Parent training and communication empowerment of children with cochlear implants

Introduction

In the last decade, the role of parents in the habilitation process with their children who are deaf or hard of hearing (DHH children) has been emphasized. Family-centered programs have been designed to increase families' active participation (Hintermair, 2006; Moeller, Carr, Seaver, Stredler-Brown, & Holzinger, 2013). Specialists strongly recommend family-centered programs due to the growing amount of research that emphasizes the influence of family variables such as parental involvement and communication style in determining long-term outcomes after a deafness diagnosis and cochlear implantation (Cole & Flexer, 2007; Moeller et al., 2013). Indeed, parents play an important role in the communicative development of their children. During daily interactions, parents may naturally offer wide and varied child-directed words and syntactic structures (Cole & Flexer, 2007; Landry, Smith, & Swank, 2006; Quittner et al., 2013; Sarant, Holt, Dowell, Rickards, & Blamey, 2009) that contribute to children's acquisition of new words and morphosyntactic elements (e.g., Hadley, Rispoli, Fitzgerald, & Bahnsen, 2011).

However, a high rate of exposure to linguistic input alone is not sufficient to support communicative development. A key element of communicative learning is parental responsiveness, or the ability of parents to "tune in" to their children, and to recognize their child's communicative attempts and provide contingent responses (Suskind, Suskind, & Lewinter-Suskind, 2015).

Parental responsiveness supports a relaxed interpersonal climate in which children may be encouraged to communicate with the adult in a "back and forth" manner that is optimal for learning (Nittrouer, 2010). Parents who are verbally responsive support advances in children's language when they provide labels and comments for objects and events under joint attention and when they imitate and expand children's production of sounds and words

(Tamis-LeMonda et al., 2001). In this way, children are likely to match linguistic symbols to their referents and reinforce the social-communicative functions of language (Tamis-LeMonda, Kuchirko, & Song, 2014). Children with more responsive parents, when compared with less responsive ones, may reach the vocabulary burst milestone earlier and have broader expressive and receptive vocabularies (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008; Hart & Risley, 1995; Masur, Flynn, & Eichorst, 2005; McGillion et al., 2013; Tamis-LeMonda et al., 2001). Moreover, higher levels of parent responsiveness seem to facilitate greater growth in social, emotional, and cognitive competence (Landry, Smith, & Swank, 2006; Merz et al., 2015; Walker, Greenwood, Hart, & Carta, 1994).

Parental communication is also essential for language development in DHH children. Research has associated different types of communicative behaviors played out by parents with better linguistic outcomes in their children. Studies demonstrate that listening strategies (e.g. reduction in environmental noise, speaking within earshot, the use of acoustic highlighting, or auditory hooks) create listening environments with favorable speech-noise ratio and facilitate auditory attention and processing (Estabrooks, MacIver-Lux, & Rhoades, 2016). The use of interactive strategies (e.g. following the child’s lead and sharing joint attention) by parents after a deafness diagnosis was positively associated to spoken language skills of their children at three years of age (Cejas, Barker, Quittner, & Niparko, 2014). Responsive strategies (e.g. warm and contingent responding, balancing conversational turns, positive regard and respect of child’s autonomy) together with facilitative language techniques (e.g. modeling child productions, commenting, expanding, recasting, adults’ use of parallel talking) have been identified as predictors of the development of expressive and receptive language when both are used during play (Cruz, Quittner, Marker, DesJardin, & CDaCI Investigative Team, 2013; Quittner et al., 2013) and joint book reading (DesJardin et al., 2014).

A deafness diagnosis can alter most of these natural responsive behaviors (Hintermair, 2006) because of three key elements: the effect of limitations on the child's access to sounds (Cole & Flexer, 2007), the way parents may modify their interactions with their DHH children (Luterman & Kurtzer-White, 1999; Reichmuth, Embacher, Matulat, Am Zehnhoff-Dinnesen, & Glanemann, 2013), and the psychological status of the parents after a diagnosis of deafness (Kurtzer-White & Luterman, 2003; Zaidman-Zait, 2008).

