Being deaf at the playground: the effects of hearing loss on children's social participation

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Chapter 5

Empathy and emotions in deaf or hard-of-hearing preschoolers

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ABSTRACT

Empathy is a crucial aspect of children's daily lives, as it helps them to understand others and build strong bonds with others. In this study we examined the extent to which empathy levels (i.e. emotion contagion, attention to others' emotions, and prosocial actions) differed in deaf or hard-of-Hearing versus hearing children, and the unique contribution of emotion regulation and emotion recognition to each of these levels. Thirty two DHH and 149 hearing preschoolers participated in this study. Caregivers rated their children's empathy, emotion recognition, and emotion regulation. Hearing and language related factors were analysed as possible control variables. Children performed tasks to assess language comprehension, production and pragmatics; emotion vocabulary was measured through parent reports. Clinical information was obtained through each child's designated doctor. Both groups showed similar levels of empathy, emotion recognition and emotion regulation, but DHH showed lower language skills. Better emotion recognition, regulation and vocabulary were associated with more prosocial actions in both groups. The current findings shed a positive perspective on DHH preschoolers emotional development, and suggest that being bilaterally rehabilitated may contribute to better social access in a predominantly hearing environment.

INTRODUCTION

Empathy, also called “the social-glue of human relationships”, is a crucial aspect of social interactions throughout life, and it can be defined as the ability to share others’ emotional states and show concern towards them (Hoffman, 2001). From birth until the preschool years children go through three subsequent, but not mutually exclusive levels of empathy: emotion contagion, attention to others’ emotions, and prosocial actions (Hoffman, 1987). Although emotion contagion is presumably innate, the other two levels of empathy rely on social learning opportunities (Davidov et al., 2020; de Waal, 2008; Decety et al., 2016), which might be more difficult to access for children who are deaf or hard-of-hearing (DHH) compared to their hearing peers, because children’s social environment is predominantly hearing and thus often does not, or only partially, take into account the special needs or requirement needed for DHH children to fully participate, such as clear turn taking and showing the DHH child your face when talking (NCDS, 2015). These limited opportunities for social learning seemed to have an impact on DHH children’s emotional development in previous studies, but this is yet unknown regarding empathy and related factors, such as emotion recognition and regulation. Therefore, differences in the levels of empathy between DHH and hearing preschoolers, and the unique associations of these empathy levels with emotion recognition and emotion regulation are the focus of this study.

SOCIAL LEARNING IN HEARING AND DHH CHILDREN

Social learning, i.e., learning in and from the social environment, largely depends on ‘incidental learning’, which can be defined as unintentional or unplanned learning from the social environment that arises when children observe and/or overhear how others interact (Bandura, 1977; Kelly, 2012). Children’s socio-emotional development greatly relies on these opportunities to observe and / or overhear how others’ communicate their emotions, negotiate, argue, and problem-solve among one another (Moeller, 2007; Saarni, 1999). Everyday opportunities for incidental learning are available across the various contexts that children spend time in (e.g., at home, preschool, and neighborhood). However, access to these different social situations can be less easy for many DHH children who grow up in a predominantly hearing world.

Notwithstanding different kinds of technology to improve DHH children's hearing, their access to the auditory environment is not to the level of hearing children. For example, although cochlear implants (CIs) are effective in transmitting sounds and decoding speech in quiet environments, CI users often report difficulties picking up speech in noisy environments like playgrounds, locating where sounds are coming from, and perceiving pitch and prosodic cues (Jiam et al., 2017; Paquette et al., 2023; Pisoni et al., 2017). These factors can diminish opportunities for DHH children to join their peers in situations where spoken language is important. Moreover, attitudes of peers who have no hearing loss, and a lack of awareness on how to communicate with their DHH peers, can add to this (Musau, 2021). For example, group interactions can be more difficult as children with a CI might be unable to determine who is talking, following the conversations from different people can be exhausting, and poor acoustics can cause listening fatigue (Arioli et al., 2023). Furthermore, the quality of DHH children's social interactions with their hearing peers might also be affected, because DHH children might miss out on words in conversations, misinterpret a joke, or it can be more difficult for them to grasp the emotion expressed in the voices of their peers (Arioli et al., 2023; Jiam et al., 2017).

