- In *sequential* or *successive bilingualism,* the age of onset is comprised between 3 years and the puberty (McLaughlin 1978). A child experiences a situation of sequential L2 acquisition when he/she is exposed to only the language of his/her family from birth, and later starts experiencing

a second language in kindergartens or in pre-school daily care environments (Lasaux et al. 2007; Genesee 2008). Some studies have pointed out that children can reach a native-like proficiency in their L2 if the first exposure to the second language is before the completion of the critical period.

Some differences stand out if simultaneous and sequential bilingualisms are compared on several language domains. For instance, simultaneous bilinguals show a pattern comparable to monolinguals' one, while sequential bilinguals make errors comparable to adults acquiring a second language. Errors appear not only when the L1 and the L2 are typologically different, but also when the languages are very similar to each other. On the one hand, if two languages are dissimilar, the child makes errors since he/she would have to set those parameters that had been already established during his/her first language acquisition. On the other hand, if two languages are similar, the child encounters difficulties in distinguishing between them, giving rise to cases of code *switching* or *mixing* (Zobl 1980).
Starting from the typical errors of sequential bilinguals, Bozzolan (2015), Bozzolan and Volpato (2017), and De Nichilo (2017) presented some studies in which the explicit teaching of syntactic rules helps the acquisition of Italian as L2.

4.7.1. Training a bilingual Romanian-Italian girl with Italian as L2

Bozzolan (2016) and Bozzolan and Volpato (2017) described an approach to the training of movement-derived sentences in a bilingual Romanian-Italian 7;4-year-old girl, JM. She can be considered as a *sequential* bilingual, since she came to Italy at the proper age for kindergarten. Therefore, she was exposed to the Italian language in a proper period for an effortless acquisition of language (Guasti 2002).
JM was tested before and after treatment on her general level of comprehension of Italian by resorting to the *Test di Comprensione Grammaticale per Bambini* (TCGB, Chilosi & Cipriani 2006). Then, she was assessed with more specific tasks. She was tested on the production and comprehension of subject relatives, and two types of object relatives, with preverbal and postverbal embedded subjects (Volpato 2010, 2012; Volpato & Vernice 2014), and she was administered the production and comprehension tasks of passive sentences (Verin 2010). The results of the TCGB showed that JM's performance was comparable to that of 6-year-old children. She performed poorly in locative constructions, relative clauses, passive sentences, and sentences containing dative complements. Her difficulties with relative clauses and passive sentences were confirmed by more specific tests. Results on the production and comprehension tests on relative clauses showed the typical asymmetry between subject relatives, object relatives with preverbal subjects, and object relatives with postverbal subjects, namely

subject relatives are easier than both types of object relatives, and object relatives with preverbal subjects are less challenging than object relatives with postverbal subjects (SR>OR>ORps) (Volpato & Adani 2009; Volpato & Vernice 2014). Therefore, JM's production and comprehension of subject relatives were preserved, with only few errors of thematic roles inversion, that is, she produced an object relative instead of a subject relative. JM avoided the production of both types of object relatives by resorting to several incorrect strategies. She inverted the thematic roles, namely she produced a subject relative instead of an object relative. She produced relative clauses with resumptive clitic pronouns. Moreover, she produced ungrammatical sentences, sentences with wrong number and/or gender agreement, and ambiguous sentences. Interestingly, differently from her Italian-speaking age-peers, who avoided the production of an object relative by producing a passive sentence, JM never resorted to this strategy. Results of the comprehension task showed many difficulties with object relatives with postverbal subjects. Particularly problematic were object relatives with a singular head in which the thematic roles were usually reversed. The results of the tests on the production and comprehension of passive sentences showed a preference for actional verbs over non-actional verbs. The participant showed more difficulties in the production task.

Considering these errors, Bozzolan developed an intervention focused on relative clauses and passive sentences in order to improve JM's production and comprehension of these structures. The intervention comprised of ten sessions lasting from 45 to 60 minutes each and carried out over three months. Following previous studies on the explicit teaching of syntactic rules, the intervention was split into four phases:

- *Verb argument structure*. During this phase the differences between intransitive, transitive and ditransitive verbs were explained to JM. Differently from Levy and Friedmann (2009) the metaphor used perfectly fitted with the participant's interests, hence the verbs were compared to queen bees who can have power over one (intransitive verbs), two (transitive verbs) or three (ditransitive verbs) bees/arguments, according to their importance. Following the *Shape Coding Therapy* (Ebbels & van der Lely 2001), the different elements of a sentence were presented with different shapes and colours, as an example, subjects were all presented on orange circle-shaped strips of paper. This strategy allowed a more immediate explanation of verb argument structure.
- *Theta criterion*. Once the participant had shown that she was accurate with the previous stage, the Theta criterion was introduced. Taking inspiration from Haegeman's (1994) comparison between verbs' structure and the theatre environment[35], the experimenter painted a stage on a

[35] "Predicates are like the script of a play. In a script a number of roles are defined and will have to be assigned to actors. The arguments of a predicate are like the roles defined by the script of a play. For an adequate performance of the play, each role must be assigned by an actor. It will not do either to miss out on a part in the play or to have actors on the stage

poster: some verbs could afford only an actor, some could have two actors, and some other even three; however, all the available actors had to be on the stage, otherwise the play would not work. Moreover, every character had to have one specific part to perform on the stage.

- *Wh-movement*. Following previous studies (Levy & Friedmann 2009; D'Ortenzio 2015), the experimenter explained the *wh*-movement in subject relatives and object relatives by resorting to a card game. To start the game, the experimenter wrote SVO order simple sentences with different cards, then she moved the cards in order to derive a new complex sentence.
- *NP-movement*. Taking inspiration from the "Smuggling" hypothesis by Collins (2005), the experimenter resorted to the card game to teach JM all the necessary steps to derive a passive sentence from a simple SVO sentence. Even though the explanation of these structures took more time, JM showed great interest and succeeded during the following activities.

Results at the end of the intervention showed an improvement in some of the tasks administered. In the TCGB, JM made less errors than in the pre-intervention test, thus reaching the competence of a 6;6-year-old child. The production of relative clauses did not improve significantly, namely all the strategies used during the pre-intervention assessment, ambiguous sentences above all, were maintained. The participant's outcomes in the comprehension task showed an improvement, unexpectedly higher in sentences characterised by match conditions, where both the subject and the object were either plural or singular. This result goes in the opposite direction of what has been proved for monolingual Italian-speaking children, i.e. the comprehension of relative clauses is improved when the number features of the arguments of a sentence are manipulated. For example, Italian monolingual children show a higher accuracy in object relatives with a subject showing number features [+pl] (*La gallina che i pulcini beccano* 'The hen that the chicks peck') (Adani et al. 2009; Volpato 2010; Adani et al. 2014)[36]. The results collected during the assessment of passive relatives are more encouraging. In the production task, JM produced less than the half items, which is a good result considering that she did not produce any target passive sentences during her pre-intervention assessment. The comprehension of passive sentences was at ceiling (100%) in all the items tested. Concluding, in this experiment also the reliability of intervention grounded on the explicit teaching of syntactic rules has been confirmed in this experiment.

who have no part to play. Adjuncts might be compared to the parts in the script which are not central to the play" (Haegeman 1994: 44).

[36] The author suggested that this result could have been be caused by the influence of JM's L1. In fact, in standard Romanian the 3rd person singular and plural of the verb are homophone and homograph, and this condition may have provoked confusion, rather than being a helping cue.

4.7.2. Training a Bengali-speaking adolescent with Italian as L2

A. is a Bengali-speaking adolescent aged 18 years attending the second year of Secondary school (Applied Sciences), who showed a problematic production and comprehension of complex structures, such as relative clauses, passive sentences, and clitic pronouns.

Before treatment, A. was assessed on free and guided writing; summary; grammar judgments (Chesi 2006); production of clitic pronouns (Arosio et al. 2014); production and comprehension of passive sentences (Verin 2010); production and comprehension of subject and object restrictive relative clauses (Volpato 2010). The results before intervention showed a weak mastery of Italian syntax. In the writing tasks (free and guided writing, summary), A. showed an age-inadequate competence mostly characterised by simple SVO order sentences, coordinate sentences, and ungrammatical sentences. The production and comprehension of clitic pronouns were frequently omitted or substituted with full DPs. A. showed the same tendency in the production and comprehension tasks on passive sentences: on the one hand, he performed poorly with non-actional verbs, on the other hand he showed a preference for sentences in which the auxiliary was *essere* (to be) (rather than *venire* (to come)). In the production and comprehension of relative clauses, the participant disclosed the well-known asymmetry between subject relatives and two types of object relatives (SR>OR>ORp). Moreover, the comprehension of object relatives with postverbal subject was completely absent (0%).

The intervention was built on the explicit teaching of head-to-head movement, *wh*-movement, and NP-movement starting from the most delayed structure for A.

Intervention comprised eleven sessions lasting 120 minutes each, carried out over two months (December 2016 – January 2017). Each session was divided in a teaching part and a practice part.

- *Verb argument structure*. It was accomplished in two sessions. Following Levy and Friedmann (2009) and Bozzolan (2016), the experimenter explained to A. the differences between intransitive, transitive and ditransitive verbs. During this phase, verb argument structure was explained by resorting to the metaphor of the verb/director and the arguments/actors, i.e. the verb is like a director who directs an exact number of arguments (Haegeman 1994; Bozzolan 2016).
- *Theta criterion*. Only one session was devoted to this topic. Resuming the metaphor of the verb/director and the arguments/actors, the experimenter explained that the verb/director, after it/he has chosen its arguments/actors, decides which roles they must play before "going on stage". The experimenter resorted to the following question to start the participant's reflexion on this syntactic rule: "Have you ever seen an actor performing two separate roles at the same time?".

- *Syntactic movement*. This stage was completed in six sessions. The teaching of the syntactic movement started from the most delayed structures, namely clitic pronouns, which were analysed using the materials described in Rossi (2015). Only when A. showed his accuracy in dealing with head-to-head movement, the experimenter introduced *wh*-movement focusing on subject relatives and object relatives with preverbal subjects.

A week after the end of the intervention, A. was tested, and results showed improvements in all the structures explained during the intervention. Clitic pronouns were largely produced and never omitted or replaced. Passive sentences with non-actional verbs were correctly produced and comprehended. The production of object relatives with preverbal subjects reached 100% (from 0% in the pre-intervention assessment;); also the comprehension of object relatives with embedded postverbal subjects largely improved (from 0% to 92%). Finally, also A's writing skills improved: he almost never or less produced ungrammatical sentences, even though he still showed a preference for simple sentences.

Concluding, it is possible to claim that explicit teaching of syntactic rules is a valid intervention to improve language skills in L2 learners.

The following table resumes the treatments presented in this chapter in order to have the main information about them at a glance.

Tab. 38: comparison of the main characteristic of experiments of syntactic intervention

Author	**Roth (1984)**	**Thompson and Shapiro (1995, 2005)**	**Levy and Friedmann (2009)**	**Piccoli (2018)**	**Volpato & Bozzolan (2017)**	**De Nichilo (2017)**	**D'Ortenzio (2015, 2017)**
Population	TD children	Agrammatic aphasics	Children with SLI	Adolescent with dyslexia	Italian L2 children	Italian L2 adults	Children with CIs
Aim	Accelerate children's language acquisition	Treatment of complex structures and analysis of generalization effects on untrained structures	Improve the comprehension and the production of trained and untrained structures	Improve the production and repetition of subject and object relative clauses, and oblique relative clauses (dative, locative, and genitive)	Improve the comprehension and the production of relative clauses and passive sentences	Improve the comprehension and the production of complex structures (relative clauses; passive sentences; clitics)	Improve the comprehension and the production of relative clauses. Analyse generalization effects on free speech
Subject(s)	TD English-speaking children in age from 3;6 to 4;6 without any handicap or impairment	People with mild to moderately severe agrammatic Broca's Aphasia with Aphasia Quotients 65-85	12;2-year-old Hebrew-speaking child with syntactic SLI	15;3-year-old adolescent with dyslexia	7;4-year-old bilingual Italian-Romania girl	18-year-old young man with Bangla as mother tongue and Italian as L2	8:5-year-old Italian-speaking CI child (LB)
Target structures	Interrupted and non-interrupted relative clauses	Sentences derived by NP- and *wh*-movement	Sentences derived by verb or argument movement	ORs, oblique relative clauses (dative, locative, and genitive)	Relative clauses and passive sentences	Relative clauses, passive sentences, clitics	Relative causes (SRs, ORs, ORps)
Treatment methodology	Sentences were performed by using some toy objects (ACTING-OUT). Relative clauses were simplified in coordinate sentences	4 stages: -comprehension and production of Theta theory; -NP movement to a different position; -sentence production after NP movement; -comprehension and production of sentences with non-canonical order of constituents	6 months treatment; 16 sessions lasting from 20 to 60 minutes; Each structure was trained first in writing and then orally; 3 stages: -Verb argument structure; -Theta criterion; -Verb and argument movement	2 months treatment; 11 sessions lasting 90 minutes; 4 stages: -Verb argument structure and Theta Criterion; -wh-movement; -review; -assessment	3 months treatment; 10 sessions lasting max 60 minutes; Use of colours and shapes (Ebbels & van der Lely, 2001); 4 stages: -Verb argument structure; -Theta criterion; -*wh*-movement (SRs, ORs); -NP-movement (passives)	2 months treatment; 11 sessions lasting 120 minutes; 4 stages: -Verb argument structure; -Theta criterion; -syntactic movement (head movement, NP-movement, *wh*-movement); -review	2-3 months treatment; 6-7 sessions lasting 70 minutes; 4 stages: -Verb argument structure; -Theta criterion; -*wh*-movement; -review
Results	Significant improvement in all the structures analysed	Generalization effects in untrained structures and on discourse	Improvement in trained and untrained structures → generalization effects	Improvement in trained and untrained structures → generalization effects	Improvement in all trained structures, except ORs	Improvement in all the treated structures. Better performance in writing	Improvement in trained structures.

5. TREATMENT OF MOVEMENT-DERIVED SENTENCES IN ITALIAN-SPEAKING CHILDREN WITH COCHLEAR IMPLANTS

5.1. INTRODUCTION

Several studies across languages have pointed out the struggle of children with hearing impairment and fitted with HAs or CIs with syntactically complex structures, such as relative clauses, *wh*-questions, and passive sentences (Quigley & Paul 1984; De Villiers 1988; Friedmann & Szterman 2006, 2011; Delage 2008; Friedmann et al. 2008; Volpato & Adani 2009; Guasti et al. 2012; Friedmann & Haddad-Hanna 2014; Volpato & Vernice 2014; Ruigendijk & Friedmann 2017; Volpato & D'Ortenzio 2017; Penke & Wimmer 2018). Additional studies have shown delayed narrative skills in individuals with hearing impairment who avoided the production of syntactically complex structures by resorting to several strategies (Chesi 2006; Boons et al. 2013). Examples of those strategies are the omission or substitution of determiners, clitic pronouns, and prepositions; the incorrect use of number and gender agreement; the preference for shorter simple sentences instead of complex sentences derived by syntactic movement (Beronesi & Volterra 1986; Caselli & Volterra 1993; Caselli et al. 1997; Taeschner et al. 1998; Ajello et al. 2002; Franchi 2004; Bertone & Volpato 2009; Rinaldi & Caselli 2009; Caselli et al. 2012;).

Bearing in mind the findings described in the studies listed above, two case studies will be presented in this chapter. The purpose of these experiments is to present a short-term treatment focused on the explicit teaching of syntactic rules to two Italian-speaking girls fitted with CIs, with the aim to improve their morphosyntactic abilities and narrative skills. Both treatments follow and modify the first approach to the treatment of relative clauses in a child fitted with a CI (D'Ortenzio 2015; D'Ortenzio et al. 2017), which has been described in section 4.3. Therefore, the syntactic interventions described in this chapter were founded on the explicit teaching of verb argument structure (Chomsky 1981)[37], the Theta criterion (Chomsky 1981), and *wh*-movement (Chomsky 1971; Vergnaud 1985; Kayne 1994; Bianchi 1999).

However, some changes have been made. Differently from the first treatment carried out by D'Ortenzio (2015), which was focused on three different types of subject and object restrictive relative clauses, namely subject relatives, object relatives with preverbal embedded subject, and

[37] The same verb properties, namely the number of constituents needed by different verbs, are explained by Tesnière in terms of valency (1959).

object relatives with postverbal embedded subject. For the experiments carried out for this study, it was decided to focus the treatment only on object relative clauses with preverbal embedded subject following Thompson et al.'s (2003) Complexity Account of Treatment Efficacy (CATE). According to Thompson et al. the treatment of more complex structures allows generalization effects to easier structures derived by the same type of movement. Moreover, Thompson (2003) and Thompson and Shapiro (2005) showed also that treatment focused on syntactically complex structures can generalise to narrative skills. A further change was introduced with the perspective to analyse the efficacy of treatment through generalization effects to verbs and nouns. For this reason, during treatment, different verbs and nouns from those used during the pre- and post-treatment assessment were used.
The participants at these experiments were selected and tested at the ENT Clinic, Department of Neurosciences, University of Padua, where they undergo the necessary medical examinations to check the functioning of their CIs.
The chapter is organised as follows. The syntactic rules on which the treatment of movement-derived sentences are briefly presented in section 5.2. Section 5.3. is devoted to the description of the treatment given to ES, which was put into practice by Vanzin, D'Ortenzio, Montino and Trevisi, for Vanzin's bachelor's thesis in speech therapy (November 2016). This first study presents some enhancement of the treatment described by D'Ortenzio (2015), namely the treatment of only object relative clauses with preverbal embedded subject; the introduction of the analysis of generalization effects to untrained structures and narrative skills; and the insertion of an indirect treatment carried out by the parents. Section 5.4. is dedicated to the description of the syntactic intervention given to MM, which was administered by the author of this thesis. The aims of this treatment were to confirm the enhancement of ES' treatment, and the developing of new materials that could be useful to adapt this experimental methodology to conventional speech therapies. Section 5.5. serves as a summary of this chapter and gives rise to a discussion of the methodologies and results that will be described in the following sections.

5.2. SYNTACTIC RULES AT THE BASIS OF THE TREATMENT

In this section, a brief description is provided of the three theories on which the treatment of movement-derived sentences is based. Following the order in which they were taught to the participants, the first theory is the verb argument structure (Chomsky 1981), followed by the Theta criterion (Chomsky 1981), and the *wh*-movement (Vergnaud 1985; Kayne 1994; Guasti & Shlonsky 1995; Bianchi 1999; Donati 2008).

- **Verb argument structure (Chomsky 1981)**

Verb argument structure specifies the number of obligatory arguments the verb requires. Arguments are the participants or states expressed by the verb and are usually noun phrases (NPs). Depending on how many arguments the verb selects, it is possible to distinguish four verb categories:

- *zero argument verbs* which take no arguments and are in most of the cases weather verbs (it rains, it snows, it thunders);
- *monovalent verbs* which only take one argument (John laughs);
- *divalent verbs* which take two arguments. The first argument, the subject, is positioned in an external position to the VP, while the second argument, the direct object with transitive verbs 'Mary cuts the cake' or an oblique object with intransitive verbs 'Mark looks at the painting', occur in an internal position of the VP;
- *tetravalent verbs* which take three arguments, namely the subject, the direct object and an indirect object 'Julia gives a present to Anthony', or a locative 'Julia puts a book on the table'.

If a verb expresses an activity involving two arguments, there will be at least two constituents in the sentence to enable these arguments to be expressed. For instance, the verb *follow* needs two arguments (83a); if one of the arguments is missing (83b), the sentence is ungrammatical as shown by the following examples:

(83) a. The dragon follows the prince.
b. *The dragon follows.

- **Theta criterion (Chomsky 1981)**

The verb assigns to each argument in the sentence one and only one thematic role, which determines the semantic relationship between the verb and its arguments as stated by the Theta criterion (Chomsky 1981). Here will be reported Haegeman's (1994: 54) paradigm:

(84) a. Each argument is assigned one and only one theta role.
b. Each theta role is assigned to one and only one argument.

According to the Theta criterion, a verb like *wash* assigns AGENT and THEME roles, and therefore it must assign both roles in each sentence it appears in. The AGENT is assigned to the NP that appears before the verb in subject position, while the THEME is assigned to the NP that follows it, in object position. For example, in (85a) the verb *wash* assigns the AGENT role to the NP *Mario* and the

THEME role to the DP *the cows*. Missing one of the thematic roles in (85b), or the verb assigns a wrong thematic role (85c), the Theta criterion is violated, and the sentence is ungrammatical.

(85) a. Mario washes the cows.
b. * Mario washes.
c. * Mario washes with sponges.

- ***Wh*-movement (Chomsky 1971; Vergnaud 1985; Kayne 1994; Bianchi 1999)**

Syntactic movement describes the operation by which an element can move from its original position to a new position in the sentence. The moved element leaves a trace in its original position which is a phonetically empty element working as a "place keeper" and receives the thematic role of the relocated phrase (Chomsky 1995). The trace transfers the thematic role to the moved element through a "chain". Depending on the moved element and the landing site, i.e. the position to which an element moves, it is possible to determine the type of syntactic movement. For example, passive sentences are derived by NP-movement, that is the movement of an NP to an empty subject position (88). On the other hand, *wh*-movement is the movement of *wh*-constituents to sentence-peripheral positions (89 a-b). Structures containing *wh*-movement are: relative clauses; left-dislocated sentences (90); cleft sentences (91); *wh*-questions (92 a-b).