With respect to the first aspect listed above, most DHH children who use cochlear implant(s) (CI) or hearing aid(s) (HA) typically show speech perception close to 100% (Geers, Nicholas, & Sedey, 2003; van Wieringen & Wouters, 2015). However, the limits of technology involve a difficult perception of speech in conditions such as: the presence of background noise (Yang, Hsieh, & Wu, 2012), an increased distance from the sound source (Whitmal & Poissant, 2009), an intensity of the primary signal below device threshold (Davidson, Geers, & Nicholas, 2014) and when the number of communication partners involved in an interaction increases (Tobey, Shin, Sundarrajan, & Geers, 2011). These factors reduce the quantity of words and sentences the child can hear and understand (van Wieringen & Wouters, 2015; Yang, Hsieh, & Wu, 2012) and may negatively affect the opportunity to "overhear" speech prevent consistent access to auditory linguistic information. It is therefore crucial for parents to learn how to support their children's listening environment (Cole & Flexer, 2007).

The second aspect concerns the modifications of communication modalities between hearing parents and their DHH children. A diagnosis of deafness can reduce parents' self-confidence in child education and child-oriented behavior (Luterman & Kurtzer-White, 1999; Reichmuth et al., 2013). DHH children's limited responses to oral language may negatively influence parents' communication initiatives and generate frustration and confusion (Harrigan & Nikolopoulos, 2002; Spencer & Meadow-Orlans, 1996). Consequently, the establishment of joint attention and tuned communication may be less successful (Nowakowski, Tasker, & Schmidt, 2009) and parents may become more intrusive, directive, and less flexible during interactions (Aragon & Yoshinaga-Itano, 2012; Cole & Flexer, 2007). This can reduce the number of conversational exchanges and parents' responsiveness to their child's communicative attempts (Aragon & Yoshinaga-Itano, 2012; Nittrouer, 2010; VanDam, Ambrose, & Moeller, 2012).

Finally, as to third aspect, feelings of sadness, grief, and anxiety may characterize the psychological status of parents after a diagnosis of deafness. Discrepancies between parents' expectations and their child's actual competencies, everyday communicative failures, educational concerns, and the need for knowledge regarding how to better promote language may reinforce these feelings (Kurtzer-White & Luterman, 2003; Zaidman-Zait, 2008). For example, some research has found that the level of parental distress is inversely associated with DHH children's communication and social and emotional development (Quittner et al., 2013). In the absence of adequate resources, a higher initial level of parental stress was predictive of stress maintenance as the child grows (Lederberg & Golbach, 2002) and accounts for up to 30% of the variance in receptive language development (Quittner et al., 2010).

To reduce the negative impact of these three processes and to help parents rediscover their self-confidence, parental involvement has become constant within individual sessions during Auditory Verbal Therapy (AVT) (Estabrooks, MacIver-Lux, & Rhoades, 2016) and Natural Aural Oral Education (Clark, 2006), and it was the core of structured group sessions in specific Parent Training (PT) programs (Glanemann, Reichmuth, Matulat, & Zehnhoff-Dinnesen, 2013; Harrigan & Nikolopoulos, 2002; Reichmuth et al., 2013).

In particular, the first experiences in group PT for families of DHH children with hearing aids or CIs were led by Harrigan and Nikolopoulus (2002) and Glanemann et al.

(2013) and were based on the It Takes Two to Talk (ITTT), a program developed for children with language delay by the Hanen Center in Toronto, Canada, with the aim of empowering family-child interactions and making parents the language facilitators for their children (Manolson, 1992; Pepper & Weitzman, 2004). Researchers adapted ITTT's principles to the special needs of families of DHH children (Glanemann et al., 2013; Harrigan & Nikolopoulos, 2002) and used them to enhance parental responsiveness to the communicative signals of their child. In order to achieve this goal, parents learned to apply specific strategies such as observing, waiting, and listening to the child's communication attempts before responding appropriately, mirroring vocal and non-vocal signals, such as movements and actions in order to create joint attention and balanced turn taking. The researchers also placed an emphasis on the adaptation of spoken language during interactions according to the child's developmental stage of communication, while adding information that could help the child increase their linguistic skills.

After the training, Harrigan and Nikolopoulos (2002) observed that parents' communicative behaviors shifted toward a more responsive method of interaction with their children. Their study did not include a control group of untrained parents and did not analyze the effect of such changes on the development of DHH children's communicative skills. Further, after a 12 month interval, authors observed that parents demonstrated a reemergence of excessive initiating behaviors which suggested that the parents' tendency to control interactions was subject to relapse and that the initial positive effects of PT could diminish if they received no further appropriate guidance.

