Cochlear implants in children: Development in interaction with the social context

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Chapter 4

Predicting social functioning in children with a cochlear implant and in normal-hearing children: the role of emotion regulation

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International Journal of Pediatric Otorhinolaryngology, 2012, 76, 883-889

Abstract

Objective: The purpose of the present study was to compare children with a cochlear implant and normal hearing children on aspects of emotion regulation (emotion expression and coping strategies) and social functioning (social competence and externalizing behaviors) and the relation between emotion regulation and social functioning.
Methods: Parent-report questionnaires on language skills, social functioning and emotion regulation were uses, as well as emotion-regulation tasks in children. The study group consisted of 69 cochlear implant children and 67 normal hearing children aged 1.5 to 5 years.
Results: Cochlear implant children had fewer adequate emotion regulation strategies and were less socially competent than normal hearing children. The parents of cochlear implant children did not report fewer externalizing behaviors than those of normal hearing children. While social competence in normal hearing children was strongly related to emotion regulation, cochlear implant children regulated their emotions in ways that were unrelated with social competence. On the other hand, emotion regulation explained externalizing behaviors better in cochlear implant children than in normal hearing children. While better language skills were related to higher social competence in both groups, they were related to fewer externalizing behaviors only in cochlear implant children.
Conclusions: Our results indicate that cochlear implant children have less adequate emotion-regulation strategies and less social competence than normal hearing children. Since they had had their implants relatively recently, they might eventually catch up with their hearing peers. Longitudinal studies should further explore the development of emotion regulation and social functioning in cochlear implant children.

Introduction

Prelingual profound deafness has a great impact on children's social functioning. Because deaf children do not have access to sound, they have great difficulties in learning spoken language. As a consequence, deaf children have problems with aspects of social functioning, such as social competence and behavioral problems [1,2]. When exploring benefits of receiving a cochlear implant at a younger age, researchers found that poorer language skills in young deaf children were associated with more behavioral problems [2]. In another study it was suggested that the knowledge of display rules in deaf children was delayed due to reduced opportunities for early social interaction and communication experiences [1]. For the past two decades, hearing-impaired children have had access to sound through a cochlear implant (CI). A CI is a device that electrically stimulates the auditory nerve, bypassing the damaged part of the ear. Ultimately, signals from the auditory nerve are perceived as sounds by the brain. Today, up to 94% of young, profoundly deaf children receive a CI [3]. Remarkable results have been obtained with respect to speech and language outcomes, especially in children who received the implant early [4,5]. To date, however, the effect of a CI on children's social functioning is less clear.

Social functioning involves the ways in which children initiate and maintain relationships with meaningful others around them – a matter in which emotions play a crucial role. Social relationships that are truly adaptive depend largely on how children communicate their emotions – in other words, on their capacity for emotion regulation [6]. Emotion regulation is a skill that involves coping with emotions (i.e. internally regulating their intensity) as well as expressing them. It is thus the ability to moderate an emotion and to use coping mechanisms for its management (coping), thereby enabling it to be expressed appropriately (emotion expression). If effective, emotion regulation enhances social interactions [7,8].

Consequently, in typically developing children, adaptive emotion regulation is associated with good social functioning, in which social competence is high and behavioral problems are limited, which can be observed even in very young children [7,9,10]. Common adaptive emotion-regulation

strategies in preschool children are avoidance and distraction: less distraction in early childhood was found to be related to rejection by their peers a few years later [11,12]. Another adaptive strategy in young children is to express fewer negative emotions; this is associated with fewer behavioral problems and more pro-social behavior [13].

To the best of our knowledge, little is known about the effect of a CI on children's social functioning and about the relationship between social functioning and emotion regulation in CI children.

Our first objective was to compare CI children and normal hearing (NH) children on aspects of emotion regulation (emotion expression and coping strategies) and social functioning (pro-social skills and behavioral problems). Both emotion regulation and social functioning are related to language development in NH children, which is known to be delayed in young children with cochlear implants [14]. Therefore, we expected CI children, compared to their NH peers, to have less skills in emotion regulation (higher scores on negative emotion expression measures and lower scores on coping) and a lower level of social functioning (more behavioral problems and less pro-social behaviors).