(86) [$_{DP}$ the witches [$_{IP}$ are [$_{VP}$ followed <the witches>] by [$_{vP}$ the princess [<followed the witches>]]]]

(87) a. [$_{CP}$ The princess that [$_{IP}$ <the princess> [$_{VP}$ follows [$_{DP}$ the witches]]]]
b. [$_{CP}$ The witches that [$_{IP}$ the princess [$_{VP}$ follows [$_{DP}$ <the witches>]]]]

(88) [$_{CP}$ the car [$_{IP}$ John [$_{VP}$ washes it [$_{DP}$ <the car>]]]]

(89) [$_{CP}$ [$_{TP}$ it [$_{vP}$ is [$_{FocP}$ JOHN [$_{FinP}$ that [$_{TP}$ <John> washes the car]]]]]]

(90) a. [$_{CP}$ Which princess [$_{IP}$ <which princess> [$_{VP}$ follows [$_{DP}$ the witches?]]]]
b. [$_{CP}$ Which princess [$_{VP}$ do [$_{IP}$ the witches [$_{VP}$ follow [$_{DP}$ <the princess>?]]]]]

5.3. TREATMENT OF MOVEMENT-DERIVED SENTENCES IN ES[38]

As was anticipated in the introduction to this chapter, the treatment of movement-derived sentences in ES was described in the bachelor's thesis in speech therapy by Francesca Vanzin (2016) under the

[38] A preliminary version of the data presented in this section have been published in the proceedings of the conference 'SPEECH AND LANGUAGE 2017 – 6th International Conference on Fundamental and Applied Aspects of Speech and Language, Life activities advancement center The Institute for Experimental Phonetics and Speech Pathology "Đorđe Kostić".

supervision of Silvia D'Ortenzio, Silvia Montino and Patrizia Trevisi. The purpose of this experiment was to modify the syntactic intervention described by D'Ortenzio (2015) in order to analyse generalization effects to untrained structures and to narrative skills. As a matter of fact, in D'Ortenzio's work generalization effects were not taken into account because it focused on the validity of treatment and the maintenance of the results over time. Moreover, Vanzin suggested some strategies which are typically used during conventional speech therapies, as for example the insertion of an indirect treatment.

This section is organised as follows. Section 5.3.1. is devoted to the description of ES and the participants of her control group[39]. In section 5.3.2. the results collected before treatment are presented. Section 5.3.3. gives an overview of the treatment given to ES. Finally, in section 5.3.4.the results of post-treatment assessment are presented.

5.3.1. Participants

The participant in this study is ES, a 10;5-year-old girl, who was diagnosed with hearing impairment at the age of 1;10. After she was fitted with HAs, she was only exposed to oral language. ES received the CI at the age of 8;4, therefore she uses the CI for 3;4 (years; months). At the time of the experiment, she gained an auditory experience of 1;11 (years; months) with her CI. ES wears the CI on the right ear, and the HA on the left ear. At the time of treatment, ES received speech therapy once a week, she was followed by an assistant teacher at school and by an educator eight hour a week. Since kindergarten, ES uses the FM System[40] during the school hours.

During her follow-up medical examination at the ENT Clinic, ES performed almost at ceiling during the speech perception tests. The following table shows the results related to an identification task which examines one's auditory discrimination of vowels, consonants, disyllabic words, trisyllabic words, non-words, and sentences. The task is administered by the speech therapist hiding his/her mouth, in order to evaluate the prosthetic gain in a condition of normal volume of speech:

[39] Following Levy and Friedmann's (2009) methodology the participant's performance was compared with that of control participants matched on comparable chronological age and with no diagnosis of speech, language or hearing impairment. As in Levy and Friedmann, the aim of this study was to bring the participant to the syntactic competence of her TD age-peers. Therefore, the control group was tested only once so as to provide a syntactic benchmark to attest whether the participant reached the same syntactic level of her TD age-peers or not.

[40] A Frequency Modulated System (FM System) allows individuals with hearing impairment fitted with HAs or CIs to have a better hearing experience in noisy places, such as school classrooms. The FM System consists of two parts: (i) the transmitter and microphone worn by the teacher, which picks up the speaker's voice and transmits it to the listener's ears; (ii) and the receiver attached to the HA or the CI, which receives the sounds from the transmitter and delivers it to the HA or CI. The FM System allows to shorten the distance between the speaker and the listener to 3-6 inches. In order to have a good signal the receiver must be at 15 metres away from the transmitter.

Tab. 38: rate of correctness of the audio-perceptual test administered to ES during her follow-up examinations.

TASK	Rate
Vowel identification	100%
Consonant identification	95%
Disyllabic word identification	100%
Trisyllabic word identification	100%
Non-word identification	60%
Sentence identification	90%

Lexical and morphosyntactic skills were assessed with several standardized tests. ES' comprehension of vocabulary was assessed through the Italian version of the Peabody Picture Vocabulary Test (PPVT, Stella et al. 2000). Results collected after PPVT showed a performance comparable to the participant's normal hearing age peers. The vocabulary production was tested with the *Test di Denominazione Figurato* 'Picture Naming Task' (Brizzolara 1996). Also in this task ES showed a performance comparable to normal hearing age-peers.

ES' performance was compared with a control group (NH group) of fourteen normal hearing children aged 6;8 - 11;1 (mean age: 8;2), seven boys and seven girls. The participants of the control group were tested individually during the summer camp at the kindergarten Asilosanvito in Valdobbiadene (TV). In the following table, the data of the control group are summarized:

Tab. 39: main information about the participants at the control group

SUBJECTS	AGE	SEX
1	6;8	M
2	7;3	F
3	7;3	F
4	7;6	M
5	7;7	M
6	7;8	F
7	7;10	M
8	7;11	F
9	8;7	M
10	9;9	F
11	9;9	F
12	10;5	M
13	11	M
14	11;1	F

5.3.2. Pre-treatment assessment

The participant's morphosyntactic abilities and narrative skills were evaluated before treatment, so as to detect the most impaired structures and to settle down a starting point for treatment. Vanzin tested ES during two meetings. During the first meeting she accomplished the TCGB (Chilosi et al.

2006) and the Frog story (Meyer 1969), in order to have a general overview of her morphosyntactic abilities and narrative skills. During the second meeting, ES was assessed by Vanzin on the production and the comprehension of subject and object restrictive relative clauses with an elicited production task and a character selection task both developed by Volpato (2010) for a more detailed analysis of her competence in syntactically complex structures.

5.3.2.1. Test di comprensione grammaticale per bambini

The *Test di comprensione grammaticale per bambini* 'Grammar Comprehension Task For Children' (TCGB, Chilosi et al. 2006) is a standardized test used for the assessment of morphosyntactic abilities in children aged between 3;6 and 8 years. TCGB is very common in clinical practice and is also administered to older children in order to determine their linguistic age, as in the case of ES, who is 10;5 (years; months) old.

The test comprises of 76 tables. Each table presents four pictures and only one of them matches with the target sentence, while the other scenarios have the role of lexical and semantic distractors. The test analyses the comprehension of several Italian structures such as locatives, inflections, SVO sentences, negative SVO sentences, passives, negative passives, datives. Speech therapists usually analyse the quantitative data, however, TCGB allows also a qualitative analysis of the errors made by the participants pointing out the strategies adopted in the comprehension of the tested structures.

The following picture provides some examples of the TCGB:

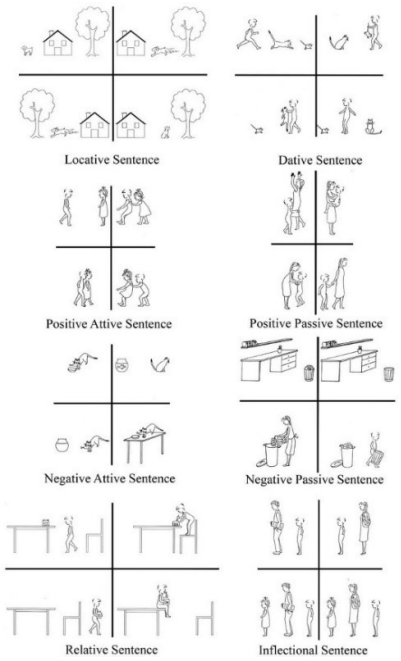


Fig. 21: some stimuli from TCGB (Chilosi et al. 2006)

ES' performance was compared to the data available for typically developing 8-year-old children, since no data referred to older children is available. During the pre-treatment assessment, ES scored 11 points showing poorer performance than typically developing children at the age of 8 years (<5°). Positive and negative passive sentences were found as the most impaired structures (only 7 correct responses over 18 stimuli). Relative clauses, which were expected to be impaired, were found not as problematic as passive sentences. TCGB is provided by an error score: the higher the total score, the worse is the participant's performance. The score depends on the number of repetitions of the items: if the participant gives a correct answer the first time, he/she receives 0 point; when the answer is correct after the first repetition, 0,5 point is given; when the participant does not answer correctly after the second repetition, he/she receives a 1,5 point.

The table below shows the results related to the TCGB and collected before treatment.

Tab. 40: Results after the pre-treatment assessment with TCGB.

	first try errors	**error score**	**Percentile (reference: 8 y.o.)**
	PRE	**PRE**	**PRE**
Inflection	2	2	<5°
Locative	2	1	<5°
Relative	1	0,5	25°
affirmative simple SVO	0	0	>25°
Negative simple SVO	0	0	>50°
Dative	1	1,5	<5°
Positive passives	4	2,5	<5°
Negative passives	3	3,5	<5°
TOT	13	11	<5°

5.3.2.2. Frog story

Discourse-specific skills, involving distinct types of competence, are required during storytelling. Therefore, narrative production represents a crucial tool through which it is possible to study and analyse children's typical and atypical developmental process of several abilities: cognitive, linguistic, pragmatic, and social understanding in different observational settings (D'Amico et al. 2008). Starting from this assumption, ES' narrative skills were assessed by resorting to the *Frog story*. *Frog, where are you?* (Meyer 1969) is a book composed of 24 pictures telling the story of a boy, a dog and a frog. In a nutshell, the boy owns a dog and a frog, but the frog escapes during the night. When the boy and the dog wake up the following morning, they notice that the frog has escaped, so

they start to search it first in the house, and then outside in a wood, where they find several animals. At the end of the story, the boy and the dog find the frog. The *Frog story* helps therapists to analyse whether the child has an appropriate use of complex sentences, has an adequate Mean Length of Utterances (MLU), makes morphosyntactic errors, and displays narrative competence. This task is administered to children ranging in age from 3;6 to 12.

The following table summarizes ES' narrative skills before treatment:

Tab. 41: number and rate of the strategies adopted by ES during her assessment of narrative skills through the frog story.

FROG STORY			
		N	**Rate**
	words	274	
	sentences	56	
	MLU	4.89	
	hesitations	19	
Sentences	Main	10/56	18%
	Coordinate	23/56	41%
	Subordinate	10/56	18%
	Relative	1/56	2%
	Passive	0/56	0%
	Ungrammatical/incomplete	12/56	21%
Clitics	Personal	7/11	64%
	Reflexive	2/11	18%
	No-agreement	1/11	9%
	Omission	1/11	9%
	Total	11/274	4%

As Table 41 shows, ES produced 274 word distributed over 56 sentences, resulting in an MLU equal to 4,89. The participant hesitated 19 times. She produced a high number of coordinate sentences (23/56), followed by main sentences and subordinate clauses (10/56), only one relative clause was produced, and the number of ungrammatical or incomplete sentences was equal to 12. ES showed a good use of clitic pronouns, she omitted them only once. Only one wrong clitic pronoun was produced. She used more personal clitic pronouns than reflexive ones. Before treatment, ES' oral production was characterized by ungrammatical sentences, incorrect Theta-role assignment, and age-inappropriate MLU, even though she produced some relative clauses and clitic pronouns.

5.3.2.3. Production of relative clauses

Before analysing ES' responses to the elicited production task (Volpato 2010) it is important to clarify that, differently from the participants to this study (CI children and TD children) who were assessed on a short version of the elicited production task[41], ES and her control group (NH group) were administered the full version of this task. Therefore, they answered to 12 stimuli eliciting a SR, and to 12 stimuli eliciting an OR.

As the table below shows, ES' answers to the task were characterised by the typical asymmetry between subject relatives and object relatives with preverbal embedded subject, namely the former are easier than the latter. The participant produced 83% of correct subject relatives, while she produced only 34% of object relatives. When an object relative was elicited, ES sometimes produced the target structure, with either gaps (*I bambini che il papà sta pettinando* __ 'The children that the father is combing __') or resumptive full DPs (*Il bambino che il papà sta lavando il bambino* 'The child that the father is washing the child'). In order to avoid these complex structures she resorted to several strategies, namely the inversion of theta roles (*I bambini che tirano i leoni* 'The children that pull the lions', target: *I bambini che i leoni tirano* 'The children that the lions pull'); subject relatives with head inversion (*L'orso che accarezza il bambino* 'The bear that caresses the child', target: *Il bambino che l'orso accarezza* 'The child that the bear caresses'); ungrammatical or incomplete sentences (*Mi piacciono i bambini che … con i nonni* 'I like the children that … with the grandparents', target: *Mi piacciono i bambini che i nonni baciano* 'I like the children that the grandparents kiss'); finally, she resorted to other strategies including the use of non-target verbs (*I bambini che la maestra gli ha dato un premio* 'The children that the teacher them gives a reward', target: *I bambini che la maestra premia* 'The children that the teacher rewards').

Tab. 42: number and rate of the correct answers of ES' response to the elicited production task. SR= subject relative clause; OR= object relative clause with preverbal embedded subject; N= number.

	ES		**NH group**	
	N	**Rate**	**N**	**Rate**
SR	10/12	83%	165/168	98%
OR	4/12	34%	10/168	6%

[41] As previously described in chapter 3, sections 3.5.2. and 3.5.5. the time employed in the ENT clinic for the elicited production task and for the comprehension task (Volpato 2010) was reduced so as to respect the time limit imposed by the ENT Clinic. The stimuli of the elicited production task were halved, namely participants were asked to produce six subject relative clauses and six object relative clauses with preverbal embedded subject. In the character selection task, all stimuli investigating ambiguous sentences and several filler sentences were omitted.

5.3.2.4. Comprehension of relative clauses

The comprehension of relative clauses was assessed with the character selection task developed by Volpato (2010). Before treatment ES showed an atypical behaviour in the comprehension of relative clauses, she performed indeed better in the comprehension of object relative clauses with preverbal embedded subject than subject relatives, while the comprehension of object relatives with postverbal embedded subject was more impaired than subject relatives and object relatives with preverbal embedded subject, as it was expected. A qualitative analysis of the data collected showed that ES selected the answer to subject relative clauses at chance level since she chose most of the times the character indicating an incorrect interpretation of the thematic roles. When an object relative with preverbal embedded subject was asked, ES selected the reversible character most of the cases. The same strategy was also selected when was assessed the comprehension of an object relative clause with a postverbal embedded subject was assessed.

The following table resumes the number and rate of correctness of the answer of the character selection task.

Tab. 43: number and rate of the correct answers collected by ES' responses at the character selection task. SR= subject relative clause; OR= object relative clause with preverbal embedded subject; ORp= object relative clause with postverbal embedded subject; N= number.

	ES		**NH group**	
	N	**Rate**	**N**	**Rate**
SR	9/12	75%	143/168	85%
OR	20/24	83%	249/336	74%
ORp	2/12	17%	114/168	68%

5.3.3. Treatment

ES was selected for the study because she showed a problematic production on several aspect of the processing of relative clauses. Indeed, ES produced a low number of object relative clauses with preverbal embedded subject; she comprehended with effort subject relative clauses and object relative clauses with postverbal embedded subject; and she did not show age-adequate narrative skills. The intervention given to ES lasted seven weeks and consisted of seven sessions divided in three phases. Each session lasted between 60 and 75 minutes. Each session was divided into two parts: the first half concerned the review of previous topics, while the second half introduced new topics. During each session, different exercises were proposed. The intervention also comprised an indirect therapy, which was not carried out by the experimenter, but it consisted in playing a card game with a member of the family for 15 minutes three times a week, or she was asked to tell the story described by a

picture book. The following table summarizes the duration, and the session's frequency and timing of the treatment carried out by Vanzin (2016).

Tab. 44: structure of the direct and indirect therapy given to ES

	Direct therapy	**Indirect therapy**
Duration	2 months	
Sessions	7 weeks	7 weeks
Frequency	Twice weekly	Three times a week
Session's timing	60-75 minutes	15 minutes

The several stages of the treatment carried out by Vanzin (2016) will be now presented. The first stage is focused on verb argument structure and Theta criterion, the second stage consisted in explaining *wh*-movement, and the third stage consisted in the review of all the topics taught during treatment.

- *Verb argument structure and Theta criterion*. The first stage comprised two sessions. As in Levy and Friedmann (2009) and D'Ortenzio (2015, see also D'Ortenzio et al. 2017), the purpose of this stage was to turn the implicit knowledge of the verb argument structure and Theta criterion into explicit knowledge, which could be used as a support during the explanation of *wh*-movement.
  Differently from D'Ortenzio (2015), during this first phase the verb list did not include the verbs used in the elicited production and character selection tasks, in order to avoid that the participant got used to the same verbs contained in the tasks administered during the pre- and post-treatment assessment, influencing the validity of the results of the treatment.
  Verb argument structure was introduced asking the participant to pick three different verbs from a list and to write for each verb a simple SVO sentence. After the sentences were reviewed by the experimenter, the participant was asked to underline the verb and its arguments. This exercise was further improved by resorting to some cards. On each card the nouns and the verbs of each sentence were written. Then, the experimenter added or removed the arguments of the verbs, so as to show the participant that verbs need a fixed number of arguments to avoid the ungrammaticality of the sentence. Resorting to a card game made the verb argument structure more evident to the child and much easier to explain. When ES showed a good mastery of verb argument structure, the Theta Criterion was introduced.
  As in Levy and Friedmann (2009) and D'Ortenzio (2015), the Theta Criterion was introduced resorting to a metaphor. However, since the participant in this study is a girl and, above all things,

the experimenter wanted to use a peaceful metaphor[42], the verb was compared to an orchestra leader, the arguments were compared to musicians, and the theta roles to music instruments[43]. Like the orchestra leader, who is essential for the success of a symphony, the verb is indispensable for the meaning of the sentence. Each musician has one and only one music instrument, and the orchestra leader decides how many musicians must play a symphony and which music instruments he needs. After each session, ES filled in a 'review table', where verbs were divided depending on their argument structure. During this first phase also a more complex text was introduced 'Hiccup and the magic beans' written by the experimenter following ES' interest for dragons and the cartoon *Dragon trainer*.

- *Wh-movement*. The second stage included four sessions. Even though this phase was largely dedicated to *wh*-movement, verb argument structure and Theta criterion were briefly reviewed at the beginning of each session.

  As said before, differently from D'Ortenzio (2015), only object relative clauses with preverbal embedded subject were treated in order to analyse generalization effects to subject relative clauses and object relative clauses with a postverbal embedded subject. Even though the comprehension of object relative clauses with preverbal embedded subject was more preserved than subject relative clauses and object relative clauses with postverbal embedded subject, this structure was selected since its derivation is difficult for children. Moreover, said structureis also more complex than subject relatives and allows generalization effects to making it hard to distinguish it from easier sentences derived by the same movement (Thompson et al. 2003). Moreover, only reversible and non-reversible transitive verbs were used as target. Sentences without semantic reversibility were introduced first; semantically reversible object relative clauses with preverbal embedded subject were presented only when the movement was clear to the participant. *Wh*-movement was explained using a card game. Each sentence was presented on different cards. The moved constituent was first shown in its original position, then it was moved to a position in the left periphery of the sentence. ES was told that when the object moves, it leaves a trace, which functions as a bookmark, in the position where it was generated. The verb assigns the thematic role to the trace, which transfers the theta role to the moved object through a chain.

- *Review*. The last phase of the syntactic intervention was carried out in one session. The experimenter decided to plan it fifteen days after the completion of the second phase, to facilitate

[42] Both Levy and Friedmann (2009) and D'Ortenzio (2015) compared the verb to an officer and the arguments to soldiers.
[43] The metaphor used for this treatment was developed by Vanzin and D'Ortenzio, the authors then realised that the metaphor can be comparable to that used by Haegeman (1994) and cited also by Bozzolan (2016) and De Nichilo (2017), in which the verb is compared to a director and the arguments to the actors of a theatre company.

generalization effects. During this last phase all the topics taught during the treatment were reviewed using the card game and the 'review table'.

Table 45 summarizes all the stages and sessions of the treatment conducted by Vanzin (2016). The first column presents the syntactic rules taught during each session, while the second column shows the related activities to the syntactic rules.

Tab. 45: summary schema of the syntactic treatment given to ES with some of the activities done during the seven sessions

FIRST STAGE – VERB	
SESSION 1	
Differences between intransitive, transitive, and ditransitive verbs	- introduction of the VERB TABLE; - choice of three verbs; - write a simple SVO sentence with each of the chosen verbs.
Theta Criterion	- use of cards; **-THE ORCHESTRA LEADER METAPHOR** (using the sentences written by the participant): each sentence constituent plays the role of a musician (the AGENT and the THEME) or of the orchestra leader (the verb).
SESSION 2	
Review of the topic tackled during the first session	-completion of the REVIEW TABLE by resorting to the ORCHESTRA LEADER METAPHOR; -underline verbs in given sentences.
Verb argument structure and Theta criterion	-underline the AGENT and the THEME of the sentences written by the participant during the first session.
Differences between intransitive, transitive, and ditransitive verbs	- position the underlined verbs in the REVIEW TABLE
SECOND STAGE – *WH*-MOVEMENT	
SESSION 3	
Review of the first phase topics (verb argument structure, Theta Criterion)	-complete the REVIEW TABLE resorting to the ORCHESTRA LEADER METHAPHOR; -analysis of 3 sentences of the text 'Hiccup and the magic beans'; -writing some simple SVO sentences using a card game[44].
- ***WH*-MOVEMENT**	- **The syntactic intervention is focused only on ORs.** - to explain the *wh*-movement a card game is used. The experimenter and the participant write simple SVO sentences, then the experimenter adds an external VP that attracts the object of the embedded sentence.
SESSION 4	
Review of the first phase topics (verb argument structure, Theta Criterion)	- the participant completes the REVIEW TABLE; - analysis of 3 sentences of the text 'Hiccup and the magic beans'.

[44] To play the card game, each participant picks eight cards (three verbs, and five names) and tries to write a simple SVO sentence. When the cards avoid the writing of a sentence, the participants can exchange the cards with each other or pick a new card from the set.