All these aspects might limit DHH childrens' opportunities for incidental learning and social participation, which can prevent DHH children from developing and/or showing of their empathic skills, unlike in the same way that hearing children do: by observing the social world around them, and by spontaneously interacting with their peers.

LEVELS OF EMPATHY IN HEARING AND DHH CHILDREN

Children are born with an innate capacity to mimic or synchronize with other people's emotional states, also referred to as 'emotion contagion' (Davidov et al., 2013, 2020; de Waal, 2008). For example, most babies start crying while hearing and/or seeing another baby cry (Hoffman, 2000; Simner, 1971). Studies with DHH children have shown that their levels of emotion contagion are similar to their hearing peers, which is in line with the assumption that this level of empathy is innate (Ketelaar et al., 2013; Tsou, Li, Wiefferink, et al., 2021). For example, emotion contagion levels of DHH and hearing toddlers and preschoolers were similar based on parental reports, and observational tasks in which the experimenter pretended to hurt herself, or be angry with a pen that did not work (Ketelaar et al., 2013). These similar levels of

contagion seem consistent across age groups (e.g. older-children and adolescents), and methods (e.g. observations and parental reports) (Dirks et al., 2017; Netten et al., 2015; Tsou, Li, Wiefferink, et al., 2021). Therefore, feeling contagion seems to be common to most children, independent of individual differences.

Although an important part of social bonding, emotion contagion can also feel overwhelming for young babies as they still have difficulties in regulating their levels of arousal (Bird & Viding, 2014; Davidov et al., 2013). For example, although the 'triggering' emotional distress is not their own, young babies often show self-focused concern by signaling that they need comfort (Batson, 1991; Davidov et al., 2013). Therefore, a crucial step in the transition from emotion contagion to attention to others' emotions is the ability to decrease levels of arousal so that others can become the focus of attention, thus showing other-focused concern (Bird & Viding, 2014; Hoffman, 1990).

Other-focused concern becomes visible when babies show attention to others' emotions, which is the second level of empathy (Hoffman, 1987). Attention to others' emotions is visible in young babies when they orient towards the person in distress, and as children grow older they start to show concerned facial expressions, or stop their play or activities to direct their focus to others (Hoffman, 1987; Roth-Hanania et al., 2011). Moreover, attention to others' emotions can be seen as the primary steps of emotion understanding, as paying attention to others is necessary to understand how they feel (Tsou, Li, Wiefferink, et al., 2021). Studies with DHH children have shown that their levels of attention to others' emotions are similar to their hearing peers (Ketelaar et al., 2013; Tsou, Li, Wiefferink, et al., 2021). These results could indicate that similarly to emotion contagion, attending to others' emotions might be innate and/or not fully depend on social learning (Ketelaar et al., 2013).

As children show progressively more signs of attention to others' emotions, they also begin to show support and comforting behaviors aimed to alleviate others in distress, which we refer to as prosocial actions, the third level of empathy (Hoffman, 1987; Rieffe et al., 2010). As children grow older, prosocial actions increase in both hearing and DHH children, although research showed that DHH children tend to respond less prosocially than their hearing peers (Tsou, Li, Wiefferink, et al., 2021). For most children caregivers are their first models on how to act prosocially (Eisenberg & Fabes, 1998; Hoffman, 2000), for example when a parent discusses how compassionate they felt towards another person's situation, or they help others in the presence of the child (Hoffman, 2001). However, for obvious reasons, DHH children are

disadvantaged here, as they are often unable to overhear these kinds of conversations. Besides the family environment, interactions with peers are important opportunities for children's prosocial development (Jambon & Malti, 2022; Rieffe et al., 2015). However, peer interactions typically occur in noisy environments like playgrounds, which make it more difficult for DHH children to join in, thus showing fewer comforting behaviors (Arioli et al., 2023; Tsou, Li, Wiefferink, et al., 2021). Therefore, all these different aspects might hinder opportunities for DHH children to train and develop their prosocial skills.