The second objective was to examine separately in the two groups how these aspects of emotion regulation were inter-related to the two indices for social functioning). It was hypothesized that less expression of negative emotions and more expression of positive emotions would be related to better social functioning (fewer behavioral problems and more pro-social behaviors) in NH children. We also expected adequate coping strategies, such as distraction in frustrating situations, to be related to fewer behavioral problems and more pro-social behaviors in NH children.

Yet, our expectations regarding the strength of the relationships between emotion regulation and social functioning in CI children were less clear. While it might be equal to that in NH children, one might also hypothesize that emotion-regulation skills and social functioning are subject to developmental linguistic delays in CI children, and therefore may be less inter-related than in NH children.

Since social functioning and emotion regulation develop as children grow older and increase their communication skills, we included language

measures in our analysis. It was hypothesized that better language skills would be related to better social functioning and more adequate emotion regulation strategies.

Methods

Participants

NH children and their parents were recruited through day-care centres and schools, and CI children were recruited through healthcare organizations. CI children from nine different counseling services and hospitals all over the Netherlands and one counseling service in the Dutch speaking part of Belgium were included. Seventy-one percent of the sample was recruited directly by health care professionals from one hospital and one counseling service. A response rate of 84% implies that this part of the sample is representative of the population of children with CI in the Netherlands. The remaining 29% of the sample was recruited via letters dispersed by the counseling services that participated in the study. The response rate was much lower, only 26% chose to participate. Since no information is available on the non-respondents, it is unknown whether this part of the sample is representative of the population. Informed consent was obtained from all parents, and the study was approved by the university's medical ethical committee. The total sample consisted of 136 children aged 1.5–5 years: 69 CI children and 67 NH children (table 1). All CI children were born to hearing parents, had profound prelingual hearing loss with no other disabling conditions, and all had had their implant before the age of 43 months, with one exception, who had received it at 57 months (range = 6–57 months). At the start of the study, the mean duration of CI use was 21 months; 83% of the children had had their CI for more than 10 months (range = 1–44).

The questionnaires were completed by parents of 104 children (N = 53 NH; N = 51 CI).

Table 1. Participant characteristics

	CI (n=69)	NH (n=67)
Mean age in months (SD)	41 (12.1)	44 (12.6)
Sex – n (%)		
Male	44 (64%)	36 (54%)
Female	25 (36%)	31 (46%)
CI characteristics		
Mean age at implantation in months (SD)	19 (9.7)	
Mean duration CI use in months (SD)	21 (12.2)	
Language skills (range 0–50)		
Mean receptive language score (SD)	31.0 (13.0)	39.3 (11.9)
Mean expressive language score (SD)	32.2 (12.6)	42.6 (10.7)
Motor development (range 0–23; 0–30)		
Mean score for gross motor skills (SD)	16.8 (4.0)	18.5 (3.8)
Mean score for fine motor skills (SD)	21.2 (6.1)	22.7 (5.8)

Materials

Parent questionnaires

General development was assessed using the Dutch version of the Child Development Inventory (CDI), a standardized instrument for children aged 15–72 months [15]. Parents answered the statements with "yes" or "no". As it is very difficult to obtain reliable IQ scores in such young children, motor-development scales were used as an indication of cognitive development [16]. Because most deaf children have problems with their organ of balance [17], which is situated in the inner ear, seven items referring to balancing skills were removed from the gross motor scale. Although there were no significant differences regarding fine motor skills, CI children scored lower on gross motor skills than NH children did ($t(96) = 2.22$, $p = .029$). Language development – spoken and/or sign language – was assessed using the expressive scale and receptive scale from de CDI, each with 50 items. Items on both scales addressed syntactic, pragmatic, semantic, and intelligibility aspects. Examples of the

expressive scale are "[he or she] calls or signs you 'mama' or 'dada' or a similar name" (age 6-12m),"uses at least five words or signs as names of familiar objects" (age 1-2), and "asks questions beginning with "why", "when," or "how" (age 3-4). Examples of the comprehension scale are "usually comes when called" (age 6-12m), "follows simple instructions" (age 1-2), and "talks about the future, about what is going to happen" (age 3-4). Because we were interested in the communication skills of children, parents were asked to answer "yes" when their child mastered the topic in either spoken or sign language.