- ***WH*-MOVEMENT**	- the participant plays production and comprehension games only on ORs
Session 5	
Review of the first phase topics (verb argument structure, Theta Criterion)	-the participant reads the REVIEW TABLE, since I was completed during the last session; -analysis of 3 sentences of the text 'Hiccup and the magic beans'.
- ***WH*-MOVEMNT**	- the participant still plays games on the comprehension and the production of ORs with the card game.
SESSION 6	
- ***WH*-MOVEMENT**	- during the comprehension activities the experimenter introduces also SRs, and ORps in order to analyse whether any generalization effect has occurred
THIRD PHASE	
SESSION 7	
- Review	- analysis of the text 'Hiccup and the magic beans'; - production and comprehension activities with the card game; -written exercises focused only on ORs.

5.3.4. Post-treatment assessment

In this section the results of ES' post-treatment assessment are provided[45]. It is worth mentioning that the participant was assessed twice after treatment: the first soon after the end of the intervention, while the second was carried out two months after the first post-treatment assessment, to analyse whether the results of the treatment had been maintained over time.

5.3.4.1. Test di comprensione grammaticale per bambini

The TCGB was re-administered to evaluate ES' morphosyntactic abilities. As previously mentioned, results were compared with the data available for typically developing 8-years-old children, since no data referred to older children is available. Recalling the data collected before treatment, during the pre-treatment assessment, ES scored 11 points showing poorer performance than younger typically developing children (<5°). Positive and negative passive sentences were found to be the most impaired structures (only 7 correct responses out of 18 stimuli). Relative clauses, which were expected to be impaired, were found not as problematic as passive sentences.

The post-treatment assessments showed a general improvement in all the structures tested by the TCGB. An interesting outcome is the improvement in the comprehension of positive and negative

[45] Differently from Levy and Friedmann (2009) where statistical analysis (t-test and χ^2) were carried out to compare the participant's performance to his TD age-peers, for this study no statistical analysis was conducted since the number of participants was too small.

passive sentences. This piece of data will be discussed in the last section of this chapter. ES made only few errors that may be caused by a lack in concentration.

The table below shows the results related to the TCGB before and after treatment:

Tab. 46: results before and after treatment related to ES' morphosyntactic abilities

	first try errors			error score			percentile (reference: 8 y.o.)		
	PRE	**POST 1**	**POST 2**	**PRE**	**POST 1**	**POST 2**	**PRE**	**POST 1**	**POST 2**
Inflection	2	0	1	2	0	0,5	<5°	>25°	10°-25°
Locative	2	1	0	1	1,5	0	<5°	<5°	>50°
Relative	1	0	0	0,5	0	0	25°	>50°	>50°
Positive simple SVO	0	0	0	0	0	0	>25°	>25°	>25°
Negative simple SVO	0	0	1	0	0	0,5	>50°	>50°	>25°
Dative	1	0	0	1,5	0	0	<5°	>10°	>10°
Positive passives	4	0	0	2,5	0	0	<5°	>50°	>50°
Negative passives	3	0	0	3,5	0	0	<5°	>25°	>25°
TOT	13	1	2	11	1,5	1	<5°	>50°	>50°

5.3.4.2. Frog story

Before treatment, ES did not show age-adequate narrative skills, which were mostly characterised by ungrammatical sentences, inaccurate Theta-role assignment, and an age-inappropriate MLU, even though she produced some relative clauses and clitic pronouns.

After treatment, her performance showed a decrease in the number of hesitations from 19 to 6, and in the number of ungrammatical or incomplete sentences. However, improvement did not concern an increase in the production of complex sentences or in the use of clitic pronouns.

Table 47 shows the results of the participant's narrative skills tested trough the Frog story before and after treatment.

Tab. 47: comparison between ES' pre- and post-treatment assessment of narrative skills through the frog story.

FROG STORY					
		PRE		POST	
		N	Rate	N	Rate
	Words	274		261	
	Sentences	56		53	
	MLU	4.89		4.92	
	Hesitations	19		6	
Sentences	Main	10/56	18%	15/53	28%
	Coordinate	23/56	41%	21/53	40%
	Subordinate	10/56	18%	9/53	17%
	Relative	1/56	2%	0/53	0%
	Passive	0/56	0%	0/53	0%
	Ungrammatical/incomplete	12/56	21%	8/53	15%
Clitics	Personal	7/11	64%	9/16	56%
	Reflexive	2/11	18%	5/16	31%
	No-agreement	1/11	9%	2/16	13%
	Omission	1/11	9%	0/16	0%
	Total	11/274	4%	16/261	6%

5.3.4.3. Production of relative clauses

As aforementioned, ES and her control group (NH group) were administered the full version of the elicited production task (Volpato 2010).

Before treatment, ES showed the typical asymmetry between subject relatives and object relatives with preverbal embedded subject, namely the former are easier than the latter. After treatment, ES performed almost at ceiling in all the structures analysed. Therefore, she resorted in most of the cases to the target structure, namely a relative clause with a gap in the subject or object position. However, she still made a couple of errors in the production of object relatives with preverbal embedded subject. In fact, she produced a sentence where the Theta roles were inverted (*I bambini che tirano i leoni* 'The children that pull the lions', target: *I bambini che i leoni tirano* 'The children that the lions pull').

Tab.48: Results of the elicited production task administered before and after treatment. SR= subject relative clauses; OR= object relative clause with preverbal embedded subject; N= number.

	ES						NH group	
	PRE		POST 1		POST 2			
	N	Rate	N	Rate	N	Rate	N	Rate
SR	19/12	83%	12/12	100%	12/12	100%	165/168	98%
OR	4/12	34%	8/12	67%	11/12	92%	10/168	6%

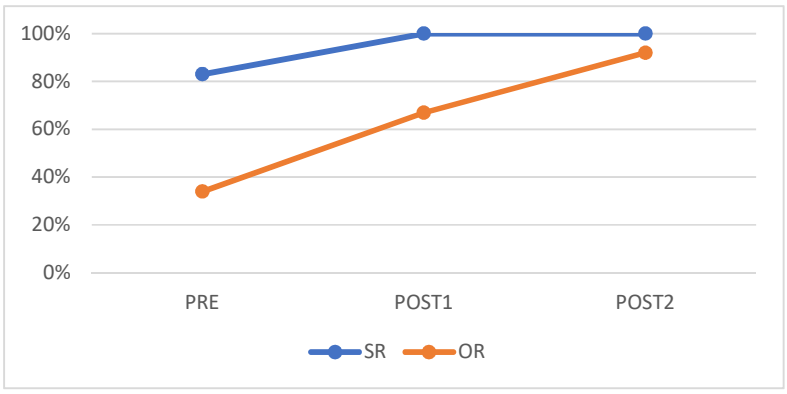


Fig. 22: graph showing ES' improvement in the production of restrictive relative clauses

5.3.4.4. Comprehension of relative clauses

The comprehension of relative clauses was assessed using the character selection task developed by Volpato (2010). Before treatment ES showed an atypical behaviour in the comprehension of relative clauses, she performed better in the comprehension of object relative clauses with preverbal embedded subject than subject relative clauses, while the comprehension of object relative clauses with postverbal embedded subject was more impaired than subject relative clauses and object relative clauses with preverbal embedded subject.

Soon after treatment, ES made some errors related to the selection of the reversible referent. For instance, she analysed an object relative clause with preverbal embedded subject as a subject relative clause. Two months after the end of treatment, her performance improved even more reaching ceiling effects in all the structures analysed.

Tab.49: results of the character selection task before and after ES' treatment. SR= subject relative clause; OR= object relative clause with preverbal embedded subject; ORp= object relative clause with postverbal embedded subject; N= number.

	ES						**NH group**	
	PRE		**POST 1**		**POST 2**			
	N	Rate	N	Rate	N	Rate	N	Rate
SR	9/12	75%	11/12	92%	12/12	100%	143/168	85%
OR	20/24	83%	23/24	96%	24/24	100%	249/336	74%
Orp	2/12	17%	10/12	83%	12/12	100%	114/168	68%

Fig. 23: graph showing ES' improvement in the comprehension of restrictive relative clauses

5.4. TREATMENT OF MOVEMENT-DERIVED SENTENCES IN MM[46]

In this section is described the treatment given to MM.

Before starting the description of the participant, the methodology and the results, some clarifications are needed. Differently from D'Ortenzio (2015) and D'Ortenzio et al. (2017), the participant in this study did not show any deep impairment or delay in the processing of RCs and, more in general, of the other syntactically complex structures and narrative skills. Nevertheless, among the children tested at the ENT Clinic, her parents were the only who showed interest in the innovative approach proposed for the treatment of movement-derived sentences. Interest in the research is indispensable both for the experimenter and the participant in order to get involved in the experience without feeling the pressure of a research environment.

A further problem was represented by the period of execution of the treatment, overall between July and October 2017[47]. Summer is a negative period for a regular planning of a treatment, since families have already organised their summer vacations with many activities. Moreover, she received the second CI in June 2017 and started the syntactic intervention in July 2017, this meant that she had many speech-therapy sessions for the training of the new CI. Therefore, also speech therapies influenced a regular planning of treatment since MM was often tired and decided to postpone a lesson. Therefore, the total duration of the treatment is only one month and a half, during which MM was given the treatment and tested again to analyse any improvement.

Differently from D'Ortenzio (2015) and the treatment carried out by Vanzin (2016), MM was not assessed several months after the end of treatment to investigate whether the treatment effects have

[46] A preliminary version of this experiment was presented during: Hearing Across the Lifespan 2018 (HEAL), Cernobbio (Italy), 7-9th June 2018, and Conference on Developmental Language Disorders (DeVo), Madrid (Spain), 26-28th September 2018.

[47] The treatment stopped during August and started again roughly in September.

been maintained during time. This decision was taken by the author since the participant established a kind of friendship with the experimenter and did not concentrate during the assessment part at the end of treatment. In defence of this decision, in the following sections the fruitless necessity of a further post-treatment assessment will be shown.

This section is divided as follows. In section 5.4.1. the participant and her control group are presented. Section 5.4.2. is devoted to the analysis of the results collected during the pre-treatment assessment. In section 5.4.3. the treatment given to MM will be described. Section 5.4.4. is dedicated to the analysis of the results collected soon after the end of the treatment.

5.4.1. Participant

The participant in this experiment is MM, a 9;9-year-old Italian-speaking girl suffering from bilateral severe-to-profound sensorineural hearing loss and fitted with bilateral CIs. She was diagnosed and received her first HA at 0;5 months. Since she did not receive enough benefits from her HAs, she was given a CI at the age of 2;9 on the right ear. After 6;11 (years; months), namely when she was 9;8 years old, she received the second CI on the left ear. She attended speech therapy once or twice a week. Since the experimenter met the participant the first time in July 2017, and the syntactic intervention lasted up to 2 months, the author did not collect any information about support teachers or communication assistants.

During her follow-up medical examination at the ENT Clinic, MM performed at ceiling during the audio-perceptual tests on her right ear. Since she received her left CI one month before the start of the treatment, her perception of sounds was not yet stationary. The following table shows the results related to MM's identification task of vowels, consonants, disyllabic words, trisyllabic words, non-words, and sentences, administered to check the participant's audio-perceptual ability with the only use of the right CI. The task is administered by the speech therapist hiding his/her mouth, in order to evaluate the prosthetic gain in a condition of normal volume of speech:

Tab. 50: percentages of correctness of the audio-perceptual test administered during MM's follow-up examinations.

TASK	Rate
Vowel identification	100%
Consonant identification	100%
Disyllabic word identification	100%
Trisyllabic word identification	100%
Non-word identification	100%
Sentence identification	100%

MM's results will be compared with the results of a control group[48] composed of typically developing normal hearing children matched on chronological age (mean age: 9;6) (TG group). The participants of the TG group are three Italian-speaking children, two girls and one boy, who came from different regions of Italy. The table below resumes the main information about the TG group:

Tab. 51: personal data of the participants of the TG group

SUBJECTS	AGE	SEX
GM	9;6	F
PN	9;5	M
GD	9;7	F

5.4.2. Pre-treatment assessment

Differently from the study on ES, it was decided not to assess MM's morphosyntactic abilities with standardized tests, but with more structure-specific experimental tests. Therefore, prior to the intervention study, MM was assessed on the repetition of complex sentences (Del Puppo et al. 2016); the production of relative clauses (Volpato 2010); the comprehension of relative clauses (Volpato 2010); the production of *wh*-questions (Guasti et al. 2012, 2015); the production of passive sentences (Verin 2010); the comprehension of passive sentences (Verin 2010); the production of clitic pronouns (Arosio et al. 2014); the 'Frog story' (Meyer 1969). Testing took place two weeks before the intervention study, and new tests were proposed one week later. Moreover, following previous studies (Thompson & Shapiro 2005, 2007; Ebbels 2014, 2017), the experimenter also tried to provide a baseline by testing the participant two times consecutively on the production and comprehension of relative clauses[49] before the start of the treatment. The baseline period consists in assessing the participant/s on the same task/structure at least twice before intervention starts. This helps providing the rate of possible progress without the intervention. Changes during the baseline could be caused by language acquisition or practice of the test (Ebbels 2014). Conversely, the improvement during intervention or at the end of treatment could be a result of intervention (Ebbels 2017).

In the following sections, the results of the tests administered in the pre-treatment phase will be analysed: the sentence repetition task (Del Puppo et al. 2016), the task eliciting production of relative clauses (Volpato 2010), the character selection task (Volpato 2010), and the task eliciting production of *wh*-questions (Guasti et al. 2012, 2014).

[48]As in the case of the previous treatment (section 5.3), a control group was established only to compare MM's syntactic competence with those of her TD age-peers.

[49] The baseline period was provided only on RCs, following Roth (1984)'s assumption, namely RCs are considered *substantive universal*, hence their processing is difficult both for children and adults.

5.4.2.1. Sentence Repetition task

Table 52 shows the number and percentages of correct responses in the sentence repetition task (Del Puppo et al. 2016)[50].

Tab. 52: number and rate of the correct responses of MM and TG group after the sentence repetition task. CLEFT_INF= infinitival cleft sentences; CLEFT_O= object cleft sentences; DSL_M= left-dislocated sentences with number match condition; DSL_MM= left-dislocated sentences with number mismatch condition; CLEFT_PASS= passive cleft sentences; SQ_+SETRESTR= subject wh-questions with set restriction; SQ_-SETRESTR= subject wh-questions without set restriction; OQ_SPRE_+SETRESTR= object wh-question with preverbal embedded subject and set restriction; OQ_SPRE_-SETRESTR= object wh-question with preverbal embedded subject and without set restriction; OQ_SPOST_+SETRESTR= object wh-question with postverbal embedded subject and set restriction; OQ_SPOST_-SETRESTR= object wh-question with postverbal embedded subject and without set restriction; REL_GEN= genitive relative clause; REL_OBL_QUALE= oblique relative clause introduced by 'quale'; REL_OBL_CUI= oblique relative clause introduced by 'cui'; REL_OBL_GEN= oblique genitive relative clause; N= number.

		MM		**TG group**	
		N	**Rate**	**N**	**Rate**
12	FILLER	2/2	100%	6/6	100%
	CLEFT_INF	2/2	100%	6/6	100%
	CLEFT_O	2/2	100%	6/6	100%
14	FILLER	3/3	100%	9/9	100%
	DSL_M	4/4	100%	6/6	100%
	DSL_MM	2/2	100%	12/12	100%
16	FILLER	7/7	100%	19/21	90%
	CLEFT_PASS	0/2	0%	5/6	83%
	SQ_+SETRESTR	2/2	100%	6/6	100%
	SQ_-SETRESTR	2/2	100%	5/6	83%
	OQ_SPRE+SETRESTR	2/2	100%	6/6	100%
	OQ_SPRE-SETRESTR	2/2	100%	6/6	100%
	OQ_SPOST+SETRESTR	2/2	100%	6/6	100%
	OQ_SPOST-SETRESTR	2/2	100%	6/6	100%
19	FILLER	1/1	100%	3/3	100%
	REL_GEN	2/2	100%	3/6	50%
21	FILLER	3/3	100%	9/9	100%
	REL_OBL_GEN	1/2	50%	3/6	50%
	REL_OBL_QUALE	2/4	50%	1/12	8%
	REL_OBL_CUI	1/1	100%	2/3	67%

At a first glance it is possible to notice a better performance of MM, she performed at ceiling in most of the sentences, except for: (i) cleft sentences with the verb in the passive form (CLEFT_PASS), which were uttered without the typical prosody; (ii) genitive restrictive relative clauses (REL_OBL_GEN, *La mamma bacia la bambina a cui fratello piacciono le tigri* 'The mother kisses the girl to which brother likes the tigers', instead of *La mamma bacia la bambina al cui fratello piacciono le tigri* 'The mother kisses the girl whose brother likes the tigers'); (iii) oblique relative clauses with the complementizer *quale* 'which' (REL_OBL_QUALE, *Il gatto lecca le bambine alla*

[50] A detailed description of the sentence repetition task (Del Puppo et al. 2016) is provided in section 3.4.2.

quale la mamma dona un gioco 'The cat licks the girls to which-sg the mother gives a toy' instead of *Il gatto lecca le bambine alle quali la mamma dona un gioco* 'The cat licks the girls to which-pl the mother gives a toy'). Interestingly, the children of the TG group performed worse than MM. They showed weak performance in the following structures: (i) subject interrogatives introduced by a collective noun (SQ_SETRESTR, *Quale animale guardano i tacchini?* 'Which animal do the turkeys watch?' instead of *Quale animale guarda i tacchini?* 'Which animal does the turkeys watch?'); (ii) genitive restrictive relative clauses (REL_GEN, *Il maestro pettina la signora il cui figlio lavora* 'The teacher combs the woman whose-m son works' instead of *Il maestro pettina la signora la cui figlia lavora* 'The teacher combs the woman whose-f daughter works'); (iii) oblique relative clauses with the complementizer *quale* 'which' (REL_OBL_QUALE, *Il gatto lecca le bambine a cui la mamma gli regala un gioco* 'The cat licks the girls whose the mother gives them-m a toy' instead of *Il gatto lecca le bambine alle quali la mamma dona un gioco* 'The cat licks the girls to which-pl the mother gives a toy'), (iv) oblique relative clauses with the complementizer *cui* 'that' (REL_OBL_CUI, *La bambina lava il cane il cui padrone dà i biscotti* 'The girl washes the dog that the owner gives the cookies' instead of *La bambina lava il cane a cui il padrone dà i biscotti* 'The girl washes the dog to whom the owner gives the cookies'). However, looking at the number of the correct answers, the number of errors is not that high except for REL_OBL_QUALE.

It can be probably assumed that typically developing children are not as used to repetition tasks as the children fitted with CIs, who are assessed with this type of tests regularly.

5.4.2.2. Production of relative clauses

Table 53 shows the results of the answers given during the elicited production task for RCs (Volpato 2010).

Tab. 53: number and rate of the correct responses of MM's PRE1 and PRE2 assessment of the production of RCs compared with the TG group. SR= subject relative clause; OR= object relative clause; N= number; PRE1= first assessment before treatment; PRE 2= second assessment after treatment.

	MM				**TG group**	
	PRE1		**PRE2**			
	N	**Rate**	**N**	**Rate**	**N**	**Rate**
SR	4/6	67%	6/6	100%	18/18	100%
OR	1/6	17%	0/6	0%	0/18	0%

As said before, this task was used during the baseline period. Only answers that perfectly matched the target production were counted as correct. However, not all incorrect answers have to be analysed as age-inappropriate responses, i.e. when the child produces a passive relative instead of an object

relative clause could be interpreted as an age-appropriate behaviour that shows regular language acquisition (Utzeri 2007; Contemori & Belletti 2014; Volpato & Vernice 2014).

During the first assessment before treatment (PRE-1), MM showed the typical asymmetry between subject relatives and object relatives with preverbal embedded subject, namely the former are easier than the latter. Moreover, she produced an uncommon structure in order to avoid the production of one subject relative clause (*Mi piacciono i bambini alla quale guardano i cavalli* 'I like the children to which watch the horses') and three object relative clauses (*Mi piacciono i bambini alla quale vengono baciati dai nonni* 'I like the children to which are kissed by the grandparents'). These errors may be caused by the influence the sentence repetition task (Del Puppo et al. 2016) in which are asked oblique sentences introduced by the pronoun *quale* 'which' (*Il gatto lecca le bambine alle quali la mamma dona un gioco* 'The cat licks the girls to which the mommy gives a toy'). However, she never resorted to this strategy during the second assessment before treatment (PRE-2), rather she produced passive relatives instead of object relatives, thus showing the same pattern as her typically developing age peers (*Mi piacciono i bambini che vengono baciati dai nonni* 'I like the children that are kissed by the grandparents').

5.4.2.3. Comprehension of relative clauses

Table 54 shows the results in the character selection task (Volpato 2010), which assesses the children's comprehension of subject relative clauses, object relative clauses with preverbal embedded subject, and object relative clauses with postverbal embedded subject.

Tab. 54: number and rate of correct answers of MM's PRE-1 and PRE-2 assessment compared with TG group. SR= subject relative clause; OR= object relative clause with preverbal embedded subject; ORp= object relative clause with postverbal embedded subject; PRE-1= first assessment before treatment; PRE-2= second assessment before treatment; N= number.

		MM				**TG group**	
		PRE-1		PRE-2			
		N	Rate	N	Rate	N	Rate
SR	SG_PL	6/6	100%	6/6	100%	18/18	100%
	PL_SG	6/6	100%	6/6	100%	18/18	100%
OR	SG_SG	5/6	83%	6/6	100%	13/18	72%
	SG_PL	5/6	83%	6/6	100%	15/18	83%
	PL_PL	6/6	100%	6/6	100%	15/18	83%
	PL_SG	6/6	100%	6/6	100%	14/18	78%
Orp	SG_PL	5/6	83%	6/6	100%	15/18	83%
	PL_SG	6/6	100%	6/6	100%	10/18	56%

As the previous test, this test was administered during the baseline period. It comes to the eye MM's better performance than the TG group. Indeed, the control group showed the typical asymmetry between subject relatives, object relatives with preverbal embedded subject; object relatives with postverbal embedded subject, i.e. subject relatives are easier than object relatives with preverbal embedded subject and object relatives with postverbal embedded subject, which are more difficult to master even for adults.