Glanemann et al. (2013) developed the Muenster Parental Programme (MPP) which was inspired by ITTT and integrated with the Natural Auditory Oral Approach for DHH children (Clark, 2006) and with Play and Learning Strategies (Landry, Smith, & Swank, 2006). The program was used in a group of families with DHH children who had varying degrees of deafness. The authors studied changes in parents' communication style and the consequent effects on the development of their children's vocalization. This study included a control group of untrained parents and their DHH children. They confirmed that group PT was effective as a method to increase communication-enhancing behaviors and to reduce communication-inhibiting behaviors in PT parents. By the end of the training, the researchers found that the trained parents were significantly more attentive and responsive to the child's vocal signals than untrained parents. Children of parents in the PT group demonstrated significantly more vocalizations when compared to the children in the control group.

Suskind et al. (2016) conducted a further study that utilized the ASPIRE curriculum to improve the listening and linguistic environments of DHH children from families with low socio-economic status. Their results showed a positive impact of the program on parental knowledge concerning children's language development and on the quality of the parents' linguistic exchanges with their children. The study detected no positive effects on the DHH children's language. Further, after 3 months from the end of PT, the improvements in parental quality of communication had disappeared from their interactions.

Given the paucity of studies on such an important topic, the present study was implemented with the purpose to shed further light on the efficacy of an ITTT model-based group PT program (Manolson, 1992; Pepper & Weitzman, 2004) in order to enhance the quality of interaction between a group of hearing parents and their DHH children with CIs. It was designed as a prospective clinical study, with PT and control groups matched for sociodemographic and audiological characteristics of the parents and children so that we could evaluate how changes induced by group PT impacted the parent's level of stress and the development of children's communications skills. We expected that PT could enhance parents' responsive behavior, optimize their communicative performance in daily interactions, and contribute to their children's listening and language growth. We also expected that more responsive and relaxed interactions would reduce stress, negative coping behaviors, and feelings of burden, which would improve the parents' self-confidence. Finally, we anticipated a significant improvement in the rate of language acquisition in children whose parents received PT compared to children whose parents did not.

Method

Study design

The study was implemented as a prospective clinical study in which participants in the study and the control groups were matched for parental socio-economic status (SES) and education level, children's chronological age (±2 months), hearing age (±2 months), pre-implant PTA at 250-4000 Hz, and language level. The absence of other associated disabilities in the children was verified through the General Developmental Quotient measured by the Griffith Scales of Child Development (Huntley, 1996; Luiz et al., 2006); the minimum acceptable value was set at 80, defined by the scales as "below average" (Huntley, 1996; Luiz et al., 2006). The parents who belonged to the study group attended the parent training program described above, while the control group did not. In both groups, the children attended aural-oral habilitation therapy. Both groups were assessed with the same timing: both parents and children during the immediate pre-training phase (within one month of the beginning of parent training) and at the end of the training (within one month of the end of parent training); children received a further control assessment at the three-year follow-up.

Participants

Tables 1 and 2 show the demographic and baseline characteristics of the parents and children, respectively. The study group included 22 parents of 14 children who were profoundly deaf and received cochlear implant(s) (CI-children) at the Cochlear Implant Center of xxxxxxxxx. It included 14 mothers and 8 fathers, with an average chronological age of 35.4 years (*SD* 5.4) and 40.4 years (*SD* 4.3), respectively. In 8 families, both parents chose to participate, and for the remaining 6, only the mothers attended the parent training as the fathers found it difficult to obtain permission from their employers. The parents completed a short questionnaire about their income and education level, defined as the number of years in formal education. The income bracket information was used to define the family's socioeconomic status and were determined according to the Italian National Institute of Statistics -ISTAT (https://www.istat.it/it/files/2017/12/Report-Reddito-e-Condizioni-di-vita-Anno-2016.pdf). Two families had an upper-middle SES, 7 had a middle SES, 2 had a lower-middle SES, and 3 had a low SES. The education level of the parents was on average 15.5 years of study (*SD* 3.2). Four parents had only 8 years of study. At the time of the study, the children of the trained parents (seven females, seven males) had a chronological age of 25.6 months (*SD* 6.3) and a hearing age of 7.8 months (*SD* 5.1).