THE IMPORTANCE OF EMOTION RECOGNITION AND EMOTION REGULATION

As children progress in their empathy levels, also other aspects of their emotional development come into play, i.e., emotion recognition and emotion regulation in particular. Helping or comforting others who are in distress, requires children to put together pieces of information that signal what the other needs. Emotion recognition is not only one of those pieces, but is considered as an important starting piece of this emotional puzzle (Lyusin & Ovsyannikova, 2016; Song, 2021).

Also, these aspects of children's emotional development, emotion recognition and regulation, rely heavily on children's access to their social world and thus opportunities for social learning. Again, DHH children might be disadvantaged in this if the hearing world does not provide sufficient support to DHH children to participate fully in daily social interactions like their hearing peers. Compared to their hearing peers, DHH children tend to have more difficulties in decoding others' emotion expressions (Sidera et al., 2017; Wang et al., 2019; Wiefferink et al., 2013). These difficulties may, in turn, influence DHH children's empathic behaviors to some extent, as recognizing an emotion is an important cue that someone is in distress and in need of comfort/support. In line with this assumption, previous research with hearing children has shown that children with better emotion recognition skills also pay more attention to others' emotions and show more prosocial behaviors (Da Silva et al., 2022). Similarly, a positive association between emotion recognition and social competence in DHH children was also confirmed (Ketelaar et al., 2013).

Regarding emotion regulation, its interrelation with empathy might be particularly important in the transition from emotion contagion to attention to others' emotions, and in turn, to act prosocially. This shift from empathic self-distress to other-oriented empathy largely depends

on the child's ability to control the arousal felt in the presence of someone in distress, i.e., the ability to regulate emotions (Bird & Viding, 2014; Davidov et al., 2013, 2020). Emotion regulation can be defined as the ability to modulate the levels of physiological and emotional arousal, and respond adaptively to a given situation (Gross & Thompson, 2007). Previous studies with hearing children have shown that children with lower levels of emotion regulation tend to experience higher levels of emotion contagion, and show fewer prosocial behaviors (Rieffe et al., 2010; Tsou, Li, Wiefferink, et al., 2021). Although levels of emotion regulation seem similar in DHH and hearing children (Ketelaar et al., 2015; Tsou, Li, Eichengreen, et al., 2021; Tsou, Li, Wiefferink, et al., 2021), its relation with the three levels of empathy in DHH children is yet to be known.

PRESENT STUDY

Empathy guides social interactions from a very young age (Hoffman, 2000). Although the initial signs of empathy are assumed to be innate, developing this very important skill requires exposure and practice, which is not equally accessible to all children, as it is the case of DHH children. DHH children face more challenges than their hearing peers in navigating the social world, limiting their opportunities for social learning, which may impact the manifestation of their empathic skills (Arioli et al., 2023; Jiam et al., 2017; Paquette et al., 2023). However, research on the different levels of empathy (i.e. emotion contagion, attention to others' feelings, and prosocial actions) in DHH preschoolers is scarce. To the best of our knowledge, no previous study has focused on describing and comparing the three levels of empathy separately in DHH and hearing preschoolers. Furthermore, the interrelation between the three levels of empathy and two important skills within the domain of emotional competence (emotion recognition and emotion regulation), have yet to be studied.

The first aim of this study was to examine the extent to which DHH and hearing preschoolers have similar levels of empathy, taking into account the three levels: emotion contagion, attention to others' emotions, and prosocial actions. Based on previous research which included infants and preschoolers, we expected that DHH preschoolers would show similar levels of emotion contagion and attention to others' emotions, and lower prevalence of prosocial actions, compared to their hearing peers (Ketelaar et al., 2013; Tsou, Li, Wiefferink, et al., 2021).