Also in this case, it is possible to suppose MM's better performance than her typically developing age peers is due to the many speech and language therapy sessions.

5.4.2.4. Production of wh-questions

Table 55 shows the results of the elicited production task for *wh*-questions (Guasti et al. 2012, 2015).

Tab. 55: number and rate of correct answers given by MM and the TG group during the elicited production task for wh-questions.

		MM		**TG group**	
		N	**Rate**	**N**	**Rate**
WHO	subject	6/6	100%	18/18	100%
	object	6/6	100%	18/18	100%
WHICH	subject	3/6	50%	18/18	100%
	object	2/6	33%	18/18	100%

In this task, MM performed worse than her control group. She also shows typical asymmetries: (i) between subject and object questions, namely the former are more preserved than the latter; (ii) and between *who* and *which*+NP questions, also here the former are easier than the latter. The group of typically developing children are at ceiling in all structures. Errors made by MM concern the production of incomplete sentences (*Quale cuoco?* 'Which cook?'); thematic roles inversion (*Quali bambine segue la signora?* 'Which girls does the woman follow?' instead of *Quali bambine inseguono la signora?* 'Which girls follow the woman?').

5.4.2.5. Production of passive sentences

Before the analysis of the results collected during the picture description task for the investigation of the production of passive sentences, the task developed by Verin (2010) will be described.

Before administering the participant with the experimental trials, he/she becomes familiar with the characters and the verbs that are included in the experimental and filler items.

The test is composed of twenty-four stimuli: twelve eliciting passive sentences with transitive, reversible and actional verbs (*spingere* 'to push'; *imboccare* 'to feed'; *prendere a calci* 'to kick',

colpire ‘to hit’, *baciare* ‘to kiss’, *inseguire* ‘to follow’); twelve sentences eliciting sentences with transitive, reversible and non-actional verbs (*vedere* ‘to see’; *sentire* ‘to hear’, *amare* ‘to love’, *annusare* ‘to smell’); and twelve filler sentences.

Each stimulus is associated with two pictures, which represent two characters performing an action. The experimenter introduces the figures to the child by producing two active sentences, then he/she asks to the participant something which requires the production of a passive structure as an answer. On the one hand, some stimuli present the same AGENT, but different patients, allowing the omission of the by-phrase. On the other hand, in some other stimuli the AGENT changes and the patient remain the same, thus avoiding the omission of the by-phrase and causing its obligatory production. An example of the elicitation of a passive sentence will be provided in the following picture (Fig. 24).

- **Elicitation of a passive sentence with an actional verb and obligatory by-phrase:**

Experimenter: *Ci sono due foto. Nella prima foto Marco colpisce Sara, nella seconda foto il papà colpisce Sara. Cosa succede a Sara nella seconda foto?*

'There are two pictures. In the first one Marco hits Sara, in the second one the father hits Sara. What happens to Sara in the second picture?'

Target: *Sara è/viene colpita dal papà.*

'Sara is hit by her father’.

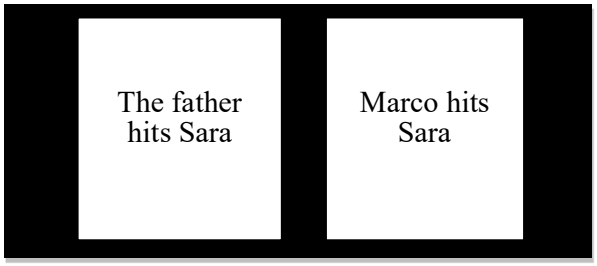


Fig. 24: Elicitation of a passive sentence with an actional verb and obligatory by-phrase

The elicitation of a filler sentence, instead, is realized through the presentation of three pictures, each one containing an animate character and an inanimate object. After the experimenter has asked what happens in one of the pictures, the child should answer with an active sentence.

The following table presents the four experimental sentence conditions elicited by the picture description task developed by Verin (2010).

Tab. 56: the four conditions investigated by the picture description task (Verin 2010)

SENTENCE TYPE	ITEM
passive sentence with an actional verb and obligatory by-phrase	*Sara è/viene colpita dal papà.*
	'Sara is hit by her father'.
passive sentence with an actional verb and non-obligatory by-phrase	*Sara è/viene baciata (da Marco)*
	'Sara is kissed (by Marco).'
passive sentence with a non-actional verb and obligatory by-phrase	*Sara è/viene amata da Marco*
	'Sara is loved by Marco.'
passive sentence with a non-actional verb and non-obligatory by-phrase	*Sara è/viene vista (da Marco).*
	'Sara is seen (by Marco).'

Tab. 57: number and rate of the correct passive sentences produced by MM during the production of passive sentences assessment

SENTENCE TYPE	N	Rate
actional verbs	9/12	75%
non-actional verbs	5/9	56%
filler sentences	11/12	92%

As Table 57 shows, MM performed better in sentences containing actional verbs (75%), whereas her performance in the production of sentences containing non-actional verbs (56%) presented a lower rate of accuracy. Because of an error by the experimenter, who produced an actional verb instead of a non-actional one, three sentences were removed from the total score.

When a sentence containing a non-actional verb was elicited, MM produced a passive causative sentence (*farsi* + verb) in four cases (*Si fa sentire da Marco* 'He/she makes himself/herself hear by Marco'). Other errors consisted in producing a part of a passive relative, namely MM started the sentence with the complementizer *che* 'that' instead of the subject of the sentence (*Che imbocca Sara* 'That feeds Sara').

5.4.2.6. Comprehension of passive sentences

The comprehension of passive sentences was assessed using the task developed by Verin (2010) adapting Driva and Terzi's version for Greek (2008).

The task is structured within a sentence-picture matching framework. As in the passive sentences production task, the test is preceded by a phase of acquaintance, which is the same administered before the passive production test. The characters and the actions are the same of the production task. The comprehension of passive sentences is assessed through forty experimental stimuli and ten filler items. For each slide the child was shown three pictures, after the experimenter uttered a passive sentence, the participant should indicate the correct figure. The following table presents the eight experimental sentence conditions investigated by the picture selection task (Verin 2010):

Tab. 58: the eight conditions investigated by the picture selection task (Verin 2010)

SENTENCE TYPE	Item
Actional verb – Auxiliary *essere* 'to be'	*In quale foto Sara è imboccata?*
	'In which pictures is Sara fed?'
Actional verb – Auxiliary *venire* 'to come'	*In quale foto Sara viene presa a calci?*
	'In which picture (comes) is Sara kicked?'
Non-actional verb – Auxiliary *essere*	*In quale foto Marco è annusato?*
	'In which picture is Marco smelled?'
Non-actional verb – Auxiliary *venire*	*In quale foto Marco viene sentito?*
	'In which picture (comes) is Marco heard?'
Actional verb – Auxiliary *essere* + by-phrase	*In quale foto Sara è imboccata da Marco?*
	'In which picture is Sara fed by Marco?'
Actional verb – Auxiliary *venire* + by-phrase	*In quale foto Marco viene baciato da Sara?*
	'In which picture (comes) is Marco kissed by Sara?'
Non-actional verb – Auxiliary *essere*+ by-phrase	*In quale foto Sara è amata da Marco?*
	'In which picture is Sara loved by Marco?'
Non-actional verb – Auxiliary *venire*+ by-phrase	*In quale foto Marco viene visto da Sara?*
	'In which picture (comes) is Marco seen by Sara?'

In the following picture an example of the procedure to assess the comprehension of passive sentences is provided.

- **Actional verb – Auxiliary *essere* 'to be'**

Experimenter: *In quale foto Sara è imboccata?*

'In which pictures is Sara fed?'

Target: *Picture 2*.

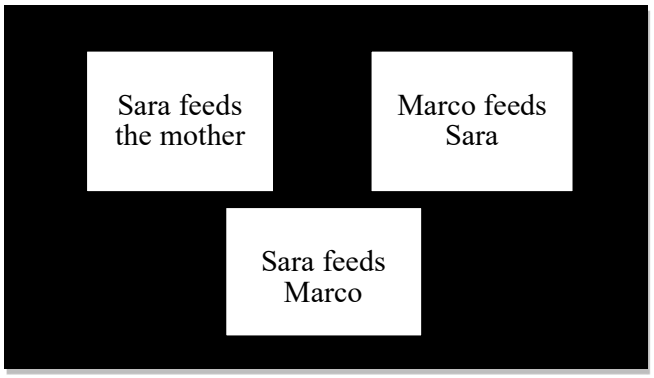


Fig. 25: comprehension of an actional passive with auxiliary 'to be'

As shown by Table 59, MM performed at ceiling in each structure analysed except for non-actional passives with the auxiliary *venire* and the by phrase[51].

Tab. 59: number and rate of correct answers of MM during the comprehension task of passive sentences

SENTENCE TYPE	N	Rate
actional verb/auxiliary 'to be'	6/6	100%
actional verb/auxiliary 'to come'	6/6	100%
non-actional verb/auxiliary 'to be'	4/4	100%
non-actional verb/auxiliary 'to come'	4/4	100%
actional verb/auxiliary 'to be'+by-phrase	6/6	100%
acional verb/auxiliary 'to come'+by-phrase	6/6	100%
non-actional verb/auxiliary 'to be'+by-phrase	4/4	100%
non-actional verb/auxiliary 'to come'+by-phrase	2/4	50%

5.4.2.7. Clitic pronouns production

MM's production of clitic pronouns was assessed using the clitic elicitation task developed by Arosio et al. (2014). The task is preceded by an acquaintance phase, which has the purpose to make the child familiar with the verbs, the nouns and the structures used and analysed in the task.

The task presents eighteen stimuli: six sentences containing third person masculine direct object clitics (3smDO-clitic) (91), six sentences containing third person feminine direct object clitics (3sfDO-clitic) as in (92), and six sentences containing a proper third person reflexive clitic (3RE-clitic) as in (93). Sentences containing feminine and masculine 3sDO-clitics present the following transitive verbs: *pescare* 'to fish'; *sollevare* 'to lift'; *distruggere* 'to destroy', *dipingere* 'to paint', *leccare* 'to lick', *sbucciare* 'to peel', *lavare* 'to wash', *buttare* 'to throw away', *catturare* 'to catch', *bagnare* 'to wet', *tagliare* 'to cut', *pettinare* 'to comb', *colpire* 'to hit'. Sentences containing a 3RE-clitic present the verbs: *lavare* 'to wash', *specchiare* 'look in the mirror', *pettinare* 'to comb', *asciugare* 'to dry', *tagliare (i capelli)* 'to cut (hair)', *graffiare* 'to scratch'.

(91) *Il bambino lo lava*
the child DO-CL_{3SM} washes
'The child is washing him.'

(92) *Il bambino la guarda*
the child DO-CL_{3SF} watches
'The child is watching her.'

[51] The same result was found by Fox and Grodzinsky (1998) in a group of English-speaking children aged 3;6-5;5.

(93) *Il bambino si pettina*

the child RE-CL_3 combs

'The child is combing himself.'

The task is administered with a power point presentation. For each stimulus two slides are shown consecutively. The first slide helps the experimenter to describe the setting, while the second slide represents the stimulus through which the experimenter asks the participant a question in order to elicit the production of a sentence with a clitic pronoun. In the following figures two examples are presented for the elicitation of a 3smDO-clitic (Fig. 26 a-b) and the elicitation of a 3RE-clitic (Fig. 27 a-b).

- **Elicitation of a 3smDO-clitic:**

Experimenter: (Fig. 26a) *In questa storia c'è un bambino che vuole lavare un cane*. (Fig. 26b) *Cosa sta facendo il bambino al cane?*

In this story there is a boy who wants to wash the dog. What he is doing to the dog?

Target: *Lo sta lavando/lo lava*.

He is washing him.

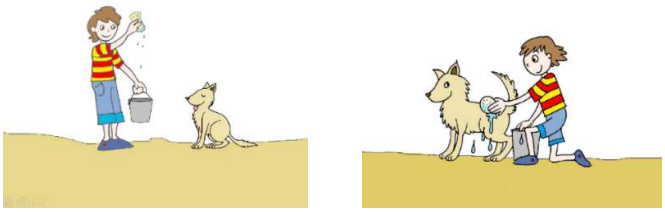


Fig. 26 a-b: elicitation of a 3smDO-clitic

- **Elicitation of a 3RE-clitic:**

Experimenter: (Fig. 27a) *In questa foto c'è un gatto molto sporco*. (Fig. 27b) *Cosa sta facendo il gatto?*

In this picture there is a dirty cat. What is he doing?

Target: *Si sta lavando/si lava.*

He is washing himself.

Fig. 27 a-b: elicitation of a 3RE-clitic

MM's responses were audiotaped and then transcribed by the experimenter. The eighteen experimental conditions were presented in a random order. The experimental session was preceded by five familiarization items eliciting the production of clitics. During the phase of acquaintance feedback was given, if requested by the child.

Following Arosio et al. (2014), responses were coded and divided in five different categories: (i) target responses, when the sentence contained a morphologically correct clitic pronoun (*Il bambino lo lava* 'The boy washes him'); (ii) full DP, when the sentence contained a full DP instead of a clitic pronoun (*Il bambino lava il cane* 'The boy washes the dog'); (iii) wrong responses, when the clitic pronoun produced by the participant was incorrect (*Il gatto si sta lavando* 'The cat is washing us'); (iv) omission responses, when the sentence presented an omission, namely neither a clitic pronoun nor a full DP is produced (*Il bambino sta lavando* 'The boy is washing'); (v) other responses, when the sentence does not contain any of the previous strategies. Moreover, MM's responses were classified as containing or not an overt subject (non-pro – pro).

The results of MM's performance during the elicited production of clitics is shown in the following table.

Tab. 60: number and rate of the results after the elicitation of 3DO-clitics

	DO-clitic									
MM	**TARGET**		**FULL DP**		**OMISSION**		**WRONG**		**OTHER**	
	N	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**
	10/12	83%	0/12	0%	1/12	8%	0/12	0%	1/12	8%

Tab. 61: number and rate of the results after the elicitation of 3RE-clitics

	RE-clitic									
MM	**TARGET**		**FULL DP**		**OMMISSION**		**WRONG**		**OTHER**	
	N	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**
	6/6	100%	0/6	0%	0/6	0%	0/6	0%	0/6	0%

As shown by the tables, MM showed a good performance in the production of DO and RE clitics. She made only two errors in producing a DO-clitic, namely she omitted the clitic in one of the answers given, and she produced an oblique clitic pronoun (dative) instead of a DO-clitic pronoun because of the substitution of the verb (*Gli ha fatto un buco* 'He made to him a hole', instead of *Lo ha bucato* 'He punched him'). On the other hand, MM produced RE-clitics at ceiling.

All sentences produced by MM displayed null subjects, in other words, her productions lacked overt subjects. This is appropriate given the context of the task.

5.4.2.8. Frog story

As in ES' pre-treatment assessment, also MM's narrative skills were assessed through a storytelling task carried out with the so-called Frog story (Frog, where are you?, Meyer 1969).

Table 62 shows the results after the *Frog story*.

Tab. 62: number and rate of the structures uttered during the Frog story storytelling

FROG STORY			
		N	**Rate**
	Words	415	
	sentences	76	
	MLU	5.5	
	hesitations	17	
Sentences	Main	29/76	38%
	Coordinate	21/76	28%
	Subordinate	7/76	9%
	Relative	5/76	7%
	Passive	0/76	0%
	Ungrammatical/incomplete	12/76	16%
Clitics	Personal	7/17	41%
	Reflexive	10/17	59%
	No-agreement	0/17	0%
	Omission	0/17	0%
	Total	17/415	4%

MM produced 415 words divided in 76 sentences showing an MLU equal to 5.5. During the task, MM hesitate 17 times, hence she tried to start a sentence, but she stopped and did not finish the utterance before starting a new one. As expected, the percentage of main (38%) and coordinate (28%) sentences is higher than that of subordinate (9%), relative (7%) and passive (0%) structures, which are well-known to be difficult for hearing impaired individuals.

In the whole text, MM produced only 4% of clitics, producing higher percentage of reflexive clitics (59%) than personal clitics (41%). Assuming the hypothesis by Arosio et al. (2014), this piece of data is expected. Since reflexive clitic pronouns are base generated and do no undergo syntactic movement as DO-clitic pronouns do.

5.4.3. Treatment

As already explained at the beginning of this section, even though MM showed a good mastery of complex syntactic structures, she was chosen for the treatment since her parents were interested in the experiment and gave their consent to carry it on.

Equally to previous studies on the syntactic intervention given to Italian-speaking children fitted with CIs, this syntactic intervention aimed at observing whether improvement of complex structures was possible resorting to the explicit teaching methodology, and also if it was possible to achieve generalization effects to untrained structures and to narrative skills.

Treatment lasted two months, from July 2017 to September 2017, with a month pause in August, and it comprised seven sessions[52] each lasting 60 minutes. Some sessions were held in one of the rooms of the ENT Clinic[53], other sessions were held at MM's house.

This third attempt of the treatment of complex structures based on the explicit teaching of syntactic rules follows previous studies on the treatment of children with CI (D'Ortenzio 2015; Vanzin 2016; D'Ortenzio et al. 2017). Moreover, an accurate review of previous studies on syntactic interventions has been made (Thompson 2003, 2015; Thompson & Shapiro 1994, 1995, 2007; Thompson et al. 1993, 1995, 1997, 1998; Shapiro & Thompson 1994; Ebbels, 2005, 2007, 2014, 2017; Levy & Friedmann 2009), in order to bring about a change in some of the areas of the treatment to make it more reliable and suitable to be administered together with conventional speech therapy.

The first adjustment concerned the list of verbs that would be used during treatment, namely different verbs from those used in the tasks administered before and after treatment were employed. This strategy allowed to use a kind of control of the generalization effects, since the participant worked with a list of verbs different from that used during the testing sessions. Verbs used during treatment were:

- Intransitive verbs: *tornare* 'to come back', *abbaiare* 'to bark'*, abitare* 'to live'*, andare* 'to go', *ballare* 'to dance'*, camminare* 'to walk', *cenare* 'to dinner', *correre* 'to run', *dormire* 'to sleep', *litigare* 'to argue', *navigare* 'to sail', *nuotare* 'to swim', *parlare* 'to talk', *pensare* 'to think', *rispondere* 'to answer', *riuscire* 'to achieve', *russare* 'to snore', *saltare* 'to jump', *starnutire* 'to sneeze', *strisciare* 'to slither', *tramontare* 'to set', *ubbidire* 'obey', *viaggiare* 'to travel'.
- Transitive verbs: *abbottonare* 'to botton up', *accendere* 'to switch on', *affettare* 'to slice', *aggiustare* 'to repair', *aiutare* 'to help', *annusare* 'to smell', *calpestare* 'to step on', *cercare* 'to search', *chiudere* 'to close', *collezionare* 'to collect', *colorare* 'to paint', *coltivare* 'to farm', *conoscere* 'to know', *contare* 'to count', *coprire* 'to cover', *cucinare* 'to cook', *cucire* 'to sew', *disegnare* 'to draw', *esplorare* 'to explore', *fotografare* 'to take a picture', *immaginare* 'to imagine', *incontrare* 'to meet', *intrappolare* 'to trap', *lanciare* 'to throw', *lodare* 'to praise', *macchiare* 'to stain', *massaggiare* 'to massage', *masticare* 'to chew', *osservare* 'to observe', *pulire* 'to clean', *ricevere* 'to receive', *ritrarre (fare un ritratto)* 'to portray', *schizzare* 'to spray', *spedire* 'to send', *stendere* 'to hang', *studiare* 'to study', *suonare* 'to play', *vestire* 'to clothe.

[52] Sessions were given once or twice per week. Planning a stricter calendar was impossible since MM's had many medical appointments and her parents were full of work engagements.
[53] During her follow-up examinations.

- Ditransitive verbs: *appendere* 'to hand', *caricare* 'to load', *chiedere* 'to ask', *consegnare* 'to deliver', *dare* 'to give', *mandare* 'to send', *mettere* 'to put', *mostrare* 'to show', *poggiare* 'to place', *regalare* 'to give (a gift)', *riscaldare* 'to heat', *trasferire* 'to transfer'.

A further adjustment was the development of a tiny workbook (APPENDIX I) divided into sections facing the three distinct phases of treatment. This tool was elaborated following De Nichilo (2017), in order to help the participant reviewing the topics of the syntactic intervention by herself.
The treatment was split into three different stages. The first focused on verb argument structure and Theta criterion; the second centred on *wh*-movement; the third and last phase was dedicated to the review of the arguments taught during the syntactic intervention. Only when MM showed to have reached a good mastery of the arguments which she had dealt with, she progressed to the next session/stage (Ebbels 2007; Levy & Friedmann 2009).

- *Verb argument structure and Theta criterion*. This stage comprised two sessions during which the experimenter explained verb argument structure and Theta criterion to the participant so as to turn her implicit knowledge into explicit knowledge, in order to be used for support during the explanation of *wh*-movement (Levy & Friedmann 2009). Both sessions started with some exercises followed by a teaching part. Giving the exercises before the explanation of the syntactic rules helps the participant to start thinking about her language so as to internalize some issues, rather than just having provide conventional notions.

    - During the **first session**, a list of several verbs was given to MM and for each verb she had to write a simple sentence. After this first activity, MM was asked to underline the subject of the sentence with a blue colour, and the object of the sentence with an orange colour. Then, the experimenter put emphasis on the similarities and differences of verbs, namely verbs always have a subject, but not always an object, therefore, there were different types of verbs depending on the number of elements that accompany them. Successive to this part, the participant chose three different sentences and wrote them on cards so that it was easier for the experimenter to represent grammatical and ungrammatical sentences by adding or removing cards. At the end of this first session the experimenter explained some syntactic rules, i.e. the verb argument structure was introduced using the metaphor of the orchestra leader: the verb is like an orchestra leader who chooses how many musicians must play music. Orchestra leaders are different, they can indeed choose only one musician (intransitive verbs), two musicians (transitive verbs), or three musicians (ditransitive verbs). At the end of the

session, the participant was asked a question "What have I learned today?", so as to induce her to review the arguments done during the first session.