Social functioning was assessed with the *SDQ,* a brief behavioural screening questionnaire [18], consisting of 25 items. Two scales were used for this study: Social Competence (10 items of the original scales Pro-social Action and Peers) and Externalizing Behaviours (10 items of the original scales Hyperactivity and Behavioral Problems). Parents can rate each item on a 3-point scale (0 = not true, 1 = somewhat true, 2 = certainly true). The internal consistencies of the scales are moderate to good (Table 2).

Table 2. Psychometric properties and mean scores of all questionnaires and tasks

	No. of items	Min-Max	Cronbach's alpha		Mean scores (*SD*)	
			CI	NH	CI	NH
Emotion Regulation						
Coping						
Bottle Distraction*	4	0-2	.65	.52	.17(.32)	.29(.38)
Coping Task***	6	0-1	.87	.87	.05(.18)	.24(.33)
Emotion Expression						
Negative Reaction to Bottle	3	0-2	.68	.78	.27(.42)	.36(.46)
Negative Emotion Exp**	8	1-5	.71	.83	2.55(.40)	2.28(.53)
Positive Emotion Exp	6	1-5	.64	.76	3.63(.51)	3.53(.60)
Behavioural functioning						
Social Competence**	10	0-2	.76	.53	1.42(.36)	1.61(.23)
Externalizing Behaviors	10	0-2	.80	.66	.62(.40)	.51(.29)

*p (two-tailed) < .05; ** p (two-tailed) < .01; *** p (two-tailed) < .001

Emotion expression was assessed with two scales from the *EEQ,* a 35-item parent-report questionnaire for measuring a child's emotion expression

[19]. These scales were a) Negative Emotion Expression (8 items), which indicates the intensity and frequency of children's negative emotion expression and the extent to which they can calm themselves or be calmed by their parents when angry or sad; and b) Positive Emotion Expression (6 items), which indicates the extent to which children express happiness and joy. To complete **t**hese scales**,** parents rate the degree to which each item is true on a 5-point response scale (1 = (almost) never, 2 = rarely, 3 = sometimes, 4 = often, 5 = (almost) always). The internal consistencies of the scales are good (Table 2).

Observational measurements

The *Emotion Regulation Task* was designed for this study and examines children's responses to a frustrating event. The experimenter opens a bottle in front of the child, closes it again and then asks the child to open it. The child does not know that the bottle features a safety lock that makes it impossible for children to open. The experimenter waits for a minimum of 30 seconds and a maximum of 60 seconds, and then opens the bottle to an extent that will enable the child to complete the task successfully. During this waiting period, the experimenter scores the child's behavioural reactions on a checklist consisting of two scales. The first scale, the Bottle Distraction scale (4 items), is a coping scale that denotes the extent to which children can divert their attention from the negative stimulus. An example item is 'The child starts doing something else'. One item is formulated contra-indicatively ('The child keeps trying') and recoded. The second scale, the Negative Reaction to Bottle scale (3 items), is an emotion-expression scale that denotes the extent to which children show a negative reaction. An example item is 'The child shows a negative facial expression'. The experimenter can score the items on a 3-point scale (0 = not, 1 = a bit / unclear, 2 = clearly evident). The internal consistencies of the scales are moderate to good (Table 2).

The material for the *Coping Task* had also been designed especially for this study, and consisted of six vignettes depicting prototypical emotion-eliciting situations. Two vignettes were designed for each emotion (anger, sadness and fear). After children had been asked to look at the drawing and had been told, either in spoken language or in sign language, very simple illustrative words, such as "Boy sees dog", they were first asked to say or sign how the protagonist

would feel. The children were then asked how the protagonist could become happy again (e.g., "How can boy get happy again?"). All responses were coded by two raters. Interrater agreement was good (Cohen's Kappa varying from .91 to 1.00) and disagreements were resolved by discussion. Children's scores were calculated as the proportion of appropriate coping strategies (e.g. 'when dog leaves' or 'when boy leaves'). Children who were unable to perform a task because they did not understand 'why' questions received the score 0 for this task, meaning they could not perform this task.