The control group included 22 parents, 14 mothers and 8 fathers, with an average age of 37.8 years (*SD* 5.3) and 44.5 (*SD* 4.9), respectively, and their 14 CI-children (seven females, seven males) with a chronological age of 26.2 months (*SD* 6.2) and a hearing age of 8.1 months (*SD* 4.3). The SES of the parents in the control group was similar to that of the study group: 2 families had an upper-middle SES, 8 had a middle SES, 2 had a lower-middle SES, and 2 had a low SES. The parents had, on average, 13.7 years education (SD 3.8). Four but 4 of them had only 8 years of study.

Families were recruited when accessing the CI center for the routine follow-up appointment. The selection followed the order of arrival at the center and ended when all well-matched subjects were identified.

Treatment

The parent training (PT) was based on the ITTT model (Manolson, 1992; Pepper &Weitzman, 2004), with additional information on deafness, hearing devices, hearing environment, and strategies to improve listening skills that was relevant to families of DHH children. This further information was adapted from AVT (Estabrooks, MacIver-Lux, & Rhoades, 2016), the Natural Aural-Oral Approach (NAOA) (Clark, 2006), and Learn To Talk Around The Clock (Rossi, 2003). Two of the authors held ITTT certifications, and one was in the process of AVT certification. The PT program included both a primary (Phase 1) and a maintenance phase (Phase 2). Table 3 illustrates the detailed structure.

During Phase 1, nine group training sessions in the clinic and three individual sessions at home were performed, as indicated by the ITTT (Manolson, 1992; Pepper &Weitzman, 2004). A training group could include a minimum of three to a maximum of five families. Both parents were invited to participate. Each participating family received an illustrated handbook, observation sheets, and checklists to support the learning process. Group sessions took place every 15 days for the duration of the program. Each group session lasted 2.5 hours and focused on a specific theme. A ninth group session was planned to sum the PT's experience. The primary phase lasted a total of 4.5 months.

Various teaching strategies for the primary phase included problem solving activities, brainstorming, role playing, and video analysis, according to the instructions in the ITTT manual (Manolson, 1992; Pepper &Weitzman, 2004). Parents attended individual sessions between group sessions, which allowed them to practice the new strategies with their child based on previously agreed communication objectives. Video modeling (Pepper &Weitzman, 2004) was used to help parents transfer the knowledge they learned during group sessions to their everyday interactions with their child.

The observation was guided by the sheets and checklists provided by the ITTT program. The specialist provided the parents with feedback to help them apply the less-used strategies (e.g. waiting more, expand child's language, etc.) and played back video recordings during subsequent group sessions to create a dialogue between the parents and to allow all the families to learn from one another's experiences.

Table 4 illustrates the themes and the strategies presented in each group session. The first five group sessions aimed to support the parents' acquisition of new skills to improve listening environments and listening skills, to appropriately manage hearing devices, to better understand communication and language development, to use effective strategies to facilitate communication and language, and to apply these strategies in everyday activities and routines. In the last three sessions, parents learned how to apply the presented facilitation strategies to help their children achieve specific and realistic communication goals in the context of play, early literacy, and music.

At the end of Phase 1, an individual reinforcement and maintenance phase (Phase 2) was implemented to avoid the parents' regression to previous communicative methods or unbalanced interactions. The reinforcement and maintenance phases for all the families included an individual session per month for 6 months after the end of the primary phase. These individual sessions followed the same structure as the three individual home visits performed during the PT program.

Parent assessment

Parents were assessed with the Parent Stress Index-Short Form (PSI-SF) (Abidin, 2003) to evaluate the level of stress, and the Communication-Promoting Behaviors Checklist for Caregivers, to evaluate the quality of their interactions with their children (Cole, 1992).