- The **second session** started with a new and different activity: MM was given some sentences; for each sentence she had to underline the verb, understand which type of verb was and then write it down in one of the columns of a table. The second activity was to underline the subject with a blue colour and the object with an orange colour. At the end of these two activities, the experimenter explained the Theta criterion recalling the metaphor of the orchestra leader and adding a second part: after the orchestra leader choses one or more musicians, he also decides which instruments the musicians must play.

- *Wh-movement*. This phase comprehended four sessions during which *wh*-movement in object relative clauses with preverbal embedded subject was explained through a card game first, and by resorting to a kind of syntactic Scrabble later. Following Vanzin (2016) and D'Ortenzio et al. (2017), only object relative clauses with preverbal embedded subject were considered in order to analyse whether the effects of the treatment generalised also to untrained structures derived from the same syntactic movement, i.e. subject relative clauses, subject and object *wh*-questions. During each session the arguments of the first stage were reviewed so as to strengthen MM's knowledge of verb argument structure and Theta criterion.

    - The first activity of the **third session** was a grammaticality judgment task, namely MM was asked to decide whether a sentence was grammatical or not, and whenever the answer was negative, she had to explain the reason why the sentence was incorrect. The second activity was to select only the verbs contained in the sentences of the grammaticality judgment task, divide them into distinct categories, and write them down in a table. After these activities the experimenter introduced the card game to MM. The card game used to explain *wh*-movement is composed of several cards (the number can vary) having the function of the elements of a sentence, namely there are cards representing names, cards that have the function of verbs, cards that played the role of the trace, cards acting for the complementizer, and cards symbolizing an external VP. As in previous studies (D'Ortenzio 2015; Bozzolan 2016; Vanzin 2016; D'Ortenzio et al. 2017; Volpato e Bozzolan 2017), the first step to explain *wh*-movement consisted in writing a simple SVO order sentence. Then, the experimenter added an external VP, whose number features were able to attract the object of the starting sentence. Once the object was moved to the left part of the sentence, the

experimenter left a trace-card in the position from which the object has moved. Finally, the complementizer was inserted in the new sentence and the experimenter tied the trace-card with the noun-card acting as the object of the sentence with a ribbon.

- The **fourth session** started with a short text written by the experimenter. The text tells the story of Gianni, the son of two linguists who travel all around the world and spend their time in the hugest libraries of the planet. Since Gianni is a child and for him to follow his parents is boring, his mother suggests him to choose some books and, in each book, he must find verbs. Gianni is a very smart boy, so he decides to look at the verbs better. Suddenly he founds that verbs are not the same, for this reason, he divides the verbs into three groups: intransitive verbs, transitive verbs, and ditransitive verbs. He also discovers that playing with verbs is fun, so he invented a game called "Find the trace!". The activity focused on the text was to find all the verbs and then their arguments. This exercise is well known to be a bit difficult but pushes the participant to work with the sentences contained in a more complex and longer text rather than working with single sentences. The text was analysed during the remaining sessions. After having worked with the text, MM was asked to play the card game.
- The **fifth session** was largely focused on *wh*-movement. After having played with the card game, the experimenter asked MM to help her in developing a new game called 'syntactic Scrabble'. During this first part, the experimenter and the participant moved the elements of the sentences searching to combine them. However, since the game was too similar to the simple card game, MM proposed to draw a table in which every box could host a card, and also to give points to the sentences, in order to give the possibility to the players to "buy" new elements and build new sentences.
- During the **sixth session** it was possible to play with the 'syntactic Scrabble'. This activity lasted for the whole length of the session and it was enjoyed both by the experimenter and MM, who was enthusiastic about it. The following picture show the first idea of 'syntactic Scrabble'.

Fig. 28: The syntactic scrabble has a grid with several rectangles. The participants are given some cards (six noun-cards; three verb-cards; two VP-cards; two complementizer-cards; two trace-cards). One of the players starts by combining cards in a sentence, usually a simple SVO sentence, then, in turn, players build other sentences, simple sentences or relative clauses. Players collect points which allow them to "buy" other cards.

- *Review*. The last stage of the syntactic intervention comprised of only one session and was focused on the review of the arguments taught during the intervention. This last session was administered in September; therefore, it was useful to observe if MM had maintained the teaching of the first and second stages.

    - During the **seventh session**, MM was asked to choose some of the sentences contained in the workbook in order to analyse them using a schema which was first used by Vanzin (2016). The rest of the session was spent playing the 'Syntactic scrabble'.

To conclude this section focused on the syntactic intervention given to MM, a table summarizing the activities proposed during each session is provided.

Tab. 63: summary schema of the syntactic treatment given to MM with some of the activities done during the seven sessions

FIRST STAGE — VERB	
SESSION 1	
Differences between intransitive, transitive, and ditransitive verbs	- write three simple SVO sentences with a list of given verbs; - underline the subject and the object with distinct colours; - write the sentences on cards
Verb argument structure	**THE ORCHESTRA LEADER METAPHOR (1st part):** the verb is like an orchestra leader that decides how many musicians must play a song.
SESSION 2	
Differences between intransitive, transitive, and ditransitive verbs	- search the verb and its arguments in given sentences; - write the verbs in the columns of a table.
Verb argument structure and Theta criterion	**THE ORCHESTRA LEADER METAPHOR (2nd part):** as an orchestra leader, the verb chooses also which musical instruments its musicians must play.
SECOND STAGE – *WH*-MOVEMENT	
SESSION 3	
Differences between intransitive, transitive, and ditransitive verbs	-Grammaticality judgments; -divide the verbs into the columns of a table
- ***WH*-MOVEMENT**	- **The syntactic intervention is focused only on ORs.** - to explain the *wh*-movement a card game is used.
SESSION 4	
Verb argument structure and Theta criterion	- using a text, the participant is asked to find the verbs and its arguments; -the participant must explain the relations between the verb and its arguments.
- ***WH*-MOVEMENT**	- the participant plays production and comprehension games only on ORs
Session 5	
- ***WH*-MOVEMNT**	- the participant still plays games on the comprehension and the production of ORs with the card game; - a new game is introduced → **Syntactic scrabble**
SESSION 6	
- ***WH*-MOVEMENT**	-the experimenter and the participants play the Syntactic scrabble; - the experimenter pushes the participant to produce always complex sentences, in order to gain more points and win the game.
THIRD STAGE	
SESSION 7	
- Review	- analysis of several sentences chosen from the workbook; - Syntactic scrabble tournament.

5.4.4. Post- treatment assessment

In this section the results of MM's post-treatment assessment are provided. Data have been collected some weeks after the end of treatment in two separated sessions, considering the high number of tests.

As said in section 5.4.1., MM's performance was compared with that of a control group (TG group) only for the sentence repetition task, the elicited production of relative clauses, the character selection task, and the elicited production of *wh*-questions.

5.4.4.1. Sentence repetition task

Table 64 shows MM's results at the sentence repetition task administered before and after the syntactic intervention.

Tab. 64: number and rate of correct responses of the sentence repetition task administered before and after treatment and compared with the TG group. CLEFT_INF= infinitival cleft sentences; CLEFT_O= object cleft sentences; DSL_M= left-dislocated sentences with number match condition; DSL_MM= left-dislocated sentences with number mismatch condition; CLEFT_PASS= passive cleft sentences; SQ_+SETRESTR= subject wh-questions with set restriction; SQ_-SETRESTR= subject wh-questions without set restriction; OQ_SPRE_+SETRESTR= object wh-question with preverbal embedded subject and set restriction; OQ_SPRE_-SETRESTR= object wh-question with preverbal embedded subject and without set restriction; OQ_SPOST_+SETRESTR= object wh-question with postverbal embedded subject and set restriction; OQ_SPOST_-SETRESTR= object wh-question with postverbal embedded subject and without set restriction; REL_GEN= genitive relative clause; REL_OBL_QUALE= oblique relative clause introduced by 'quale'; REL_OBL_CUI= oblique relative clause introduced by 'cui'; REL_OBL_GEN= oblique genitive relative clause; N= number.

		PRE_1		**POST**		**TG group**	
		N	**Rate**	**N**	**Rate**	**N**	**Rate**
12	FILLER	2/2	100%	2/2	100%	6/6	100%
	SCISSA_INF	2/2	100%	2/2	100%	6/6	100%
	SCISSA_O	2/2	100%	2/2	100%	6/6	100%
14	FILLER	3/3	100%	3/3	100%	9/9	100%
	DSL_M	4/4	100%	4/4	100%	12/12	100%
	DSL_MM	2/2	100%	1/2	50%	6/6	100%
16	FILLER	7/7	100%	7/7	100%	19/21	90%
	SCI_PASS	0/2	0%	2/2	100%	5/6	83%
	SQ_+SETRESTR	2/2	100%	2/2	100%	6/6	100%
	SQ_-SETRESTR	2/2	100%	2/2	100%	5/6	83%
	OQ_SPRE+SETRESTR	2/2	100%	2/2	100%	6/6	100%
	OQ_SPRE-SETRESTR	2/2	100%	2/2	100%	6/6	100%
	OQ_SPOST+SETRESTR	2/2	100%	2/2	100%	6/6	100%
	OQ_SPOST-SETRESTR	2/2	100%	2/2	100%	6/6	100%
19	FILLER	1/1	100%	1/1	100%	3/3	100%
	REL_GEN	2/2	100%	1/2	50%	3/6	50%
21	FILLER	3/3	100%	3/3	100%	9/9	100%
	REL_OBL_GEN	1/2	50%	2/2	100%	3/6	50%
	REL_OBL_QUALE	2/4	50%	4/4	100%	1/12	8%
	REL_OBL_CUI	1/1	100%	1/1	100%	2/3	67%

Overall, the participant showed an improvement in those sentences in which he/she performed worse during the pre-treatment assessment. During the post-treatment assessment, MM made only two errors in two different structures, namely she missed the repetition of the clitic pronoun in a left dislocated sentence with number mismatch (*I leoni, il pinguino colpisce forte* 'The lions, the penguin

hit heavily' instead of *I leoni, il pinguino li colpisce forte* 'The lions, the penguin hits them heavily'), and a restrictive genitive relative clause (*Il postino saluta la signora a cui il figlio disegna* 'The postman greets the lady to whom the son draws', instead of *Il postino salute la signora il cui figlio disegna* 'The postman greets the lady whose son draws').

5.4.4.2. Production of RCs

The results of the elicited production of relative clauses are presented in table 65.

Tab. 65: number and rate of the correct responses of MM's pre and post-treatment assessment on RCs production compared to the TG group. SR= subject relative clauses; OR= object relative clauses.

	MM						TG	
	PRE 1		PRE 2		POST 1			
	N	Rate	N	Rate	N	Rate	N	Rate
SR	4/6	67%	6/6	100%	6/6	100%	18/18	100%
OR	1/6	17%	0/6	0%	0/6	0%	0/18	0%

As in the second assessment made before treatment (PRE-2), also in the post-treatment assessment when an object relative clause was elicited, MM produced a passive relative, except in one case in which she inverted the thematic roles (*Mi piacciono i bambini che tirano i leoni* 'I like the children that pull the lions' instead of *Mi piacciono i bambini che i leoni tirano* 'I like the children that the lions pull').

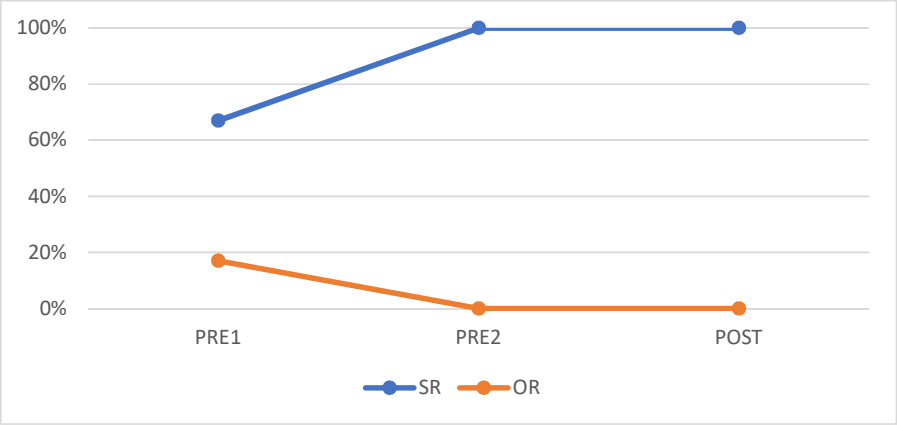


Fig. 29: graph showing the results of MM's performance during the assessment of the production of relative clauses

5.4.4.3. Comprehension of relative clauses

Similarly to the production of relative clauses, MM's performance in the comprehension of these structures did not change and her performance was stable at ceiling. The following table shows the results collected before and after treatment compared with the results of the control group.

Tab. 66: number and rate of correct answers of MM's pre- and post-treatment assessment on RCs' comprehension compared with the TG group.

		MM						TG	
		PRE1		PRE2		POST			
		N	Rate	N	Rate	N	Rate	N	Rate
SR	SG_PL	6/6	100%	6/6	100%	6/6	100%	18/18	100%
	PL_SG	6/6	100%	6/6	100%	6/6	100%	18/19	100%
OR	SG_SG	5/6	83%	6/6	100%	6/6	100%	13/18	72%
	SG_PL	5/6	83%	6/6	100%	6/6	100%	15/18	83%
	PL_PL	6/6	100%	6/6	100%	6/6	100%	15/18	83%
	PL_SG	6/6	100%	6/6	100%	6/6	100%	14/18	78%
ORp	SG_PL	5/6	83%	6/6	100%	6/6	100%	15/18	83%
	PL_SG	6/6	100%	6/6	100%	6/6	100%	10/18	56%

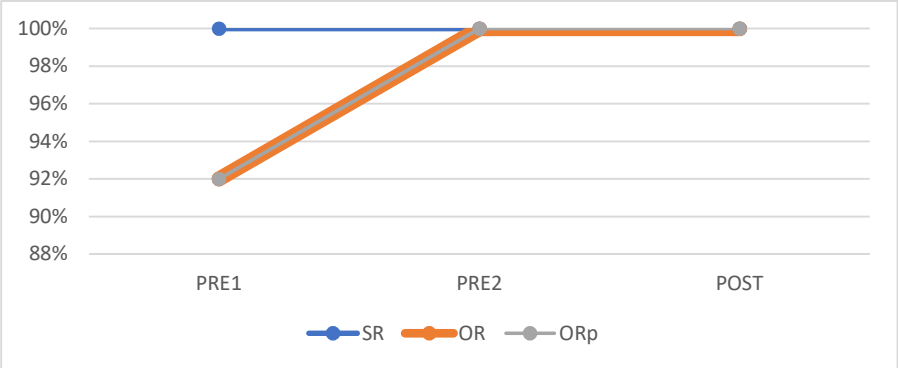


Fig. 30: graph showing the tendencies of the results of MM during the assessment of the comprehension of relative clauses

5.4.4.4. Production of wh-questions

Results after treatment show that MM has improved in the production of *wh*-questions. Since in the pre-treatment data collection *which*+NP questions were the most impaired structures, after treatment MM made only two errors, namely she produced a subject *who* question instead of a subject *which*+NP question. The most evident improvement is the production of object which+NP which raised from 33% to 100%.

Tab. 67: number and rate of correct answers of MM's pre- and post-treatment assessment on wh-question production compared to TG group.

		MM				TG	
		PRE		POST			
		N	**Rate**	**N**	**Rate**	**N**	**Rate**
WHO	subject	6/6	100%	6/6	100%	18/18	100%
	Object	6/6	100%	6/6	100%	18/18	100%
WHICH	Subject	3/6	50%	4/6	100%	18/18	100%
	Object	2/6	33%	6/6	100%	18/18	100%

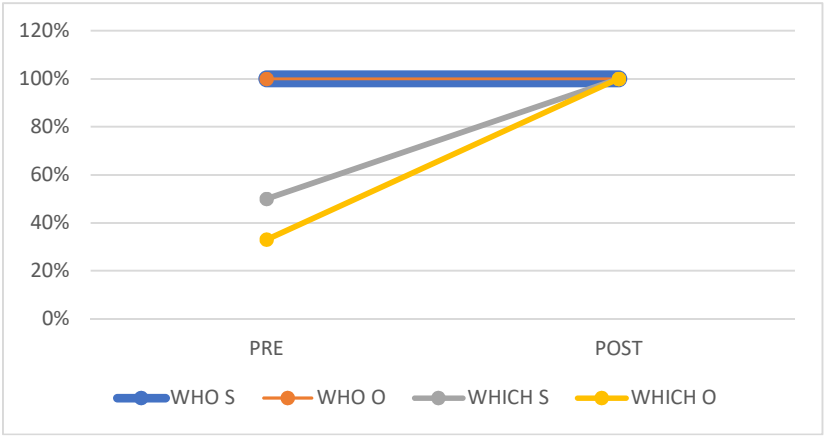


Fig. 31: graph showing MM's performance before and after treatment in the production of subject and object wh-questions

5.4.4.5. Production of passive sentences

As showed already by ES in the results collected during her post-assessment with the TCGB, also MM showed an improvement in the production of passive sentences. She performed at ceiling when a passive sentence with an actional verb was elicited, and almost at ceiling when non-actional verbs were included in the stimuli.

Tab. 68: number of correct responses and related percentages of MM's pre and post treatment assessment on the production of passive sentences.

	PRE		POST	
Sentence type	**N**	**Rate**	**N**	**Rate**
actional verbs	9/12	75%	12/12	100%
non-actional verbs	5/9	56%	11/12	92%
filler sentences	11/12	92%	12/12	100%

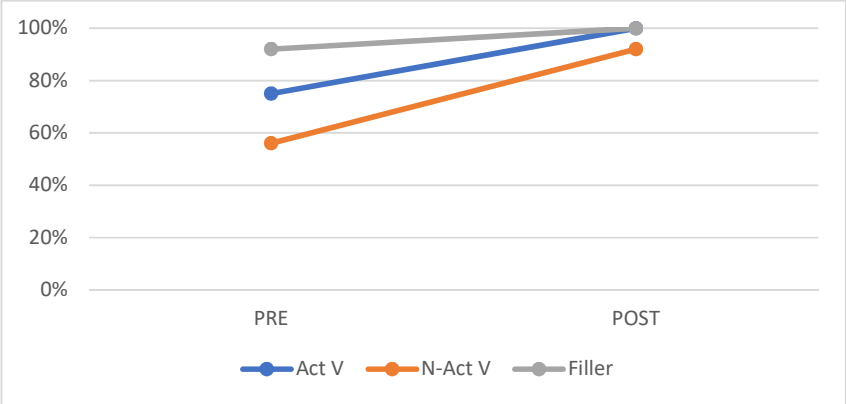


Fig. 32: graph showing MM's performance before and after treatment in the production of passives with actional verbs (Act V), and with non-actional verbs (N-Act V)

5.4.4.6. Comprehension of passive sentences

Tab. 69: number and rate of correct responses of MM's pre and post treatment assessment on the comprehension of passive sentences

	PRE		**POST**	
Sentence type	N	Rate	N	Rate
actional verb/auxiliary 'to be'	**6/6**	**100%**	**6/6**	**100%**
actional verb/auxiliary 'to come'	6/6	100%	6/6	100%
non-actional verb/auxiliary 'to be'	4/4	100%	4/4	100%
non-actional verb/auxiliary 'to come'	4/4	100%	4/4	100%
actional verb/auxiliary 'to be'+by-phrase	6/6	100%	6/6	100%
acional verb/auxiliary 'to come'+by-phrase	6/6	100%	6/6	100%
non-actional verb/auxiliary 'to be'+by-phrase	4/4	100%	3/4	75%
non-actional verb/auxiliary 'to come'+by-phrase	2/4	50%	**4/4**	**100%**

Table 69 shows that MM's comprehension of non-actional verbs introduced by the auxiliary *venire* 'to come' followed by a by-phrase has improved (from 50% to 100%). However, she made an error in one of the sentence types in which she did not show any difficulties during the pre-test assessment, namely she missed the comprehension of a non-actional passive sentence with auxiliary *essere* 'to be' and followed by a by-phrase. This error can be probably due to an attention decrease.

5.4.4.7. Clitic pronouns production

The following tables show MM's performance in the production of clitic.

Tab. 70: number and rate of correct responses in the production of DO-clitics

	DO-clitic									
MM	**TARGET**		**FULL DP**		**OMISSION**		**WRONG**		**OTHER**	
	N	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**
PRE	10/12	83%	0/12	0%	1/12	8%	0/12	0%	1/12	8%
POST	11/12	92%	1/12	8%	0/12	0%	0/12	0%	0/12	0%

Tab. 71: number and rate of correct responses of the production of RE-clitics

	RE-clitic									
MM	**TARGET**		**FULL DP**		**OMMISSION**		**WRONG**		**OTHER**	
	N	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**
PRE	6/6	100%	0/6	0%	0/6	0%	0/6	0%	0/6	0%
POST	6/6	100%	0/6	100%	0/6	100%	0/6	100%	0/6	100%

While the production of RE-clitics has not changed, in the production of DO-clitics it is possible to notice an improvement, since she produced one more correct sentence and she did not omit the clitic or resorted to other strategies. As in the pre-treatment assessment, also during the post-treatment assessment MM produced all sentences with non-overt subject.

5.4.4.8. Narrative skills

At the end of treatment MM's narrative skills were re-assessed with the 'Frog story'. In addition to this, an additional story was presented in order to investigate if the participant's narrative skills had generalized also to an unknown new story. The selected story was one of the books written by Dr. Seuss and is entitled 'The cat in the hat'[54] (1957). During both assessments she showed some improvement, namely an increased number of subordinate clauses, relative clauses and passive sentences, and a decrease in the production of hesitations, ungrammatical or incomplete sentences. Her production of clitics did not change among the different assessments.