Procedure

Children were tested individually in a quiet room. CI children who communicated only or partly in sign language were tested by a researcher who was familiar with spoken and sign language. More than half of the CI children (58%) were tested using some form of spoken Dutch combined with signs; 27% were tested using spoken Dutch, and 15% in sign language. All sessions were recorded on video and took approximately 20 minutes, including other tasks that are not presented in this manuscript. After the sessions, transcripts of the tape were made by the researcher.

Statistical analyses

All analyses were carried out with raw scores. Addressing our first hypothesis, group *t*-tests were carried out to compare CI and NH children with regard to the different aspects of emotion regulation and social functioning.

To test the second hypothesis, correlation analyses were used to establish the strength of the relationships between emotion regulation and social-functioning variables. Hierarchical regression analyses (method enter) were used to test the effect of language skills and aspects of Emotion Regulation on Social Functioning, with social competence and externalizing behaviors as dependent variables, and with emotion regulation measures (step 1) as independent variables. To examine the relationship of language skills with indices of Emotion Regulation and Social Functioning, language measures were entered in step 2 of the hierarchical regression analyses. These analyses were also repeated excluding children who had received their CI after their third birthday, those who had had their CI for less than 1 year, and those who were tested in sign

language. There were no differences in outcomes between the analyses that included these participants and those that excluded them.

Because girls were slightly overrepresented in the NH children, group *t*-tests were carried out to compare boys and girls with regard to language skills and the different aspects of emotion regulation and social functioning. Boys and girls did not significantly differ on any of these variables and therefore, these outcomes are not further reported. Regression analyses were carried out including age as an independent variable. Results indicate that age did not contribute to the regression model. For reasons of clarity, the outcomes of these analyses are not included in the results presented below.

Results

Language skills

CI children had poorer receptive and expressive language skills than NH children (receptive: $t(92)=3.25$, $p=.002$; expressive: $t(88)=4.26$, $p<.001$) (table 1). In CI children and NH children alike, age and language skills were strongly correlated (Pearson correlation varying from .67 to .79; $p<.001$). In CI children, expressive language and duration of CI use were also strongly correlated ($r=.72$; $p<.001$), as were receptive language and duration of CI use ($r=.66$; $p<.001$).

Group differences regarding Emotion Regulation and Social Functioning

Group differences were found with regard to three aspects of Emotion Regulation. Table 2 shows that parents of CI children reported that their children expressed negative emotions more often and more intensely ($t(103)=2.92$, $p=.004$) than parents reported of their NH children. On the Bottle Distraction Task, CI children were less able than NH children in diverting their attention ($t(134)=2.01$, $p=.046$). On the Coping Task, CI children were barely able to invent ways the protagonist could become happy again, whereas NH children were more successful ($t(134)=3.97$, $p<.001$). Most CI children (68%) could not perform this task and fourteen CI children (20%) could perform the task but could not think of adequate strategies to become happy again. Only eight CI children (12%) could name one or more adequate strategies, whereas 30 NH

children (45%) could do this. No differences were found concerning Positive Emotion Expression reported by parents and the Negative Reaction to Bottle Task.

Group differences were also found for Social Competence: parents of CI children reported lower social competence ($t(102)=3.09$, p=.003) than parents of NH children. There were no group differences for Externalizing Behaviour.

Table 3. Pearson's Correlation of language skills with Emotion Regulation and Social Functioning for CI children and NH children, controlled for age

	Receptive language		Expressive language	
	CI	NH	CI	NH
Coping				
Bottle Distraction	.10	-.05	.16	.07
Coping Task	.03	.06	.14	-.04
Emotion Expression				
Negative Reaction to Bottle	.27*	.09	.21	.11
Negative Emotion Exp	-.08	.12	-.07	-.05
Positive Emotion Exp	.06	.07	.09	.13
Social Functioning				
Social Competence	.64***	.49***	.61***	.41***
Externalizing Behaviors	-.27*	-.07	-.31*	-.06