Second, we examined the extent to which the two emotion skills (i.e., emotion recognition and emotion regulation) were uniquely related to preschoolers' levels of empathy. Based on previous research with hearing children, we expected emotion recognition to be positively related to attention to others' emotions and prosocial actions, in both groups (da Silva et al., 2022). Regarding emotion regulation, based on previous studies we expected that preschoolers with lower levels of emotion regulation would show higher levels of emotion contagion and lower levels of prosocial action (Rieffe et al., 2010; Tsou, Li, Wiefferink, et al., 2021). Additionally, we did not expect differences in the strengths of the relationships between these concepts for the DHH preschool children in our study.

Third, we aimed to understand the extent to which hearing factors and language indices were associated with the three empathy levels. Previous research has shown no relation between these factors, empathy and other emotional skills in DHH children who predominantly communicate through oral language, and are early users of hearing devices (i.e. hearing aid, cochlear implant), which is the case of our sample (Antia et al., 1998; Leigh et al., 2009; Patrick et al., 2018; Stevenson et al., 2015; Theunissen et al., 2015; Tsou, Li, Wiefferink, et al., 2021). Therefore, we expected that hearing factors (i.e., hearing age, type of hearing device, and degree of hearing loss), and language indices (i.e., emotion vocabulary, language comprehension, production and pragmatics) to be unrelated with the three levels of empathy.

METHOD SECTION

Participants and Procedure

A total of 32 DHH (Mage = 58.06 months, SD = 11.06 months; 63% boys) and 149 hearing (Mage = 60.08 months, SD = 10.88 months; 52% boys) preschoolers participated in this study (Table 1). The DHH preschoolers were recruited directly by their reference doctors from two hospitals in Lisbon. Among the DHH preschoolers, 18 were with bilateral cochlear implants (CI), 10 with bilateral hearing aids (HA), and 4 with CI in one ear and HA in the other. All DHH children used aural communication as their primary modality. Caregivers of these children were first informed about the purpose and planning of the study and asked to indicate their willingness to participate. Caregivers also indicated the preschool that their DHH child attended. Next, all preschools and caregivers of preschoolers in the same classes as the DHH child were asked to provide written consent for their children to participate in the study. All participating caregivers filled out the Empathy Questionnaire (EmQue; da Silva et al., 2022;

Rieffe et al., 2010), and the Emotion Expression Questionnaire (EEQ; Rieffe et al., 2010) on paper for every participating child. Approval for the study was obtained from the Ethical Committees of Leiden University, the Portuguese National Committee of Data Protection, and the Portuguese Directorate of Education.

Table 1. Demographic characteristics of participants

	Total study population		DHH study population		
	Hearing	DHH	Bilateral CI	Bilateral HA	Bimodal (CI&HA)
No. of children	149	32	18	10	4
Age					
Mean – in months (SD)	60.08 (10.88)	58.06 (11.06)	57.17 (10.22)	60 (12.02)	57.25 (14.86)
Range – in months (SD)	36 – 79	37 - 79	37 - 73	41 - 79	40 – 72
Gender					
Male (%)	77 (51.7%)	20 (62.5%)	10 (55.6%)	7 (70%)	3 (75%)
Language Indices					
Emotion Vocabulary**	.70 (.17)	.51 (.23)	.54 (.27)	.43 (.19)	.53 (.12)
Comprehension**	.96 (.08)	.88 (.11)	.87 (.12)	.89 (.07)	.88 (.18)
Production**	.97 (.07)	.72 (.33)	.71 (.37)	.71 (.31)	.79 (.23)
Pragmatics**	.56 (.33)	.17 (.30)	.20 (.33)	.09 (.17)	.21 (.42)
Degree of hearing loss					
Moderate – 40 – 60 dB (%)		3 (9.4%)		3 (30%)	
Severe – 61 – 90 dB (%)		7 (21.9%)		7 (70%)	
Profound - > 90 dB (%)		19 (59.4%)	18 (100%)		1 (25%)
Severe & Profound (%)		3 (9.4%)			3 (75%)
*Hearing age***	60.08 (10.88)	38.41 (12.17)	41.50 (9.30)	32.60 (12.75)	39.00 (19.58)