[54] 'The cat in the hat' tells the story of two siblings, a boy and a girl, who were left alone in their house during a rainy day. Suddenly, a cat knocks at their door and, without asking, enters in the house pretending to amuse the children with juggling. But the children are worried that their mother will unexpectedly come back. So, the cat begins to take things from around the house and start to put them in different places causing a huge chaos. At a certain point the children see the mother coming back home and ask the cat to go away. He exits the house, but he returns back to help the children to tie up the house seconds before the mother enters in the house.

Tab. 72: Number and rate of the structures used by MM during the narrative skills assessment.

		FROG STORY				The cat in the hat	
		PRE		POST 1		POST 2	
		N	Rate	N	Rate	N	Rate
	words	415		349		421	
	sentences	76		66		84	
	MLU	5.5		5.3		5	
	hesitation	17		4		5	
Sentences	Principal	29/76	38%	24	36%	38	45%
	Coordinate	21/76	28%	16	24%	25	30%
	Subordinate	7/76	9%	14	21%	11	13%
	Relative	5/76	7%	4	6%	5	6%
	Passive	0/76	0%	1	2%	0	5%
	Ungrammatical/incomplete	12/76	16%	7	11%	3	4%
Clitics	Personal	7/17	41%	3	21%	6	40%
	Reflexive	10/17	59%	11	79%	9	60%
	No-agreement	0/17	0%	0	0%	0	0%
	Omission	0/17	0%	0	0%	0	0%
	Total	17/415	4%	14	4%	15	4%

5.5. DISCUSSION

The delay in the processing of movement-derived structures in individuals with hearing impairment fitted with HAs or CIs has been pointed out by several studies (relative clauses: Friedmann & Szterman 2006; Friedmann & Haddad-Hanna 2014; Volpato 2010, 2012; Volpato & Adani 2009; Volpato & Vernice 2014; *wh*-questions: Friedmann & Szterman 2011; Ruigendijk & Friedmann 2017; Volpato & D'Ortenzio 2017; Penke & Wimmer 2018; clitic pronouns: Guasti et al. 2012). Similar delays have also been found in populations with a language impairment presenting a different origin from hearing loss, such as Specific Language Impairment (SLI) (Jakubowicz et al. 1998; Hamman & Belletti 2006; Friedmann & Novogrodsky 2007; Pozzan 2007; Levy & Friedmann 2009; Contemori & Garraffa 2010; Tuller et al. 2011; Adani et al. 2014), and agrammatic aphasia (Chinellato 2004, 2007; Grillo 2008; Garraffa & Grillo 2008; Thompson & Shapiro 1995, 2005). In these populations, so as in a group of very young children (Roth 1984), has been described a new method for the treatment of syntactically complex structures based on the explicit teaching of syntactic rules. Because of the fruitful results confirmed by many studies conducted on children with SLI (Levy & Friedmann 2009; Ebbels 2014, 2017) and on patients with agrammatic aphasia (Thompson 2003; Thompson & Shapiro 1995, 2007; Thompson et al. 1997), the aim of this study was to verify the validity of this methodology in children fitted with CIs as already proved by D'Ortenzio (2015). Further aims of this study were: (i) to modify the first approach in the treatment of relative clauses in a child fitted with a CI (D'Ortenzio 2015) so as to analyse generalization effects

to untrained structures and narrative skills; (ii) to develop a protocol which can be compatible with the conventional speech therapy; (iii) using an approach similar to those described by Thompson and her research group.

The first intervention described in this chapter was given to ES, a 10;5-year-old girl suffering from severe-to-profound hearing loss and fitted with a CI (section 5.3). Before treatment, ES' responses during the assessment of the production of relative clauses showed the typical asymmetry between subject relatives and object relatives with preverbal embedded subject. This asymmetry was not found in the answers given during the comprehension test. Indeed, ES showed a different pattern characterised by a better performance in the comprehension of object relative clauses with preverbal embedded subject than subject relative clauses, while object relative clauses with postverbal embedded subject were found the most difficult structures as shown by previous studies (Volpato 2010). During this pre-treatment assessment, it was decided to investigate generalization effects to untrained structures and narrative skills. Therefore, ES' general comprehension of Italian grammar (TCGB) and narrative skills ('Frog Story') were tested. Results in the TCGB showed her delay especially in the comprehension of passive sentences. Her performance during the assessment of narrative skills was age-inadequate mostly characterised by ungrammatical sentences and hesitations. Taking into account the difficulties shown during pre-treatment assessment, ES was given a 7-sessions treatment lasting two months. Differently from the treatment described by D'Ortenzio (2015), two main enhancement were made in the structure of the treatment. The first was related to the use of verbs which are not contained in the tasks used during pre- and post-treatment assessment. The second change was influenced by Thompson et al. (2003) and consisted in the use of only object relative clauses with preverbal embedded subject. Indeed, assuming Thompson et al. (2003), the treatment of more complex structures facilitates the generalization effect to untrained structures derived by the same syntactic movement (*wh*-movement). Results after treatment showed an improvement that lasted over two months after the completion of the treatment. The data collected soon after treatment showed a better performance of ES compared to her performance before treatment. TCGB results before treatment showed that ES made a high number of errors related to inflections, locatives, datives, and passives. After treatment, her performance improved. The most interesting outcome is that before treatment, ES failed in the comprehension of all items testing the passive voice, while soon after treatment, she did not make any error in the comprehension of this structure, and this result was maintained two months after the completion of the treatment protocol. Considering the results described by several studies carried out by Thompson and her research group, this outcome is unexpected since passive sentences are derived by a different type of movement, namely NP-movement. However, it is possible to suppose that the massive work on verb argument

structure and Theta criterion, which was conducted throughout the treatment, may have influenced an improvement also in this structure. The analysis of ES' narrative skills were assessed through the administration of the *Frog story* (Mayer 1969). Before treatment, ES' oral production was characterized by ungrammatical sentences, inaccurate thematic role assignment, and an age-inappropriate MLU, even though she produced some relative clauses and clitic pronouns. After treatment, the rate of ungrammatical sentences decreased, thematic roles were correctly assigned, and the MLU increased. However, the production of complex structures was lower than before treatment. These results were maintained two months after the end of treatment.

The second treatment was given to MM a 9;9-year-old girl suffering from profound sensorineural hearing loss and fitted with a bilateral CI (section 5.4). Even though MM showed a good performance in quite all the structures analysed during the pre-treatment assessment, she was selected for this study because her parents were interested in the experiment and they were the only ones who gave consent to the treatment during the author's internship at the ENT Clinic. As in the study conducted on ES, also in this case some enhancement was made. The first change was to provide a kind of baseline, which consists in testing the participant twice consecutively on the production and comprehension of relative clauses before the start of the treatment. The baseline period consists in assessing the participant/s on the same task/structure at least twice before intervention starts, in order to provide the rate of possible progress without the intervention. The choice of relative clauses was made following Roth's (1984) assumption of the universality of relative clauses, which present a difficult processing for both children and adults. During the first assessment, she produced an uncommon structure in order to avoid the production of one subject relative clause (M*i piacciono i bambini alla quale guardano i cavalli* 'I like the children to which watch the horses') and three object relative clauses (*Mi piacciono i bambini alla quale vengono baciati dai nonni* 'I like the children to which are kissed by the grandparents'). However, she never resorted to this strategy during the second assessment before treatment (PRE2), during which she produced all passive relatives instead of object relative clauses, thus showing the same pattern as her typically developing age peers (*Mi piacciono i bambini che vengono baciati dai nonni* 'I like the children that are kissed by the grandparents'). Moreover, MM was tested on the repetition of syntactically complex structures, *wh*-questions production, production and comprehension of passive relatives, and the production of clitic pronouns. She was not assessed with standardized tests in favour of more detailed and structure-specific test, so as to verify the result found in ES' experiment, namely an improvement in structures presenting a movement different from *wh*-movement. Also in these tasks she showed a good competence in all the structures analysed. An asymmetry was found in the production of passive sentences, namely passives containing actional verbs were easier than passives containing non-actional verbs. Anyway, she was

given the syntactic intervention since her parents were collaborative for this study. MM was given a 7-session treatment during which a new game was developed (Syntactic Scrabble) which helped the experimenter to indirectly teach the *wh*-movement without resorting to much theoretical explanations. After treatment, MM showed an improvement in all the tasks administered reaching the ceiling in all the structures analysed. Moreover, also her narrative skills improved. However, the relationship established with the experimenter influenced the last sessions of treatment and especially the post-treatment assessment, therefore the experimenter decided not to retest the participant after some months after the end of the syntactic intervention.

Summing up, the common purpose of these interventions was to improve the participants' morphosyntactic abilities after a short-term treatment, which can be compatible with standard speech treatment. Differently from the first study on the treatment of syntactically complex structures focused on the explicit teaching of relative clauses given to a child fitted with a CI (D'Ortenzio 2015), these two studies present some changes. The first enhancement concerned the use of verbs, namely it was avoided the use of all the verbs contained in the tests during pre- and post-treatment assessment, as not to influence the participants responses because of a previous habit to known words. The second improvement concerned the analysis of generalization effects to untrained structures which was carried out by focusing on the teaching of *wh*-movement only in object relative clauses with preverbal embedded subject, which were chosen since they are considered more difficult than subject relative clauses because of their non-canonical word order. The third change was the insertion of a baseline during MM's treatment. Baseline should be considered as a goal in case study designs, and in the practice, experimenters should make at least three measures until baseline is stable.

Some difficulties were noticed during the planning and the development of the treatments. The need of a collaboration not only with a hospital but also with the speech therapist who gives the conventional therapy to the participant, which could help to plan a stricter treatment in line with the conventional speech therapies. A stricter plan can also help to determine a more stable baseline and post-treatment assessments. The collaboration with the single speech therapist could also allow the use of a more formal setting, which probably helps to avoid that the child develops a kind of friendship with the experimenter, which brings to the child's loss of attention during treatment.

Concluding, the reliability of a treatment based on the explicit teaching of syntactic theory was confirmed also for children fitted with CIs. This study further shows that a short-term treatment appears to have the same results as a long-term treatment. The treatment described in this paper comprised seven sessions and lasted approximately three months, while the treatments given to patients with agrammatism (Thompson et al. 1997) and to a child with syntactic SLI (Levy & Friedmann 2009) lasted more than six months and comprised of 16 to 42 sessions. This could be

interpreted as an advantage from the clinical point of view: a short-term therapy would be more adaptable to speech therapy sessions. Moreover, it was demonstrated that a work on verb argument structure and Theta criterion may involve an increase in the production and comprehension of untrained structures derived by a different movement (NP-movement) than the one on which the treatment is based (*wh*-movement).

These last two experiments also fostered the following observations. First, the collaboration with speech therapists will help to give the treatment of movement-derived sentences a more formal setting, precisely by defining the role of the experimenter and the role of the participant. This collaboration can certainly help to design a stricter planning of all the phases of the treatment starting from the pre-treatment assessment. Therefore, providing a baseline before the start of the treatment helps to determine the rate of progress without intervention. This practice is largely requested by the scientific community since it helps to describe the reliability of the treatment protocol. Secondly, a better control on passive sentences should be provided, since in both the experiments described for this study it was possible to check an improvement in the production and/or the comprehension of this structure, something which is unexpected under Thompsons and her collaborators hypothesis. Third, in future experiments it would be necessary to establish a larger control group than those described for these case studies so as to try to conduct a statistical analysis. Moreover, the control group will not be used only to compare the participant/s' syntactic competence with TD age-peers, but above all, it will have the function to show if there are possible memorisation effects of the test administered before and after treatment. This variable will be controlled by assessing the control group with the same frequency as the participant/s at the treatment. This type of assessment also provides information of possible effects due to language acquisition. Indeed, children may provide better answers because during the period between the two assessments, they have acquired the syntactic structures investigated.

To conclude this chapter, a summary table of the treatments carried out for this study is provided. The table also presents a comparison with the treatment described by D'Ortenzio (2015, 2017) on which the two syntactic interventions illustrated in this chapter are based.

Tab. 73: comparison between the three syntactic interventions carried out with three children fitted with cochlear implants. In bold letters are presented the main differences between treatments.

Participants	**LB**	**ES**	**MM**
Aims	Improve the production and the comprehension of relative clauses	Improve the production and the comprehension of relative clauses	Improve the production and the comprehension of relative clauses
	Duration over time of treatment effects	**Generalization to untrained structures and narrative skills**	**Generalization to untrained structures and narrative skills**
Duration	**3 months**	**2 months**	**2 months**
	6 sessions (75 minutes)	**7 sessions (70 minutes)**	**7 sessions (60 minutes)**
Structures involved	**SRs, ORs, ORps**	**ORs**	**ORs**
Stage 1	2 sessions	2 sessions	**3 sessions**
	Intransitive, transitive, ditransitive verbs	Intransitive, transitive, ditransitive verbs	Intransitive, transitive, ditransitive verbs
	Verb argument structure and Theta Criterion	Verb argument structure and Theta Criterion	Verb argument structure and Theta Criterion
			Notes, schemes
Stage 2	**3 sessions**	**4 sessions**	**3 sessions**
	SRs, ORs, Orps	**ORs**	**ORs**
	Syntactic movement	Syntactic movement	Syntactic movement
	CARD GAME: to understand syntactic movement. The child has evidence of the movement of sentence constituents	**CARD GAME**: to understand syntactic movement. The child has evidence of the movement of sentence constituents	**CARD GAME**: to understand syntactic movement. The child has evidence of the movement of sentence constituents
			SYNTACTIC SCRABBLE: gives the child the opportunity to play with sentences and to transform simple sentences into complex ones
Stage 3	1 session	1 session	1 session
	final review of all topics	final review of all topics	Final review of all topics
	written and oral excercises	written and oral excercises	written and oral excercises
	notes, schemes	notes, schemes	**SYNTACTIC SCRABBLE**

6. GENERAL DISCUSSION AND CONCLUSIONS

The aim of this research is twofold: Firstly, we analysed how children with hearing impairment, fitted with CIs, process syntactically complex structures derived by syntactic movement. We then propose a syntactic intervention based on the explicit teaching of syntactic rules, thereby modifying a previous attempt carried out with a child fitted with a CI (D'Ortenzio 2015; D'Ortenzio et al. 2017a, b).

Several syntactically complex structures were analysed in order to describe the syntactic competence of children with CIs. On the one hand, the analysis of movement-derived structures concerned the production and comprehension of restrictive subject and object relative clauses, which have been well-investigated in different languages and in several populations: healthy adults (De Vincenzi 1991; Cooke et al. 2002; Wingfield et al. 2003); adults with an acquired language disorder such as agrammatic aphasia (Thompson & Shapiro 1995; Grillo 2008; Garraffa & Grillo 2008); typically developing children (Labelle 1990; Pérez-Leroux 1995; Varlokosta & Armon-Lotem 1998; Guasti & Cardinaletti 2003; Utzeri 2007; Arosio et al. 2009; Brandt et al. 2009; Belletti & Contemori 2010; Volpato 2010; Adani 2011); children with SLI (Dick et al. 2004; Friedmann & Novogrodsky 2007; Levy & Friedmann 2009; Contemori & Garraffa 2010; Guasti et al. 2015); children with developmental dyslexia (Guasti et al. 2015; Pivi et al. 2016; Delage & Durrleman 2018); children and adolescents with hearing impairment fitted with HAs or CIs (Quigley & Paul 1984; De Villiers 1988; Friedmann & Szterman 2006; Delage 2008; Friedmann et al. 2008; Volpato & Adani 2009; Volpato 2010, 2012; Friedmann & Haddad-Hanna 2014; Volpato & Vernice 2014).

On the other hand, one of the aims of this research was to provide new data on structures that are never, or rarely, analysed in Italian-speaking children with CIs (i.e. left-dislocated sentences containing resumptive clitic pronouns, cleft sentences, long-distance *wh*-questions, restrictive genitive and oblique relative clauses).

The participants of the experimental group were selected and tested in the ENT Clinic. Children were tested during the medical examination necessary for the checking of CIs. The assessment lasted from March 2017 to September 2017, a period that is not long enough to allow the building of a consistent homogeneous group of individuals sharing personal and clinical features. Indeed, since the ENT Clinic is a well-known centre all over Italy for CIs checking, patients come from several regions of Italy once or twice a year and it is difficult to plan a second meeting for the assessment. In addition to this, because of the many medical examinations necessary for the complete checking of CIs, the ENT Clinic has strict time schedules which allowed the experimenter only forty-five minutes to assess the participants on movement-derived structures. As a consequence, children and adolescents were

assessed under the weight of tiredness and not all of them, especially the younger ones, completed the assessment part. However, testing children during their follow-up medical examinations allows a data collection in a condition similar to what the child experiences every day. Thus, giving us a more realistic sample to test whether the children would be able to comprehend *wh*-questions under in everyday condition, for example after a long day at school.

The data collected from the CI group were compared with the performance of children with normal hearing and typical development matched on chronological age; we did that in order to investigate whether a difference exists between these two groups in the processing of syntactically complex structures. The control group was built in an unconventional way, since the experimenter had some difficulties in establishing a collaboration with schools. Therefore, the TD children enrolled in this research were selected among CI children's siblings, the author's colleagues and acquaintances contacted per e-mail or via social media. Other participants were selected among the members of Lisabilità[55], and some children were selected and tested by a MA student for the essay she wrote at the end of the course of Linguistics for deafness and hearing impairments. Following this unconventional methodology for the construction of the control group, it was difficult to control some variables such as the number of the participants and the chronological age. Indeed, the control group of this research is composed by a small number of participants which are younger than the children with CIs. This is the reason why, for each experiment, we built small experimental and control groups matching participants on comparable chronological age. As a consequence, the data collected from some participants were not taken into account.

Data collection involved the analysis of the following movement-derived structures:

- restrictive subject relative clauses, restrictive object relative clauses with preverbal subjects, restrictive object relative clauses with postverbal subjects, restrictive genitive and oblique relative clauses,
- subject and object *who* questions, subject and object *which*+NP questions, subject and object long distance *wh*-questions,
- cleft sentences,
- left dislocated sentences with resumptive clitic pronouns.

[55] Lisabilità is a Venetian association that promotes Italian Sign Language as Augmentative and Alternative Communication (AAC)

These structures were analysed by resorting to: a sentence repetition task (Del Puppo et al. 2016); a preference task and a character selection task (Volpato 2010), and a task for the elicitation of *wh*-questions (Guasti et al. 2012, 2015).
The main findings of the assessment part of this research are listed below:

- The data collected through each task evidenced a poorer performance of the children and the adolescents fitted with CIs compared to their TD age peers. The hypothesis that a delay in the exposure to an oral language may influence the acquisition of more complex structures is confirmed. However, even though previous studies pointed out the importance of early intervention on hearing loss (Friedmann & Szterman 2006; Volpato & Vernice 2014), in this research this hypothesis was not confirmed. Assuming the point of view of some speech therapies, the variability in the effects of CIs is also caused by the type of speech therapy administered to the child, as pointed out in chapter 1. Indeed, speech therapies do not follow a common protocol, but they can be modified by speech therapists in order to train some language domains more than others.

- However, children with CIs and children with TD showed similar tendencies in processing some of the movement-derived structures. Indeed, children present a subject-object asymmetry in the production, comprehension and repetition of restrictive relative clauses and *wh*-questions. This outcome confirms what was pointed out by previous studies on typically developing populations, children with a language disorder, or people with an acquired language disorder (healthy adults: De Vincenzi 1991; Cooke et al. 2002; Wingfield et al. 2003; typically developing children: Labelle 1990; Pérez-Leroux 1995; Varlokosta & Armon-Lotem 1998; Guasti & Cardinaletti 2003; Utzeri 2007; Arosio et al. 2009; Brandt et al. 2009; Belletti & Contemori 2010; Volpato 2010; Adani 2011; children with SLI: Dick et al. 2004; Friedmann & Novogrodsky 2007; Levy & Friedmann 2009; Contemori & Garraffa 2010; Guasti et al. 2012, 2015; Del Puppo et al. 2016; children with developmental dyslexia: Guasti et al. 2015; Pivi et al. 2016; Delage & Durrleman 2018; children and adolescents with hearing impairment fitted with HAs or CIs: Quigley et al. 1974; Quingley e Paul 1984; De Villiers 1988; Friedmann e Szterman 2006; Delage 2008; Friedmann et al. 2008; Volpato & Adani 2009; Volpato 2010, 2012; Friedmann & Szterman 2011; Friedmann & Haddad-Hanna 2014; Volpato & Vernice 2014; Ruigendijk & Friedmann 2017; Volpato & D'Ortenzio 2017; Penke & Wimmer 2018; agrammatic patients: Thompson & Shapiro 1995; Grillo 2008; Garraffa & Grillo 2008). Several of the aforementioned studies (as for example: Grillo 2008; Friedmann et al. 2009; Volpato 2010, 2012; Volpato & Vernice 2014; Volpato & D'Ortenzio 2017) resorted to the locality principle of Relativized Minimality (RM)

(Rizzi 1990, 2004; Starke 2001) to explain the subject-object asymmetry. RM principle affirms that a local relation between two elements, X and Y, cannot hold if there is a third element, namely Z, that intervenes in this relation. Moreover, since Z shares some features with X, can also be a potential candidate for the relation with X. Several features can provoke intervention effects. Grillo (2008) was the first to adapt the RM to explain the subject-object asymmetry in a population with language impairment, namely patients with agrammatic aphasia. According to Grillo, individuals with limited processing resources struggle to activate, select, maintain, and manipulate the array of morphosyntactic features required to distinguish the intervening subject from the moved object, thus wrongly computing sentences derived by object movement. Friedmann et al. (2009) claim that intervention effects are caused by the presence of a lexical restriction common to the moved object and the subject. Assuming Volpato's (2010, 2012) point of view, intervention effects can be avoided by manipulating the subject and object number features, thus sentences presenting a number mismatch condition (i.e. the subject is singular, and the object is plural, and the other way around) are easier to process than sentences having a match number condition.