The PSI-SF is a parental self-report inventory designed as a screening and diagnostic instrument for the early evaluation of stress in the parent-child relationship and the identification of dysfunctional behaviors during parent-child interactions that may interfere with normal infant development and functioning (Abidin, 2003). The PSI-SF is a 36-item version derived from the full-length Parenting Stress Index inventory (consisting of 120 items). Authors developed the PSI-SF based on the assumption that some degree of parenting stress is to be expected and that the total stress perceived by parents might vary due to child and parent characteristics and in relation to contextual characteristics, such as lack of social or familial support or how difficult it is for the family to access the necessary services. Parents answered all 36 items on the PSI-SF using a 5-point Likert scale (responses ranged from Total Disagreement to Total Agreement) and items used the same wording as the PSI Long Form. This questionnaire is easy to administer, does not take much time, and provides a Total Stress (TS) score that indicates the overall level of stress a person feels in their role as a parent based on three subscales: Parental Distress (PD), Parent-Child Dysfunctional Interaction (P-CDI), and Difficult Child (DC). The PD Subscale consists of 12 items and yields a measure of perceived parental distress in relation to personal factors not strictly related to the parent-child relationship, such as discord between the parents, feelings of incompetence, poor self-confidence, or lack of social support. The P-CDI Subscale consists of 12 items that assess the level of satisfaction of parents in their interactions with the child, and also consider the parents'perceptions of non-compliance, unsatisfactory or displeasing interactions, negativity, and rejection. The DC Subscale consists of 12 items that measure the parent's perception of their child's temperament, behavior, and compliance, and the extent to which the parent perceives the child as easy or difficult to take care of. Authors consider PSI-SF scores typical if they fall between the 15th and 80th percentile and consider stress scores clinically relevant when they are above 85 for the P-CDI subscale and above 90 for the other subscales. The PSI-SF also includes a Defensive Responding (DR) scale that is not included in the Total Stress raw score. Low scores on this scale (below 10) might indicate defensive answers that minimize problems so that the parent appears competent, or that the parents have poor investment in or consciousness of stress in their parenting role.

The Communication-Promoting Behaviors Checklist for Caregivers evaluates the quality of interaction based on a video-recorded sample analysis (Cole, 1992). This checklist provides a framework that is useful when we consider the appropriateness of the parents' role in communicative interactions with their young DHH children and outlines the major components of optimal communication-promoting caregiver behaviors (see Appendix for the full checklist). It includes 22 items: the first 5 items (Sensitivity to Child - SENS) refer to the caregiver's awareness of the child's way of being and to their ability to adapt to the child in a supportive manner; items 6 to 11 assess the caregiver's conversational behaviors when they respond to the child (Response - RESP); items 12 to 15 outline the conversational behaviors in terms of how well the caregiver is able to establish and maintain shared attention with the child (Shared Attention - SA); items 16 to 22 refer to general conversational behaviors (General - GEN). A numerical rating from 1 (behavior rarely observed) to 7 (behavior often observed) is given to each item based on a videotaped sample of the parent-child interaction.

Two trained speech therapists rated the interactions of all parents in a blind setup, where they were not aware which parents participated in the parent training group. The raters assessed each item, and then calculated a mean score for all 22 items (Overall Score-OS) and for each sub-category of the checklist (SENS, RESP, SA, GEN).

Child assessment

A speech therapist assessed the children's linguistic skills pre-and immediately post-PT based on the MacArthur-Bates Communicative Development Inventory- MCDI (Fenson et al., 1993 - Italian edition, Caselli & Casadio, 2007) Gestures and Words Form, a widely recognized parent reporting tool to assess children's early language skills development for clinical and research purposes. The Gestures and Words Form is available for children ranging from 8 to 17 months of chronological age and was selected according to the average hearing age of the study and control samples (7.8 months (*SD* 5.1) and 8.14 months (*SD* 4.3), respectively.

Language abilities three years post-PT were assessed using the Italian versions of three standardized language tests: the Boston Naming Test (BNT) (Kaplan, Goodglass, & Weintraub, 2000; Riva, Nichelli, & Devoti, 2000) to assess lexical production; the Peabody

Picture Vocabulary Test (PPVT) for lexical comprehension (Dunn & Dunn, 1981; Stella, Pizzoli, & Tressoldi, 2000), and the Test for Reception of Grammar (TROG-2) (Bishop, 2003; Suraniti, Ferri, & Neri, 2009) for morpho-syntactic comprehension. The BNT originally assessed adults' lexical skills in production and was later standardized for children (Kindlon & Garrison, 1984; Guilford & Nawojczyk, 1988; Riva, Nichelli, & Devoti, 2000) as researchers considered it an useful tool to assess children with learning and language disorders (Wolf & Obregon, 1992). The TROG-2 (Bishop, 2003; Suraniti, Ferri, & Neri, 2009) is a fully revised and newly standardized version of the widely used TROG, which was originally developed to investigate morpho-syntactic comprehension skills in children. The raw scores were used for a direct comparison between the PT and control groups. This was possible because the two groups were properly matched and the differences in chronological age and in the level of their basic language were not statistically significant. The use of raw scores allowed the recording of children's use of new words and which morpho-syntactic structures they understood and produced in the same intervals and offered the possibility to perform a quantitative analysis of the differences between the two matched groups.