*p (one-tailed) < .05; ** p (one-tailed) < .01; *** p (one-tailed) < .001

Correlation and regression analyses

Pearson correlations of language skills with Social Functioning and Emotion Regulation, controlled for age, are shown in table 3. For Social Functioning, there were strong correlations in CI and NH children for both receptive and expressive language with Social Competence, even after controlling for age: children with better language skills also had better Social Competence. In contrast, language skills and Externalizing Behaviors were not correlated in NH children, whereas Externalizing Behaviors were moderately correlated in CI children for both receptive and expressive language skills. This shows that better language skills were associated with fewer Externalizing Behaviors. Language skills were not related with aspects of Emotion Regulation, except for Negative Reaction to the Bottle Task in CI children. However, language skills and some aspects of emotion regulation were correlated when we

did not control for age, especially for aspects that require a verbal reaction of children (i.e. Negative Reaction to Bottle and the Coping Task). Pearson correlations for the subgroup of children who could perform the Coping Task revealed a correlation in NH children for receptive language and the Coping Task, but not in CI children.

Table 4 and Table 5 show the Pearson correlations between aspects of Emotion Regulation and Social Functioning for the CI children and the NH children, and the outcome of the regression analyses. The independent variables are Bottle Distraction, Negative Reaction to Bottle, Coping Task, Negative Emotion Expression, Positive Emotion Expression, receptive language, and expressive language. The dependent variables are Social Competence and Externalizing Behaviors. The results of both types of analyses are fairly similar, and the regression models show average to good explained variance, except for Social Competence in children with CI, for which neither model is significant. However, more Positive Emotion Expressions and more adequate Coping Strategies are strongly associated with better Social Competence in NH children, accounting for 26% of the variance ($p=.004$) in Step 1. After the subsequent entry of language measures in Step 2, the regression model accounted for 37% of the variance ($p=.001$). NH children's Coping Strategies were no longer associated with Social Competence. Although language measures were correlated with Social Competence in both CI children and NH children, they did not contribute significantly in the regression model.

In both groups, higher levels of Negative Emotion Expression was associated with more Externalizing Behaviors. Additionally, a stronger tendency to avoid the negative stimulus and turn away from it (Bottle Distraction) was associated with fewer Externalizing Behaviors in CI children. In contrast, higher levels of negative reactions in the Negative Reaction to Bottle Task were related to more Externalizing Behaviors in NH children. The regression model in explaining Externalizing Behaviors accounted for 38% of the variance ($p<.001$) in CI children, and 21% in the NH group ($p=.015$). The subsequent entry of language measures in Step 2 did not add significantly to the model.

Table 4. Pearson's Correlation and Hierarchical Regression Analysis predicting Social Competence for CI children and NH children

	CI (n=51)		NH (n=53)	
	R	*B*	*R*	*B*
Step 1	R^2=1%		R^2=26%**	
Coping				
Bottle Distraction	.17	.13	-.17	-.11
Coping Task	.01	.05	.39**	.33*
Emotion Expression				
Negative Reaction to Bottle	.12	.12	.11	.18
Negative Emotion Exp	-.21	-.20	-.06	-.06
Positive Emotion Exp	.05	-.03	.51***	.39**
Step 2	R^2=12%		R^2=37%***	
Coping				
Bottle Distraction		.18		-.05
Coping Task		-.10		.11
Emotion Expression				
Negative Reaction to Bottle		-.07		-.00
Negative Emotion Exp		-.23		-.06
Positive Emotion Exp		.08		.37**
Language				
Receptive language		.06		.63
Expressive language		.45		-.20

*p (one-tailed) < .05; ** p (one-tailed) < .01; *** p (one-tailed) < .001

Table 5. Pearson's Correlation and Hierarchical Regression Analysis predicting Externalizing Behaviors for CI children and NH children