- A further asymmetry, evidenced by the elicitation task of *wh*-questions (Guasti et al. 2012, 2015), was found between *who* questions and *which* questions, namely the former structure is easier to process than the latter. The same asymmetry has been found in previous studies on Italian-speaking children with and without typical language acquisition (typically developing children: Guasti 2012; children with developmental dyslexia: Guasti et al. 2015). This asymmetry can be explained by resorting to several hypothesis. According to Guasti et al. (2012, 2015) and Belletti and Guasti (2015), the asymmetry between *who* and *which* questions is due to several processes involved in the derivation of *which+NP* questions. One possible process is the pied piping of the nominal element involved in the case of *which+NP* phrases (Belletti & Guasti 2015). Agreement relations are another possible process involved in the derivation of *which+NP* questions, since both the subject and the object display agreement features and must agree. The asymmetry between *who* and *which+NP* questions may also be explained assuming the Derivational Complexity Hypothesis (Jakubowicz 2004, 2005) which assumes that children acquire structures in which the syntactic movement involves only one constituent earlier than those involving two or more moved constituents. Therefore, children find *which+NP* questions more difficult than *who* questions because of the number of the constituents that must move to the Spec, CP.
- The sentence repetition task (Del Puppo et al. 2016), which allows the analysis of several syntactic structures using one and the same task, was found effective for the data collection in Italian-

speaking children fitted with CIs. The sentence repetition task has previously demonstrated to be a useful tool for data collection in Hebrew-speaking children fitted with HAs or CIs (Friedmann & Szterman 2011; Szterman & Friedmann 2015) and in different populations (patients with agrammatic aphasia: Friedmann & Grodzinsky 1997; Friedmann 2007; children with SLI: Del Puppo et al. 2016). In this research, using the sentence repetition task helped to detect some response strategies which were found in the CI group but not in the TD group. For example, children with CIs produced short *wh*-questions instead of repeating a target long-distance *wh*-question; omitted the complementizer *che*; produced a finite verb instead of an infinite one; produced simple SVO sentences instead of long-distance dependency structures.

- The difficulties showed by children fitted with CIs during the sentence repetition task may have been caused by the high complexity of the experimental sentences. Indeed, the structures investigated by this task are derived by more than a single syntactic movement. For example, in long-distance *wh*-questions, the *wh*-element undergoes cyclic movement from its base position in the subordinate clause to a new position in the main clause which is not adjacent to the clause where the *wh*-element is first merged (de Villiers et al. 1994). Assuming Jakubowicz's Derivational Complexity Hypothesis (2004, 2005), children find it difficult to process structures in which the *wh*-element must be merged more than once. This hypothesis is supported by the strategies of simplification adopted by children with CIs in order to avoid the repetition of long-distance *wh*-questions; for example, they produced simple *wh*-questions. The problematic repetition of restrictive genitive and oblique relative clauses may also be explained through the presence of a double movement that characterises the structure. Indeed, following Kayne (1994) and Bianchi (1999), these structures are derived by two movements: (i) the first involves the movement of the relative DP or the pied piped PP to Spec, CP; (ii) the second concerns the NP movement out of the complement position of the relative D° to the highest specifier position within the relative clause, which is also the one that asymmetrically c-commands everything else within the relative CP. This hypothesis is supported by children's productions of sentences with an easier structure than repeating genitive or oblique relative clauses. These structures also presented a high rate of ungrammatical or incomplete sentences. Interestingly, children also substituted the relative pronoun *quale* with the relative pronoun *cui*. This strategy was largely found in TD children's responses. It is possible to assume that this type of substitution is due to the fact that the relative pronoun *cui* is more economic than *quale* since it does not involve number and gender agreement with its antecedent.

The second aim of this research was the development of a protocol for the treatment of movement-derived structures. This procedure was found fruitful in several populations for the improvement and treatment of structures derived by *wh*- and NP-movement (very young typically developing children: Roth 1984; patients with agrammatic aphasia: Thompson & Shapiro 1995; Thompson 2005; children with SLI: Ebbels & van der Lely 2001; Levy & Friedmann 2009; L2 Italian speakers: Bozzolan 2016; Bozzolan & Volpato 2017; De Nichilo 2017; Piccoli 2018; Italian students with dyslexia: Piccoli 2018). Treatment is based on the explicit teaching of syntactic rules, namely verb argument structure (Chomsky 1981), Theta criterion (Chomsky 1981) and *wh*-movement (Chomsky 1971; Vergnaud 1985; Kayne 1994; Bianchi 1999). For this research, the teaching of syntactic rules was supported by metaphors and a card game. To investigate generalization effects, the syntactic intervention is centred only on object relatives with preverbal subjects. The outcomes collected after the end of the treatment highlighted the following findings:

- Both experiments described in this thesis pointed out that children can improve their performance in the processing of movement-derived structures through a short-term treatment. Indeed, both syntactic interventions include seven sessions and last no more than three months[56]. It is worth mentioning that a shorter treatment ensures a more adaptability to conventional speech therapies.
- Results collected after treatment also showed generalization effects on untrained structures and the participants' narrative skills. Interestingly, generalization effects involved not only untrained structures derived by the same syntactic movement, namely *wh*-movement, but they involved also untrained structures derived by a different syntactic movement, namely NP-movement in passive sentences. Since the number of the results was too small to carry out a statistical analysis, it is possible to hypothesize that exercises focused on verb argument structure and Theta criterion may also help the processing of other sentence types. A further generalization effect was found in participants' narrative skills. In this case, improvements involved most of all a decrease in the production of ungrammatical sentences and the rate of hesitations. The fact that more complex structures were not produced is not to consider a limitation since more complex structures are rarely found also in the free speech of TD children (Dabrowska et al. 2009).
- The experiments focused on the treatment of movement-derived structures unearthed some limits. The first limit concerns the planning of the sessions. If the experimenter is the only person to conduct the treatment and s/he not supported by a speech therapist, the parents of the participant

[56] The treatment duration also includes the month during which the treatment was stopped because of the summer holidays.

might modify the frequency of the meetings. Moreover, a collaboration with the speech therapist treating the child allows a better control of some variables, as, for example, the activities administered to the child during speech therapies. A second limit concerns the experimenter; if s/he is the only person to test and give the syntactic intervention, it is possible that the child develops a personal relationship with the experimenter, which brings to the child's loss of attention during treatment, since the child perceives the experimenter more as a friend than as a professional figure. Moreover, this personal relationship can also prevent a correct assessment of the participant at the end of treatment, as happened during the last treatment.

To conclude, with this thesis we wanted to: (i) provide an overview of the syntactic competence of Italian-speaking children with CIs in complex structures derived by A' movement; (ii) suggest a linguistic training focused on syntactic rules.

At a first glance, the analysis of movement-derived structures seems ambitious since the sample is too small to provide a generalization of the data to the whole population of children with hearing loss and fitted with CIs. However, the results can be considered as an important starting point for further research, also taking into account the fact that the deaf population is very heterogeneous. Therefore, considering the limitations of the present study, we propose to increase the number of the participants in the experimental and the control groups in order to carry out more precise statistical analysis comparing the two groups. Furthermore, differently from the present research, it would be interesting to focus only on one experimental task at time, in order to support it with standardised tests and/or cognitive tasks. Indeed, the use of standardised tests is a good practice in the scientific research since the comparison of the participants' competencies with normative data helps to outline a precise profile of the participants. For example, as suggested by the audience at the Romance Turn 9, it would be interesting to also evaluate children's memory abilities when testing them with the sentence repetition task. An additional research question to answer will be to identify whether the causes of the syntactic problems showed by children with CIs are a delay in the acquisition of language or a language impairment. To cope with this question, longitudinal studies are needed.

Considering the pros and cons of the syntactic intervention administered to children fitted with CIs, more research is needed, since more variables must be controlled for. Indeed, it would be interesting to analyse whether the improvement showed at the end of treatment is caused by the treatment itself or by the normal acquisition of language. Following Levy and Friedmann (2009), we have tested the control group only once. It would be however important to assess the control group with the same frequency as the participant/s at the treatment. Moreover, it would be interesting to integrate the

syntactic intervention to the conventional speech therapies so as to give to a large number of children the opportunity to improve their syntactic competence.

In light of these final considerations, we hope to carry out further studies in order to provide a much more precise profile of the syntactic competence of Italian-speaking children and adolescents fitted with CIs which can also be used by speech therapists when planning a speech therapy for this population.

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APPENDIX A

SENTENCE REPETITION TASK

(Del Puppo et al. 2016)

1. I leoni, il pinguino li colpisce forte.
2. Le oche prendono il sole nel giardino di casa.
3. La mamma bacia la bambina al cui fratello piacciono le tigri.
4. È la GALLINA che viene picchiata dalla pecora!
5. Il papà guida la macchina e la cugina ascolta la musica.
6. Quale animale hai detto che guarda i tacchini?
7. Il gatto lecca le bambine alle quali la mamma dona un gioco.
8. La mamma legge un libro di cucina sul divano.
9. Quale persona hai detto che i dottori curano?
10. La bambina pettina i gatti e il nonno scrive una lettera.
11. Quale gallina hai detto che saluta le pecore?
12. Il maestro pettina la signora la cui figlia lavora.
13. Il maestro ha deciso che oggi mangia la frutta.
14. La bambina lava il cane a cui il padrone dà i biscotti.
15. L'elefante mangia il gelato freddo con la nonna.
16. È il CAMMELLO a tirare la mucca!
17. Quale persona hai detto che saluta i ragazzi?
18. La bambola, il bambino la pettina sempre.
19. Il papà ha detto che oggi passeggia con il cane.
20. Quale animale hai detto che le scimmie grattano?
21. La bambina, il signore la saluta spesso.
22. La pesca viene mangiata dalla bambina a scuola.
23. Il topo tocca il ragazzo al quale il papà porta un regalo.
24. Quale animale hai detto che bagnano i gatti?
25. È il TORO che viene inseguito dalla giraffa!

Pause

26. Le giraffe, il serpente le insegue ora.
27. Quale coniglio hai detto che i cavalli spingono?

28. Il bambino gioca al parco con l’aquilone.
29. Il papà guarda il bambino alla cui zia piacciono i gatti.
30. La giraffa lecca la pianta tutti i giorni.
31. Il bambino, la maestra lo bacia adesso.
32. Il postino saluta la signora il cui figlio disegna.
33. Quale leone hai detto che i maiali tirano?
34. È la MUCCA a fermare il maiale!
35. Il gatto salta la corda e morde il panino col salame.
36. Il cane morde i ragazzi ai quali il nonno compra il gelato.
37. Gli elefanti bevono acqua fresca.
38. È la MOSCA che gli uccelli mangiano!
39. La nonna vuole mangiare una pera.
40. Quale maiale hai detto che solleva i cavalli?
41. Il papà lava la macchina rossa di mamma.
42. Quale pulcino hai detto che fermano le giraffe?
43. Il lupo guarda la bambina alla quale la nonna dona un fiore.
44. Il signore bagna i ragazzi e il lupo mangia una banana.
45. Quale persona hai detto che guardano le ragazze?
46. È il PINGUINO che le mucche fermano!
47. La nonna ha scritto che domani compra il giornale.
48. Quale gallina hai detto che sgridano le papere?
49. Il postino, il cane lo morde ogni giorno.

APPENDIX B

PREFERENCE TASK

(Volpato 2010)

Training part:

a. **SR**: Ci sono due bambini. Un bambino saluta il papà e l'altro saluta il cane. Quale bambino ti piace di più? Inizia con: "Mi piace il bambino …" oppure "Il bambino …"
b. Cosa c'è sul tavolo?

Experiment:

1. **SR**: Ci sono due disegni. Nel primo un bambino pettina la mamma, nel secondo un bambino pettina un cane. Quale bambino ti piace di più?
   Target: mi piace il bambino che pettina la mamma/il cane.
2. **OR**: Ci sono due disegni. Nel primo i cani baciano i bambini, nel secondo i nonni baciano i bambini. Quali bambini ti piacciono di più?
   Target: mi piacciono i bambini che il cane bacia/i nonni baciano.
3. Cosa fa il bambino in questa foto?
4. **SR**: Ci sono due disegni. Nel primo i bambini inseguono le farfalle, nel secondo i bambini inseguono le api. Quali bambini ti piacciono di più?
   Target: mi piacciono i bambini che inseguono le farfalle/le api.
5. **OR**: Ci sono due disegni. Ne primo l'orso morde un bambino, nel secondo l'orso abbraccia un bambino. Quale bambino ti piace di più?
   Target: Mi piace il bambino che l'orso morde/abbraccia.
6. Cosa fa il coniglio?
7. **SR**: Ci sono due disegni. Nel primo il padre pettina i bambini, nel secondo il barbiere pettina i bambini? Quali bambini ti piacciono di più?
   Target: Mi piacciono i bambini che il papà/il barbiere pettina.
8. **SR**: Ci sono die disegni. Nel primo i bambini guardano i cavalli, nel secondo i bambini guardano le scimmie. Quali bambini ti piacciono di più?
   Target: mi piacciono i bambini che guardano i cavalli/le scimmie.
9. Cosa fa l'orso?
10. **OR**: Ci sono due disegni. Nel primo la maestra sgrida i bambini, nel secondo la maestra premia i bambini. Quali bambini ti piacciono di più?
    Target: mi piacciono i bambini che la maestra premia/sgrida.

11. **OR**: Ci sono due disegni. Nel primo il leone segue il bambino, nel secondo il cane segue il bambino. Quale bambino ti piace di più?
    Target: mi piace il bambino che il leone/il cane segue.
12. Cosa tiene in mano la bambina?
13. **SR**: Ci sono due disegni. Nel primo i bambini salutano il papà, nel secondo i bambini salutano un amico. Quali bambini ti piacciono di più?
    Target: mi piacciono i bambini che salutano il papà/un amico.
14. **OR**: Ci sono due disegni. Nel primo i leoni inseguono i bambini, nel secondo i leoni tirano i bambini. Quali bambini ti piacciono di più?
    Target: Mi piacciono i bambini che i leoni inseguono/tirano.
15. Cosa mangia la scimmia?
16. **SR**: Ci sono due disegni. Nel primo i bambini lavano il cane, nel secondo i bambini lavano la tigre. Quali bambini ti piacciono di più?
    Target: mi piacciono i bambini che lavano il cane/la tigre.
17. **SR**: Ci sono due disegni. Nel primo i bambini accarezzano il gatto, nel secondo i bambini calciano il gatto. Quali bambini ti piacciono di più?
    Target: mi piacciono i bambini che accarezzano/calciano il gatto.
18. Dov'è il gatto?

APPENDIX C

CHARACTER SELECTION TASK

(Volpato 2010)

Training part:

a. Tocca il cane che indica i topi.
b. Tocca il topo che corre.

Experiment:

1. OSV_SG_SG Tocca la gallina che il pulcino becca.
2. SVO_PL_SG Tocca i leoni che guardano l'elefante.
3. OSV_SG_PL Tocca il pinguino che i gatti guardano.
4. OSV_PL_SG Tocca i gatti che la pecora colpisce
5. FILLER Tocca il cane che ha l'osso in bocca.
6. OVS_PL_SG Tocca i conigli che tira la gallina.
7. SVO_PL_SG Tocca le scimmie che fermano il pinguino.
8. OSV_SG_PL Tocca il nonno che i pinguini lavano.
9. SVO_SG_PL Tocca il coniglio che colpisce i topi.
10. FILLER Tocca il topo che legge un libro.
11. SVO_PL_SG Tocca i cani che toccano il ragazzo.
12. OSV_PL_SG Tocca le scimmie che l'elefante insegue.
13. OSV_SG_SG Tocca l'elefante che l'uccellino porta.
14. OVS_PL_PL Tocca le moto che le macchine spingono.
15. FILLER Tocca la bambina che corre in bicicletta.
16. OVS_SG_PL Tocca la pecora che tirano le scimmie.
17. OVS_PL_SG Tocca i nonni che tocca la tartaruga.
18. OSV_SG_PL Tocca la giraffa che le zebre tirano.
19. SVO_SG_PL Tocca il pesce che segue le tartarughe.
20. FILLER Tocca il nonno che guarda la televisione.
21. OSV_SG_SG Tocca la lepre che la giraffa saluta.
22. OVS_SG_PL Tocca il cammello che lavano gli orsi.
23. OSV_PL_SG Tocca le tartarughe che l'orso saluta.
24. OVS_PL_PL Tocca le oche che i pinguini fermano.
25. FILLER Tocca la scimmia che è in acqua.

26. OVS_SG_PL Tocca l’uccellino che guardano i cani.
27. OVS_PL_SG Tocca le ragazze che ferma il vigile.
28. SVO_PL_SG Tocca le tigri che mordono il cavallo.
29. OSV_PL_SG Tocca le bambine che il bambino lava.
30. FILLER Tocca il gatto che suona la chitarra.
31. SVO_SG_PL Tocca il cavallo che insegue i leoni.
32. OSV_SG_SG Tocca il bambino che la nonna pettina.
33. OSV_SG_PL Tocca il ragazzo che i cani toccano.
34. SVO_SG_PL Tocca la giraffa che toccano gli orsi.
35. FILLER Tocca la bambina che salta la corda.
36. OVS_SG_PL Tocca il cigno che beccano i pulcini.
37. OVS_PL_SG Tocca i bambini che insegue il cavallo.
38. OVS_PL_PL Tocca gli asini che i cani lavano.
39. OSV_SG_SG Tocca il leone che la tartaruga tira.
40. FILLER Tocca la rana che salta.
41. OVS_PL_SG Tocca i gattini che guarda il pinguino.
42. OVS_PL_PL Tocca le mucche che i cammelli tirano.
43. OVS_SG_PL Tocca la macchina che seguono i camion.
44. OSV_SG_PL Tocca il pinguino che le scimmie fermano.
45. FILLER Tocca il coniglio che legge.
46. OSV_SG_SG Tocca l’elefante che la scimmia insegue.
47. SVO_PL_SG Tocca i pinguini che lavano il nonno.
48. OVS_PL_PL Tocca i serpenti che le tigri guardano.
49. OVS_PL_SG Tocca le pecore che colpisce la gallina.
50. FILLER Tocca la capra che mangia il gelato.
51. SVO_SG_PL Tocca il bambino che lava le bambine.
52. SVO_PL_SG Tocca le zebre che toccano la giraffa.
53. FILLER Tocca la bambina che tiene il palloncino.
54. OSV_SG_PL Tocca il cavallo che le tigri mordono.
55. OVS_PL_PL Tocca le rane che le ragazze seguono.
56. SVO_SG_PL Tocca la pecora che colpisce i gatti.
57. OSV_PL_SG Tocca gli orsi che la giraffa pettina.

APPENDIX D

WH-QUESTIONS ELICITATION TASK

(Guasti et al. 2012, 2015)

1. Il signore sta innaffiando qualcosa. Domanda alla mamma/al papà cosa.
2. Il ladro sta rubando qualcosa. Domanda alla mamma/al papà cosa.

3. SUB-WHO Qualcuno acchiappa i fantasmi. Domanda alla mamma/al papà chi.
4. SUB-WHICH Ci sono due calciatori, un cuoco con il grembiule blu ed un cuoco con il grembiule rosso. Uno dei cuochi saluta i calciatori. Domanda alla mamma/al papà quale cuoco.
5. SUB-WHO I conigli accarezzano qualcuno. Domanda alla mamma/al papà chi.
6. SUB-WHICH Ci sono due scimmie, un gatto nero e un gatto bianco. Uno dei gatti lava le scimmie. Domanda alla mamma/al papà quale gatto.
7. OBJ-WHO Gli elefanti sporcano qualcuno. Domanda alla mamma/al papà chi.
8. OBJ-WHICH Ci sono due puffi, un bambino con i capelli biondi ed un bambino con i capelli neri. I puffi sognano uno dei bambini. Domanda alla mamma/al papà quale bambino.
9. OBJ-WHO I bambini colpiscono qualcuno. Domanda alla mamma/al papà chi.
10. OBJ-WHICH Ci sono un cavallo, due mucche a macchie nere e due mucche a macchie marroni. Il cavallo segue due mucche. Domanda alla mamma/al papà quali mucche.
11. SUB-WHICH Ci sono due streghe con la scopa, due streghe senza scopa ed un signore. Due streghe bagnano il signore. Domanda alla mamma/al papà quali streghe.
12. OBJ-WHICH Ci sono due bambini con i pantaloni azzurri, due bambini con i pantaloni verdi ed una fatina. La fatina tira due dei bambini. Domanda alla mamma/al papà quali bambini.
13. SUB-WHICH Ci sono due grilli rossi, due grilli gialli e un'ape. Due dei grilli legano l'ape. Domanda alla mamma/al papà quali grilli.
14. SUB-WHO Qualcuno insegue gli elefanti. Domanda alla mamma/al papà chi.
15. SUB-WHICH Ci sono due bambine con il vestito verde, due bambine con il vestito rosso ed una signora. Due delle bambine rincorrono la signora. Domanda alla mamma/al papà quale bambina.
16. OBJ-WHO I gatti svegliano qualcuno. Domanda alla mamma al papà chi.

17. SUB-WHICH Ci sono due pagliacci, una ballerina con i capelli biondi e una ballerina con i capelli neri. Una delle ballerine bagna i pagliacci. Domanda alla mamma/al papà quale ballerina.
18. SUB-WHO Qualcuno cattura gli gnomi. Domanda alla mamma/al papà chi.
19. OBJ-WHICH Ci sono due gatti, un cane a macchie nere e un cane marrone. I gatti leccano uno dei cani. Domanda alla mamma/al papà quale cane.
20. SUB-WHO Qualcuno lega gli orsi. Domanda alla mamma/al papà chi.
21. OBJ-WHICH Ci sono due streghe, un fantasma grande e un fantasma piccolo. Le streghe spaventano uno dei fantasmi. Domanda alla mamma/al papà quale fantasma.
22. SUB-WHO Qualcuno tira i cavalli. Domanda alla mamma/al papà chi.
23. OBJ-WHICH Ci sono due cavalli neri, due cavalli bianchi e un leone. Il leone rincorre due dei cavalli. Domanda alla mamma/al papà quali cavalli.
24. OBJ-WHO I cavalli mordono qualcuno. Domanda alla mamma/al papà chi.
25. SUB-WHO Qualcuno spinge i soldati. Domanda alla mamma/al papà chi.
26. OBJ-WHO Gli orsi lavano qualcuno. Domanda alla mamma/al papà chi.