* p < .05 ; ** p<.01;

Measures

Empathy was measured by the Portuguese version of the EmQue (da Silva et al., 2022; Rieffe et al., 2010). This caregiver-report questionnaire is composed of 15 items representing three scales that measure the levels of empathy: Emotion Contagion (five items), Attention to Others' Emotions (six items), and Prosocial Actions (four items). Caregivers were asked to rate the prevalence of each described behaviour in their child over the past 2 months in a 5-point scale (1 = (almost) never; 5 = (almost) always). The final score of each level of empathy was obtained by averaging the score obtained in each of the items within that specific scale. Higher total mean scores correspond to higher levels of empathy.

Emotion Recognition, is a scale in the EEQ (35 items; Rieffe et al., 2010). The Emotion Recognition scale (6 items; e.g., "Can your child properly assess the emotions of others?", "Does your child know when you are happy?") aims to assess the extent to which children recognise others' emotions. Caregivers were asked to rate the prevalence of each described behaviour in their child over the past 2 months on a 5-point scale (0 = (almost) never/very easy; 4 = (almost) always/very difficult). Higher total mean score corresponds to better emotion recognition in children.

Emotion Regulation is also a scale in the EEQ caregiver report (Li et al., 2020; Rieffe et al., 2010), aimed to assess the extent to which children can regulate their emotions when they are afraid, angry or sad (12 items; e.g., "Is your child easily calmed down when they are angry?", "How long do angry episodes last usually?"). Caregivers were asked to rate the prevalence of each described behaviour in their child over the past 2 months on a 5-point scale (0 = (almost) very easy/ 1 min; 4 = (almost) very difficult/ + 60 min). Higher total mean score corresponds to lower emotion regulation skills in children.

Language Indices, namely language comprehension, production and pragmatics were measured by the TALC tasks (Sua-Kay & Tavares, 2007). For language comprehension, children were faced with 12 designated objects (Task 1), and the instructor asked the child "where is (the object; e.g. tree, chair, key)?". If the child pointed correctly to the object they got a rating of 1. For Task 2 children were faced with 20 images divided in three categories: objects (6); activities (6); semantic relationships (8). The instructor asked the child "where is (the object) / who is (doing a certain activity)/ which one of the objects is (a certain characteristic)?". If the child pointed correctly to the object they got a rating of 1. The language

comprehension score was obtained by averaging the score obtained for each object/image. Higher scores correspond to better language comprehension skills. For language production children were faced with the same objects and images. For the object tasks the instructor pointed to the object and asked the child to name it (Task 3). If the child named the object correctly, they got a rating of 1. For the images task (Task 4) the instructor pointed to an image and asked the child to name the object/action/characteristic that was shown (Task 4). If the child named the object/action/characteristic correctly they got a rating of 1. The language production score was obtained by averaging the scores obtained for each object/image. Higher scores correspond to better language production skills. For pragmatics (Task 5) children were faced with an image of a classroom showing different scenarios (e.g. children playing together, children doing activities alone, teacher interacting with a child). While looking at the image, the instructor pointed to a certain character, presented a situation and ask the child what they would say in that specific situation which relates to daily scenarios (e.g. while pointing to the child at the entrance of the classroom, the interviewer asked "This child just arrived to the classroom. What should they say?"). Children were presented with 6 different scenarios, and for each they got a rating of 1 if the answer was correct. The pragmatics score was obtained by averaging the scores obtained for each scenario. Higher scores correspond to better pragmatics skills.

Additionally, Emotion Vocabulary was measured through a 20 item caregiver report that measures children's knowledge of emotion words (Ketelaar et al., 2015; Veiga et al., 2023). Caregivers were asked whether their child knew/used 20 emotions (e.g. "happy", "angry") and mental states (e.g. "dream", "know") by replying yes = 1 or no = 0. A higher total mean score indicated better emotion vocabulary in children.