	CI (n=51)		NH (n=53)	
	R	*B*	*R*	*B*
Step 1	R^2=38%***		R^2=21%*	
Coping				
Bottle Distraction	-.31*	-.29*	.05	-.05
Coping Task	.14	-.04	-.21	-.19
Emotion Expression				
Negative Reaction to Bottle	.04	.08	.27*	.31*
Negative Emotion Exp	.54***	.56***	.34*	.34*
Positive Emotion Exp	-.20	-.11	-.12	.00
Step 2	R^2=44%**		R^2=17%**	
Coping				
Bottle Distraction		-.31*		-.07
Coping Task		.06		-.17
Emotion Expression				
Negative Reaction to Bottle		.19		.33
Negative Emotion Exp		.58***		.36*
Positive Emotion Exp		-.14		-.00
Language				
Receptive language		.02		-.23
Expressive language		-.29		.19

*p (one-tailed) < .05; ** p (one-tailed) < .01; *** p (one-tailed) < .001

Discussion

Emotion regulation is an important skill for adaptive social functioning, which develops gradually during childhood. In NH children, it starts at a very early age. The outcomes of this study indicate that better social skills are indeed related to more expressions of positive emotions. Good social skills are further associated with the ability to intentionally reduce or divert the intensity of negative emotions for toddlers and preschool children with typical development. In contrast, we found more frequent and intense expressions of negative

emotions, which imply less advanced emotion regulation skills, were related to more externalizing behaviors in these children. This is consistent with the literature [13, 20].

Differences between CI children and NH children

As we hypothesized, CI children were less socially competent and used less adequate coping strategies than NH children. Our study did not produce the widely observed differences between deaf and NH children regarding behavioral problems. However, most studies that found more behavioral problems in deaf children than in hearing children involved children aged 5 years or older [22,23]. It is possible that the difference between deaf and NH children with regard to the prevalence of behavioral problems starts when children enter school at the age of 4 or 5. Alternatively, it is possible that deaf children who receive a CI at a relatively young age do not have more behavioral problems than NH children. A study of deaf adolescents with CI showed that while they did not have more behavioral problems, they seemed to have more peer problems – a finding that is consistent with our results[24]. A third explanation might be that parents of a child with CI experience more communication problems with their child [25]; such interactions might easily result in more frustration on both sides. Future studies should therefore consider externalizing problems in higher age-groups, and also examine the extent to which children's behavioral problems are related to the quality of interpersonal communication.

Emotion regulation in relation to social functioning

The question is to which extent the capacities for emotion regulation in children with a CI are also related to adaptive social functioning (e.g. better social skills and fewer externalizing problems). In both CI and NH children, more intense and more frequent expressions of negative emotions were related to more externalizing behaviors. For CI children, however, more distraction from a negative stimulus was a protective factor. Surprisingly, even though CI children were reported by their parents to express negative emotions more often and more intensely than NH children, and even though they were less able to divert their attention from negative stimuli than their NH peers, they did not show more externalizing behaviors. Alternatively, children with a CI might be more

expressive when emotionally evoked, which might have caused an over-report by their parents. Yet, the fact that parents did not report more arousal for positive emotions combined with the absence of a group difference for negative emotion expression during the task, contradicts this alternative explanation. Nevertheless, future studies could assess emotion regulation in different ways, using a more elaborate multi-method approach. For example, measuring the level of arousal by means of skin-conductance could show if children with CI are indeed more emotionally aroused during an emotion evoking episode and how this level of arousal is related to their communicative and social skills.

We found children with CI to be less socially competent than NH children. Furthermore, none of the indices used for emotion regulation in this study were related to social skills in CI children, where some were related to social skills in NH children. The coping task in which children were asked to spontaneously think of how protagonists could improve their negative emotions, puts an especially high verbal demand on children. This difficulty explains why very few children in the CI group could perform this task. However, expressions of positive emotion were also unrelated to better social skills in children with CI. This lack of relationship implies that these children make less strategic use of their positive emotions in order to maintain or enhance their relationships with meaningful others – a behavior that was also observed in older deaf children [26]. This might be explained by the fact that emotion socialization in young CI children differs from that of hearing children. Young CI children have less models and partners with which to practice emotion regulation. They lack this opportunity because most parents with deaf children do not know how to sufficiently practice these skills when communicating with their children [26, 27]. The parenting styles of parents with a deaf child also differ from those of parents with NH children. For example, parents with a deaf child are more likely to use physical discipline in response to perceived child transgression [28]; Physical punishment models other social rules for these children – probably none of which enhance deaf children's emotion regulation. If this is true for CI children, this could signify that social competence develops differently in children with CI than it does in NH children. This could further indicate that deaf children with CI are unaware of the valuable function of emotion in their social interactions.