Speech recognition was assessed in quiet and noisy (speech noise) environments with standard, phonetically balanced Italian disyllabic words and sentences for pediatric populations (Cutugno, Prosser, & Turrini, 2000). A practice list preceded each 10-item list. The items were administered in a sound-proof room via a loudspeaker that was placed 1-m from a table where the child sat next to a speech therapist. Stimuli were presented at 0° azimuth, with speech at 65 dB and noise at 55 dB (Speech/Noise ratio +10). The score was calculated as the percentage of correctly repeated words.

Results

Families

All the included subjects completed the study procedures; there was neither drop-out nor loss to follow-up. There was no significant difference between the PT and control groups in the demographic characteristics of either the mothers or fathers (chronological age, education level) (Table 3).

While the psychological characteristics and stress levels of the mothers did not differ between the PT and control groups, fathers belonging to the PT group had lower values for the Cole's Communication-Promoting Behaviors Checklist for Caregivers overall score (OS) and the Sensitivity (SENS), Conversation in Response (RESP), Shared Attention (SA) and General Conversation (GEN) sub-scores (p-values<0.05). However, there was no difference in the fathers' stress levels between the PT and control groups (see Table 3).

At the end of the parent training period, we found an overall improvement in the OS, the SENS, RESP, and SA scores, and the overall GEN regardless of the group, as revealed by a significant time effect, in both the mothers ($F_{1,26}$ ranging from 146.0 to 336.4; $p<0.001$) and fathers ($F_{1,14}$ ranging from 13.6 to 22.2; $p<0.01$). However, the PT group achieved better outcomes than the control group, with significant time-by-group interaction effects for all measures in both the mothers ($F_{1,26}$ ranging from 74.5 to 160.1; $p<0.001$) and the fathers ($F_{1,14}$ ranging from 11.8 to 5.1; $p<0.05$). Effects sizes exceeded 0.8; probability ranging from 84% to 96% (see Table 5).

In contrast, the stress levels did not change over time, as revealed by a nonsignificant time effect for both the mothers ($F_{1,26}$ ranging from 0.1 to 1.3; $p>0.3$) and the fathers ($F_{1,14}$ ranging from 0.4 to 2.4; $p>0.2$). The intervention did not affect the stress level, as revealed by a nonsignificant time-by-group interaction effect for both the mothers ($F_{1,26}$ ranging from 0.1 to 3.7; $p>0.05$) and the fathers ($F_{1,14}$ ranging from 0.1 to 3.6; $p>0.05$).

Children

There was no significant difference between the PT and control groups in demographic and clinical characteristics (see Table 2).

In both PT and controls, the MCDI showed an overall improvement in all the measures over time. In fact, in all children there was an increment with a significant time effect ($F_{1,26}$ ranging from 79.7 to 208.8, p-values<0.001). However, the PT group achieved better outcomes than the control group, with significant time-by-group interaction effects for all measures ($F_{1,26}$ ranging from 5.4 to 13.5, p-values<0.05) (see Table 6).

Approximately three years after the intervention, all the children were assessed with a large battery of tests appropriate for their current age, which ranged from 4 to 7 years. At this long-term reassessment, we found significant differences in favor of children whose parents had originally received the PT intervention: their lexical and morpho-syntactic skills, as formally assessed through the PPVT, BNT, and TROG-2 tests, were significantly higher (p<0.05 by the Mann-Whitney U test; see Table 7). Differences in Peabody picture vocabulary and Boston Naming tests had a small effect size, with a probability of superiority of approximately 58%. The test for Reception of Grammar had a large effect size with a probability of 73.8% in favor of those children belonging to the PT group. No differences were recorded in listening skills (see Table 7).