APPENDIX E

PASSIVE SENTENCES ELICITATION TASK

(Verin 2010)

1. Nella prima foto Sara spinge Marco. Nella seconda foto la mamma spinge Maro. Cosa succede a Marco nella prima foto?
2. Nella prima foto Sara imbocca la mamma. Nella seconda foto Sara imbocca Marco. Cosa succede a Marco?
3. Cosa succede nella seconda foto?
4. Nella prima foto Sara vede Marco. Nella seconda foto il papà vede Marco. Cosa succede a Marco nella prima foto?
5. Nella prima foto Sara prende a calci Marco. Nella seconda foto Sara prende a calci la mamma. Cosa succede alla mamma?
6. Cosa succede nella prima foto?
7. Nella prima foto Marco colpisce Sara. Nella seconda foto, il papà colpisce Sara. Cosa succede a Sara nella seconda foto?
8. Cosa succede nella seconda foto?
9. Nella prima foto Marco sente il papà. Nella seconda, Marco sente Sara. Cosa succede a Sara?
10. Cosa succede nella terza foto?
11. Nella prima foto Sara bacia Marco. Nella seconda la mamma bacia Marco. Cosa succede a Marco nella prima foto?
12. nella prima foto Sara ama il papà. Nella seconda Sara ama Marco. Cosa succede al papà?
13. Cosa succede nella seconda foto?
14. Nella prima foto Marco spinge Sara. Nella seconda Marco spinge la mamma. Cosa succede alla mamma?
15. Nela prima foto Marco insegue Sara. Nella seconda la mamma insegue Sara. Cosa succede a Sara nella seconda foto?
16. Cosa succede nella prima foto?
17. Nella prima foto Marco ama Sara. Nella seconda il papà ama Sara. Cosa succede a Sara nella prima foto?
18. Nella prima foto Marco vede la mamma. Nella seconda Marco vede Sara. Cosa succede a Sara?
19. Cosa succede nella prima foto?

20. Nella prima foto Sara colpisce il papà. Nella seconda Sara colpisce Marco. Cosa succede a Marco?
21. Nella prima foto il papà sente Marco. Nella seconda Sara sente Marco. Cosa succede a Marco nella prima foto?
22. Nella prima foto Marco annusa Sara. Nella seconda Marco sente il papà. Cosa succede al papà?
23. Cosa succede nella seconda foto?
24. Cosa succede nella seconda foto?
25. Nella prima foto il papà imbocca Sara. Nella seconda Marco imbocca Sara?
26. Nella prima foto Marco bacia il papà. Nella seconda Marco bacia Sara. Cosa succede a Sara?
27. Cosa succede nella terza foto?
28. Nella prima foto Sara vede Marco. Nella seconda il papà vede Marco. Cosa succede a Marco nella seconda foto?
29. Nella prima foto Sara ama il papà. Nella seconda Sara ama Marco. Cosa succede al papà?
30. Cosa succede nella prima foto?
31. Nella prima foto il papà sente Marco. Nella seconda Sara annusa Marco? Cosa succede a Marco nella seconda foto?
32. Nella prima foto Marco prende a calci Sara. Nella seconda la mamma prende a calci Sara. Cosa succede a Sara nella seconda foto?
33. Nella prima foto Marco sente il papà. Nella seconda Marco sente Sara. Cosa succede al papà?
34. Nella prima foto Sara insegue a mamma. Nella seconda Sara insegue Marco. Cosa succede alla mamma?
35. Nella seconda foto Marco annusa Sara. Nela seconda Marco sente il papà. Cosa succede a Sara?
36. Cosa succede nella terza foto?

APPENDIX F

COMPREHENSION OF PASSIVE SENTENCES

(Verin 2010)

1. In quale foto Marco è spinto da Sara?
2. In quale foto Sara è imboccata?
3. In quale foto Marco colpisce la sedia?
4. In quale foto Marco è visto da Sara?
5. In quale foto Sara viene presa a calci?
6. In quale foto Sara è colpita da Marco?
7. In quale foto Marco spinge la sedia?
8. In quale foto Marco è sentito?
9. In quale foto Marco viene spinto da Sara?
10. In quale foto Sara viene imboccata?
11. In quale foto Sara viene amata?
12. In quale foto Marco è annusato?
13. In quale foto Sara ama l'orsacchiotto?
14. In quale foto Sara viene colpita da Marco?
15. In quale foto Sara è presa a calci?
16. In quale foto Marco viene visto da Sara?
17. In quale foto Sara è amata da Marco?
18. In quale foto Marco è spinto?
19. In quale foto Sara bacia il cane?
20. In quale foto Marco è baciato da Sara?
21. In quale foto Marco è visto?
22. In quale foto Sara viene amata da Marco?
23. In quale foto Sara è inseguita da Marco?
24. In quale foto Sara annusa il fiore?
25. In quale foto Sara è colpita?
26. In quale foto Marco è sentito da Sara?
27. In quale fo Marco viene spinto?
28. In quale foto Marco insegue la palla?
29. In quale foto Marco viene baciato da Sara?
30. In quale foto Marco viene annusato?

31. In quale foto Sara viene colpita?
32. In quale foto Marco sente la radio?
33. In quale foto Sara viene inseguita da Marco?
34. In quale foto Sara è amata?
35. In quale foto Marco viene visto?
36. In quale foto Sara è imboccata da Marco?
37. In quale foto Marco è baciato?
38. In quale foto Marco viene sentito?
39. In quale foto Sara imbocca la bambola?
40. In quale foto Sara è presa a calci da Marco?
41. In quale foto Sara è inseguita?
42. In quale foto Marco viene sentito da Sara?
43. In quale foto Sara guarda la palla?
44. In quale foto Sara viene imboccata da Marco?
45. In quale foto Marco viene baciato?
46. In quale foto Marco è annusato da Sara?
47. In quale foto Marco prende a calci il cuscino?
48. In quale foto Sara viene presa a calci da Marco?
49. In quale foto Sara viene inseguita?
50. In quale foto Marco viene annusato da Sara?

APPENDIX G

ELICITATION OF DIRECT-OBJECT CLITIC PRONOUNS

(Arosio et al. 2009)

Acquaintance:

1. In questa storia c'è un signore che vuole pescare un pesce. Guarda, cosa sta facendo al pesce?
2. In questa storia c'è una bambina che vuole catturare una dottoressa. Guarda, cosa sta facendo alla dottoressa?
3. In questa storia c'è un pinguino che vuole sollevare un topolino. Guarda, cosa sta facendo al topolino?
4. In questa storia c'è un bambino che vuole picchiare un mago. Guarda, cosa sta facendo al mago?
5. In questa storia c'è una signora ce vuole pelare una patata. Guarda, cosa sta facendo alla patata?

Test:

1. In questa storia c'è un bambino che vuole distruggere un castello di sabbia. Guarda, cosa succede al castello?
2. In questa storia c'è una signora che vuole dipingere una maschera. Guarda, cosa sta facendo alla maschera?
3. In questa storia c'è un gatto grigio. Guarda, cosa sta facendo?
4. In questa storia c'è un bambino che vuole mangiare un gelato. Guarda cosa sta facendo al gelato?
5. In questa storia c'è una signora che vuole sbucciare una pera. Guarda, cosa sta facendo alla pera?
6. In questa storia c'è un gatto tutto sporco. Guarda, cosa sta facendo?
7. In questa storia c'è un bambino che vuole lavare un cane. Guarda, cosa sta facendo al cane?
8. In questa storia c'è un bambino che vuole buttare un libro. Guarda cosa sta facendo al libro?
9. In questa storia c'è una bambina tutta spettinata. Guarda, cosa sta facendo?
10. In questa storia c'è una bambina che vuole prendere una farfalla con il retino. Guarda, cosa sta facendo alla farfalla?
11. In questa storia c'è un bambino che vuole bagnare un signore. Guarda, cosa sta facendo al signore?

12. In questa storia c’è una mucca che vuole leccare una rana. Guarda, cosa sta facendo alla rana?
13. In questa storia c’è un orsetto che ha fatto il bagno ed è tutto bagnato. Guarda, cosa sta facendo?
14. In questa storia c’è un bambino che vuole bucare un palloncino. Guarda, cosa sta facendo al palloncino?
15. In questa storia c’è una bella ragazza. Guarda cosa sta facendo?
16. In questa storia c’è una signora che vuole tagliare una mela Guarda, cosa sta facendo alla mela?
17. In questa storia c’è una bambina che vuole pettinare la nonna. Guarda, cosa sta facendo alla nonna?

APPENDIX H

VERB LIST

Intransitive verbs:

1. ABBAIARE
2. ABITARE
3. ANDARE
4. BALLARE
5. CAMMINARE
6. CENARE
7. CORRERE
8. DORMIRE
9. LITIGARE
10. NAVIGARE
11. NUOTARE
12. PARLARE
13. PENSARE
14. RISPONDERE
15. RIUSCIRE
16. RUSSARE
17. SALTARE
18. STARNUTIRE
19. STRISCIARE
20. TORNARE
21. TRAMONTARE
22. UBBIDIRE

23. VIAGGIARE

Transitive verbs:

1. ABBOTTONARE
2. ABBRACCIARE
3. ACCENDERE
4. AFFETTARE
5. AGGIUSTARE
6. AIUTARE
7. ALZARE
8. ANNUSARE
9. CALPESTARE
10. CERCARE
11. CHIUDERE
12. COLLEZIONARE
13. COLORARE
14. COLTIVARE
15. CONOSCERE
16. CONTARE
17. CONTARE
18. COPRIRE
19. CUCINARE
20. CUCIRE
21. DISEGNARE
22. ESPLORARE
23. FOTOGRAFARE
24. IMMAGINARE
25. INCONTRARE
26. INTRAPPOLARE
27. LANCIARE
28. LODARE
29. MACCHIARE
30. MASSAGGIARE
31. MASTICARE

32. OSSERVARE
33. PULIRE
34. RICEVERE
35. RITRARRE (fare un ritratto)
36. SCHIZZARE
37. SPEDIRE
38. STENDERE
39. STUDIARE
40. SUONARE
41. VESTIRE

Ditransitive verbs:

1. APPENDERE (qcs. su qcs.)
2. CARICARE (qcs. su qcs.)
3. CHIEDERE (qcs. a qcn.)
4. CONSEGNARE (qcs. a qcn.)
5. DARE (qcs. a qcn.)
6. DOMANDARE (qcs. a qcn.)
7. MANDARE (qcs. a qcn.)
8. METTERE (qcs. su qcs.)
9. MOSTRARE (qcs. a qcn.)
10. POGGIARE (qcs. su qcs.)
11. REGALARE (qcs. a qcn.)
12. RISCALDARE (qcs. con qcs.)
13. TRASFERIRE (qcs. verso qcs.)

APPENDIX I

TREATMENT EXERCISES

GIORNO 1

ATTIVITÀ 1: Scrivi una frase con l'ordine **SOGGETTO-VERBO-COMPLEMENTO OGGETTO** per ciascuno di questi verbi:

1. CHIEDERE

---

2. SUONARE

---

3. BERE

---

4. ANNUSARE

---

5. METTERE

---

6. VESTIRE

---

7. TORNARE

---

8. PENSARE

---

9. REGALARE

---

10. INCONTRARE

---

11. COPRIRE

---

12. COMPRARE

ATTIVITÀ 2: Per ogni frase, colora di **BLU** il soggetto e di **ARANCIONE** il complemento oggetto.

ATTIVITÀ 3: Scegli tre frasi con caratteristiche diverse e scrivile sui cartoncini.

IL DIRETTORE D'ORCHESTRA (1):

Il direttore d'orchestra è il capo di un gruppo di musicisti e decide **quanti** di loro devono suonare una data musica.

Come il direttore d'orchestra, anche il verbo è un capo, ma della frase e decide **quante** parole servono affinché la frase suoni bene.

Ci sono diversi tipi di verbo, in base al numero delle parole che comandano:

- VERBI INTRANSITIVI: …
- VERBI TRANSITIVI: …
- VERBI DITRANSITIVI: …

→COSA HO IMPARATO OGGI DI NUOVO?

GIORNO 2:

ATTIVITÀ 4: Leggi le seguenti frasi, sottolinea i verbi e dividili nella tabella sottostante.

1. Willy Wonka assaggia il cioccolato.
2. Matilda trasforma la Signorina Trinciabue in un rospo.
3. Zorba dorme sul terrazzo.
4. Il Gigante gioca con i sogni.
5. La Gabbianella Fortunata chiede al gatto un libro.
6. Biancaneve cuce i calzini.
7. I topini aiutano Cenerentola.
8. Gli Umpa-Lumpa cantano una canzone.
9. Il Cappellaio Matto chiacchiera con lo Stregatto.
10. Sofia incontra i giganti.
11. La strega regala una mela a Biancaneve.
12. Alice fotografa il Cappellaio Matto.

VERBI INTRANSITIVI	**VERBI TRANSITIVI non-reversibili**	**VERBI TRANSITIVI reversibili**	**VERBI DITRANSITIVI**

ATTIVITA 5: Per ogni frase, colora di **BLU** il soggetto e di **ARANCIONE** il complemento oggetto.

IL DIRETTORE D'ORCHESTRA (2):

Il direttore d'orchestra, non decide solo quanti musicisti devono suonare, ma anche **quali** strumenti servono per ottenere una data musica.

Come il direttore d'orchestra, anche il verbo decide **quali** "strumenti" devono usare le parole. Questi strumenti si chiamano **RUOLI TEMATICI** e sono assegnati dal verbo alle parole che gli servono affinché la frase suoni bene.

Ci sono diversi tipi di ruoli tematici, i più importanti sono due:

- AGENTE: …
- TEMA: …

→COSA HO IMPARATO OGGI DI NUOVO?

GIORNO 3

ATTIVITA 6: Decidi se le seguenti frasi sono giuste o sbagliate. Poi spiega il perché della tua scelta.

1. Il cane abbaia.

---

2. I cuochi poggiano nella dispensa.

---

3. Gli Aristogatti conoscono con i Gatti Cantanti.

---

4. Willy Wonka chiude la Fabbrica di Cioccolato.

---

5. Biancaneve conta i nani.

---

6. Cenerentola ubbidisce alla matrigna.

---

7. Il postino consegna alla bambina.

---

8. Il Cappellaio Matto colleziona le tazze.

---

9. Il serpente striscia la sabbia.

---

10. Cenerentola accende con il fuoco.

---

11. Il bambino macchia.

---

12. Il falegname aggiusta.

---

13. Il Gigante viaggia la valigia.

---

14. Gli Umpa-Lumpa trasferiscono i dolci nelle scatole.

---

15. Il pittore mostra i quadri ai ragazzi.

---

16. La strega cattiva loda il cacciatore.

ATTIVITA 7: Cerchia i verbi e suddividili nella seguente tabella:

VERBI INTRANSITIVI	**VERBI TRANSITIVI non-reversibili**	**VERBI TRANSITIVI reversibili**	**VERBI DITRANSITIVI**

GIORNO 4

ATTIVITA 8: **a.** Leggi il seguente testo, cerchia tutti i verbi.

b.Per ciascun verbo cerca il **SOGGETTO**, il **COMPLEMENTO OGGETTO DIRETTO** e il **COMPLEMENTO OGGETTO INDIRETTO**.

c. Compila la tabella.

Alla ricerca della traccia perduta.

Era l'ultimo giorno di scuola e ormai tutti i bambini pensavano soltanto alle vacanze estive, durante le quali alcuni sarebbero andati al mare, altri in montagna e alcuni avrebbero visitato un paese straniero.

Tutti erano eccitati all'idea di partire, tutti tranne Gianni.

Gianni che era il figlio di due famosi linguisti, avrebbe passato la sua estate rinchiuso insieme ai suoi genitori nelle più grandi biblioteche del mondo.

Che noia!!! Come avrebbe potuto passare una bella estate rinchiuso in una biblioteca piena di libri?

La risposta non tardò ad arrivare, durante una delle prime tappe del viaggio, la mamma di Gianni consigliò al figlio di scegliere un libro in ogni biblioteca.

In ogni libro il bambino doveva trovare tutti i verbi e, successivamente, doveva notare se ci fossero delle differenze tra i verbi che Gianni aveva trovato.

Gianni, che è un bambino molto intelligente, notò che non tutti i verbi sono uguali e che alcuni possono comandare più parole rispetto ad altri verbi. Così, il bambino divise i verbi in tre gruppi:

- I verbi intransitivi che comandano una sola parola;
- I verbi transitivi che comandano due parole;
- I verbi ditransitivi che comandano tre parole.

Non contento, Gianni si concentrò anche sulle parole che il verbo comandava. Fu così che scoprì che il soggetto è la persona o la cosa che compie un'azione, mentre il complemento oggetto è la persona o la cosa che subisce un'azione. Poi si accorse anche dell'esistenza di un complemento indiretto senza il quale una frase non potrebbe avere senso.

Gianni, sempre più affascinato dalla struttura delle frasi e soprattutto dai verbi, continuò le sue ricerche e scoprì che alcune frasi sono davvero complesse, infatti, qualche volta per evitare di ripetere la stessa parola è possibile che il soggetto o il complemento oggetto di una frase possano essere anche il complemento oggetto di una frase che li precede.

Gianni era molto contento di quello che aveva scoperto, tanto che decise di condividere con i suoi compagni di scuola le sue ricerche.
La mamma di Gianni che aveva anche tanta fantasia, aiutò il bambino a costruire un gioco utile a capire come funzionano le frasi più complicate. Il gioco che inventarono, che era amato da tutti i compagni di scuola di Gianni, che la maestra aveva premiato con una bellissima coppa, si chiama CERCA LA TRACCIA.

ATTIVITÀ EXTRA: Scegli alcune frasi, poi compila la tabella rispondendo alle domande.

FRASE				
COS'È?				
COSA FA?				
RUOLO TEMATICO				
NELL'ORCHESTRA				
DOVE LO TROVO?				

Estratto per riassunto della tesi di dottorato

L'estratto (max. 1000 battute) deve essere redatto sia in lingua italiana che in lingua inglese e nella lingua straniera eventualmente indicata dal Collegio dei docenti.

L'estratto va firmato e rilegato come ultimo foglio della tesi.

Studente: D'Ortenzio Silvia matricola: 843177

Dottorato: Lingue, culture e società moderne e Scienze del linguaggio

Ciclo: XXXI

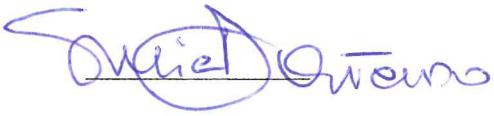
Titolo della tesi: Analysis and treatment of movement-derived structures in Italian-speaking cochlear-implanted children

Abstract:

Al centro della ricerca vi è l'analisi di alcune strutture sintatticamente complesse dell'italiano nella popolazione di bambini sordi portatori di impianto cocleare con lo scopo di individuare dei soggetti ai quali proporre il trattamento sperimentale di alcune delle strutture indagate seguendo il metodo dell'insegnamento esplicito di alcune regole sintattiche. Un gruppo di bambini sordi con impianto cocleare è stato valutato tramite tre test sperimentali (un test di ripetizione, due test di produzione e un test di comprensione) sulle strutture derivate da movimento sintattico quali: frasi scisse, frasi con dislocazione a sinistra e pronome clitico di ripresa, frasi relative restrittive, genitive ed oblique, interrogative *wh*- semplici e complesse. La performance del gruppo di studio è stata poi confrontata con quella di un gruppo di controllo composto da bambini normoudenti con pari età cronologica. I risultati hanno mostrato una competenza migliore del gruppo di controllo rispetto al gruppo di studio, evidenziando un possibile ritardo nell'acquisizione. Successivamente, a due partecipanti del gruppo di studio è stato proposto un trattamento sperimentale delle strutture derivate dal movimento sintattico e fondato sull'insegnamento esplicito di alcune regole sintattiche. I risultati hanno mostrato un miglioramento sia nelle strutture utilizzate durante il trattamento sia nelle strutture non trattate e nelle abilità di narrazione, evidenziando effetti di generalizzazione.

The present research aims at analysing some Italian syntactically complex structures in children with hearing impairment with cochlear implants in order to suggest an experimental treatment of movement-derived structures through the explicit teaching of syntactic rules. A group of children with cochlear implants was assessed with three experimental tests (a sentence repetition test, a production test, and a comprehension test) on several movement-derived structures, such as: cleft sentences, left-dislocated sentences containing a resumptive clitic, restrictive, genitive and oblique relative clauses, simple and long-distance *wh*-questions. The performance of the children with cochlear implants was compared with that of a control group composed of normal hearing children matched on the same chronological age. Results showed a better performance of the control group pointing out a delay in language acquisition of the children with cochlear implants due to a later exposure to an oral language. Later, two children with cochlear implants were given an experimental treatment of movement-derived structures based on the explicit teaching of some syntactic rules. The results after treatment showed an improvement in trained and untrained structures. Moreover, generalization effects were found also in the participants' narrative skills.

Firma dello studente



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nat a CHIETI (prov. CH.) il 24/05/1988

residente a ROSCIANO in VIA DELLA STAZIONE n. 10

Matricola (se posseduta) 843177 Autore della tesi di dottorato dal titolo:

ANALYSIS AND TREATMENT OF MOVEMENT-DERIVED STRUCTURES IN ITALIAN SPEAKING COCHLEAR IMPLANTED CHILDREN

Dottorato di ricerca in LINGUE, CULTURE E SOCIETA' MODERNE E SCIENZE DEL LINGUAGGIO

(in cotutela con .....)

Ciclo 31°

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