The role of language

In our sample, the role of language skills in emotion regulation was different than we had expected. Although language skills were related to indices for emotion regulation, these associations disappeared after controlling for age. This may have been a product of the types of tasks that were used in this study. Expressing emotions and distracting oneself from negative stimuli does not require language skills. The emotion-regulation task that put a strong verbal demand on children – the coping task – was in fact too difficult for two thirds of the CI children and one third of the NH children. It would be interesting to assess associations between language skills and indices of social functioning and emotion regulation for the small group of children that could perform the coping task. However, the sample in our current study was too small to do this. As other studies have shown the importance of language in more advanced emotion-regulation strategies [21], it is plausible that language skills become more important as children grow older. Future studies should therefore examine these strategies in CI children and the relationship with language skills.

As hypothesized, we found a strong relationship between better language skills and higher social competence. Our results that the NH children in our study not only had better language skills than CI children, but also higher social competence further supports this claim. Obviously, aspects of social competence, such as interaction with peers and pro-social behavior, require good language skills. Despite the strong correlation between language skills and social competence, language skills did not contribute significantly to the regression model in either CI or NH children. This implies that other variables, e.g. emotion socialization, might be a greater influence on social competence than language skills.

Note that language skills in this study were assessed through a parent-questionnaire, whereby it is not possible to differentiate between detailed aspects of language skills such as syntactic and phonological complexity. However, this study was conducted to compare CI children with NH children on aspects of emotion regulation and social functioning and the relationship between these two factors. The assumption was that language skills would have an indirect relationship with social functioning via aspects of emotion regulation. For this,

measures concerning daily use of language, either spoken language, sign language, or a combination of these two, are probably more valid than detailed information on spoken language skills in a test situation. We did not include information on auditory perception for similar reasons. Auditory perception is highly related to the ability to acquire spoken language skills [29], and influences emotion regulation and social functioning through language skills. Moreover, auditory perception in the Netherlands is mainly assessed using speech perception tests in quiet, often leading to ceiling effects [30].

Conclusion

CI children aged 1.5-5 years differed on some aspects of emotion regulation and social functioning from their normal hearing peers. They were less socially competent, less able to divert their attention and invent ways to become happy again, and expressed negative emotions more often and more intensely. In contrast with our expectation, CI children did not have more behavioral problems than NH children, probably explained by the fact that the children in our study were relatively young. In accordance with our hypothesis, associations between aspects of emotion regulation and social competence were different for CI children compared to NH children. None of the emotion regulation indices were associated with social competence in CI children. In NH children, adequate coping strategies and positive emotion expression was associated with social competence. Additionally, more expression of negative emotions was related to externalizing behavior in both groups, whereas the ability to distract attention in frustrating situation was associated to externalizing behavior in CI children. The influence of language skills on emotion regulation and social functioning was unclear, probably due to their young age. Especially in CI children, but also NH children, coping skills and emotion expression are not well developed in early years.

In sum, it appears that children with CI, when compared to NH peers, display more features of emotional dysfunctioning that are known to contribute to externalizing behaviors in typically developing children, although this is not yet evident in more externalizing problems. Nevertheless, because externalizing problems are more common in CI children at an older age, longitudinal studies should examine the causal relationship with the indices identified in this study. It

also appears that adaptive abilities, such as coping skills and the communication of positive emotions, are not yet evident in CI children at this young age. Hopefully, after longer CI use, longer exposure to the hearing world, and greater experience of it, these children will catch up with their NH peers. However, there is no such evidence as far as we know. It is possible that if basic emotion regulation strategies do not develop well in the early years of life, children will always have sub-optimal regulation strategies. Again, future research is needed to study this possibility. Cochlear implantation is occurring more frequently at even younger ages. This trend might influence the outcome for future children favorably, as it does regarding language development. Once again, longitudinal studies might further explore the role of protective factors in the social development of children with CI.

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