Correlations between parents' and children's changes after the intervention

The CI-children's improvement in WC and SC, as measured through the MCDI, did not correlate with the mothers' and fathers' pre/post intervention changes. On the contrary, the improvement in WP was directly correlated with the mothers' GEN change (adjusted-rho=0.44, p=0.02). Correlations between the children's improvement in WP and pre/post intervention changes in mothers' OS and SENS score (adjusted-rho=0.35 and 0.34, respectively) were not significant (p=0.08 and 0.09, respectively). No correlation was found either between the CI-children's WP improvement and the fathers' changes on any of the tests, probably due to the small sample size (all p-values>0.1).

Lastly, a greater effect of the intervention on the CI-children's WP was observed when both parents took part in the PT. The mean pre/post-intervention change in children's WP score was 137±75 when both parents attended the PT (eight families) vs. 79±54 when only the mothers attended the PT (six families) (p=0.02).

Discussion

The role of the family is crucial to achieve optimal outcomes after cochlear implantation.; the degree of parental involvement is estimated to account for 35.2% of the variance in language (Moeller, 2000) and 20% of the variance in reading skills (Geers, 2003). During the last decade, parents' ability to establish responsive interactions in everyday life and to use adequate linguistic input has received increased attention because of the strong effect they have on language development in DHH children (DesJardin & Eisenberg, 2007).

In this context, the first aim of the present study was to assess the efficacy of a parent training program based on the ITTT model and adapted to the specific needs of DHH children including strategies by AVT, NAOA and Learn To Talk Around The Clock in terms of its ability to enhance parental responsive behaviors, improve linguistic development in children, and reduce levels of stress. The improvements in responsiveness observed in the parents after training were significantly greater than natural changes detected in the matched control group: both the mothers and fathers showed a greater sensitivity toward their children's communication; they tended to be more tuned in, had fewer difficulties in maintaining joint attention, and made more comments and expansions. Natural variations in the interaction style observed in the control group parents, although present, were less evident. These results confirmed the observations made by Glanemman et al. (2013) and provided new support to the idea that it is possible to induce significant changes in parent awareness and empowerment. Indeed, Glanemman et al. (2013) did not match their control groups with the study groups, thus introducing potential bias. The level of parental education, SES, and characteristics of the child, as well as the type of hearing device used, the hearing age, and the level of communication are all aspects that can influence the degree of responsiveness of both parents and children, and can cause variations in the ease with which they adapt to each other and attune their interactions (Geers et al., 2002; Glanemann et al., 2013). Because control group of the present study accounts for all of these factors, the present findings can be more strongly related to the effects of the parent training program. It is not possible to make a comparison with Harrigan and Nikolopoulus (2002) as they did not include a control group of untrained parents.

The second objective was to verify how the increased responsiveness of parents influenced the development of the listening and language skills of their children. Prior to parent training, there were no differences on the MCDI between the CI-children of the PT group and the control group. At the end of the group sessions, CI-children whose parents attended the PT showed a larger increase in word and sentence comprehension and word production, with significantly better performance than the children in the control group. Shortly after PT, a significant correlation was found between increasing in CI-children's word production and an improvement in the general aspects of the mothers' conversational behaviors, such as: their ability to use sentences of adequate length and complexity; to pause expectantly after speaking to encourage the child to respond; to speak to the child at an appropriate speed, intensity, and pitch and to use audition-maximizing techniques and appropriate gestures. This finding supported the hypothesis that attuned verbal inputs facilitate the early stages of word learning (Adamson, Bakeman, & Deckner, 2004; Baldwin, 1995; Tomasello & Farrar, 1986). Further, the word production score of children was higher when both parents, and not just the mothers, participated in the PT. Additionally, differences in language competence between the study and the control group were still present after three years: the CI-children of PT parents still demonstrated better lexical comprehension and production skills, and an even larger improvement in morpho-syntactic comprehension. Harrigan and Nikoulopolous (2002) observed a reemergence of nonresponsive behavior one year after the completion of PT. The consistency of the findings in the present study could be linked to the type of intervention, which includes a 6-month reinforcement and maintenance phase, during which parents could stabilize the new strategies they had learned.

Regarding listening skills, all CI-children showed excellent outcomes both in quiet and in noise, and their outcomes improved over time. The differences between PT and controls did not differ significantly. This last result reinforced the idea that listening skills alone, even when they are excellent, cannot guarantee children access to an adequate verbal language if this skill is not associated with a rich and tuned communicative interaction.

A further hypothesis was that the tests of language perception used in this as well as in previous studies were not sensitive enough to evaluate the correlation between language perception and language outcomes at a very young age (DesJardin, Ambrose, Martinez, & Eisenberg, 2009; Eisenberg, Shannon, Martinez, Wygonski, & Boothroyd, 2000; Newman & Chatterjee, 2013). The authors observed that speech recognition tests might not be nuanced enough to detect differences in more complex listening skills in children younger than 7-12 years. It will be necessary to develop new techniques and tools to better assess and track whether other emerging auditory abilities, such as auditory memory, have a greater impact on language development at such young ages.

The last area examined in this study was the indirect influence that a training program, that is based on communication empowerment, could exert on the perceived level of stress reported by parents of children with CI. No significant differences were found between the PT and control groups in PSI scores, either at the beginning and at the end of the habilitation process. Hintermair (2006) tested PSI in a large sample of hearing parents of DHH children, who showed how the degree of communicative competence influenced the parents' perception of stress. The author emphasized the importance of resource-oriented counselling and a support strategy in the early intervention because parental access to personal and social resources is associated with significantly less stress. The lack of statistical correlation found in the present study could be attributed to a number of reasons. The first one was the small study sample. Also, it must be considered that there are aspects of perceived stress which are influenced by contextual problems (financial status, marital relationships, parental personality, children's temperament, accessibility to support services, single parent, family size, etc.) and some that cannot be measured by the subscales of the PSI (personal sense of parenting, presence of depression, behavioral characteristics of children, etc.) (Cooper, McLanahan, Meadows, & Brooks-Gunn, 2008; Zaidman-Zait, 2008). Further, the PSI may not be the most sensitive instrument to detect significant changes regarding the impact of communication difficulties on perceived stress compared to specific measures for disability (Lederberg & Golbach, 2002; Quittner et al., 2010; Zaidman-Zait, 2008). Finally, one could argue that the pre- and post-treatment follow-up period was too short to observe significant differences in such profound aspects as the perceived stress level.

Limitations

Several limitations should be considered in relation to current results. First, there were a small number of children and families involved in the study and we hope to increase the study group to confirm the findings. Secondly, it is possible that, despite our attempts to minimize limitations through matching demographic, audiological, linguistic, and parent's responsiveness characteristics before training began, we introduced unintentional biases when we planned the study and chose not to randomly assign parents and children to the PT or to the control group. Third, families that agreed to participate in PT may have been more motivated and compliant than others used as a control group, as one might infer from the lack of dropouts during the program. Finally, individual sessions at home, although desirable as they allow clinicians to help families in their real-life context, were not always feasible due to logistical problems (family distance from the CI center), economic costs, and time spent.

Clinical Implications and Future Directions

These results have several implications in planning habilitation intervention strategies for CI-children and their families.

Results suggest that experts can help parents to learn strategies that are useful to enhance the linguistic development of their CI-children. It is possible to modify parents' communicative behaviors and a PT program which combines group and individual sessions could reinforce these new techniques and behaviors. During the group sessions, specialists present strategies and the parents and specialists both engage in discussions. In the individual sessions, the specialists were able to indirectly guide and assist parents towards awareness of their communication style and the effects it exerts on the development of children's language. A future study that utilizes a randomized clinical trial could provide more validity to these results. It would also be helpful to increase the sample size in order to verify the effectiveness of the PT and the compliance of families who come from multicultural environments or with more disadvantaged situations and low SES.

A further direction of the study should be to include other caregivers, such us teachers, in order to improve communication in all contexts in which children can benefit from interactions with adults.

Finally, specialists could implement the use of telepractice (McCarthy, Muñoz, & White, 2010) to overcome the challenge of organizing individual sessions at the families' homes and to include families who live far away from habilitation services and would not otherwise be able to benefit from the program due to logistical problems.

Conclusion

Parents' responsiveness and sensitivity played a fundamental role in the promotion of linguistic, socio-emotional, and cognitive development in children with DHH. The differences in language skills observed between the PT group children and the control group showed a significant correlation with the shared language and the quality of the interaction with their parents. The experience gained by parents during the training seems to represent a solid basis for their children's language learning. The use of ITTT principles, reinforced by information and strategies specific for DHH children, seems to be effective in achieving this goal. Further studies are needed to expand our knowledge in this field and to produce more generalizable results.

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