Lastly, Hearing Factors, namely hearing age, degree of hearing loss and type of hearing device were obtained directly from each child's designated doctor.

STATISTICAL ANALYSES

The statistical analyses were conducted using IBM SPSS 28.0.1 version. An alpha error of less than or equal to .05 was used to determine significance. Internal consistency of the EmQue and EEQ scales were assessed using Cronbach's alpha and inter-item correlations. Group comparisons on the levels of empathy, emotion recognition and emotion regulation

between DHH and hearing preschoolers were conducted using Independent Samples T-tests. To assess whether hearing factors (i.e. hearing age, degree of hearing loss, and type of hearing device), language (i.e. comprehension, production, and pragmatics), and emotion vocabulary were associated with the three levels of empathy, Pearson's correlations were conducted. Out of all the analysed factors, only emotion vocabulary was associated with empathy, specifically to prosocial actions (Table 5), and therefore this factor was included in the subsequent regression analyses as a control variable. The unique contribution of emotion recognition and emotion regulation to the three levels of empathy was examined through three hierarchical regression analyses. In the first step, we entered the group (Hearing = 0, DHH = 1), the two emotion skills (i.e. emotion recognition and emotion regulation, and emotion vocabulary as the covariate. In the second step, we added the interactions of the group with each of the two emotion skills. Lastly, for exploratory purposes, a series of Independent Samples T-tests were conducted within the DHH group, to compare the studied variables between children with bilateral CIs (n = 18) and those with bilateral HAs (n = 10). DHH children with bimodal hearing (CI and HA) were not included in this analysis due to small sample size (n = 4).

RESULTS

The descriptive and psychometric properties of the three levels of empathy, emotion recognition, emotion regulation, and emotion vocabulary are reported in Table 2. The internal consistencies of the EmQue scales were good, with the Cronbach's alpha ranging from acceptable (regarding Emotion Contagion and Attention to Other's Emotions scales) to good (regarding Prosocial Actions scale). The inter-item correlation values of the Emotion Contagion and Attention to Other's Emotions were within the ideal range (i.e, .15 to .50; Clark & Watson, 1995). The inter-item correlation of the Prosocial actions was slightly over the desired value, which suggests that the items of this scale are more closely related, measuring a more narrowed construct. The internal consistencies of Emotion Recognition and Emotion Regulation scales were acceptable, and the inter-item correlations were within the ideal range. The internal consistency of the Emotion Vocabulary scale was good, and the inter-item correlation value was also within the ideal range.

Table 2. Descriptives and internal consistencies of the three EmQue scales; emotion recognition, emotion regulation and emotion vocabulary scales.

	N	No. items	Range	Cronbach's Alpha	Mean inter-item correlation	Mean Total (SD)
			Empathy Questionnaire			
Emotion contagion	181	5	1 – 5	.73	.34	1.44 (.69)
Attention others' emotions	181	6	1 – 5	.78	.37	2.48 (.66)
Prosocial actions	181	4	1 – 5	.85	.59	2.13 (.83)
			Emotion Expression Questionnaire			
Emotion Recognition	181	6	0 – 4	.70	.28	2.87 (.60)
Emotion Regulation	181	12	0 - 4	.70	.16	1.45 (.43)
			Emotion Vocabulary Questionnaire			
Emotion Vocabulary	178	20	0 -1	.85	.23	.66 (.20)

Group differences in empathy, emotion recognition and emotion regulation

Independent samples t-tests showed that mean scores on the three empathy scales did not differ between the DHH and hearing group (see Table 3). Furthermore, DHH and hearing preschoolers also did not differ on their emotion recognition ($t = 2.86$, $p = .367$) and emotion regulation skills ($t = 1.43$, $p = .098$) reported by caregivers.

Table 3. T-test results comparing the three EmQue levels, emotion recognition and emotion regulation between hearing and DHH preschoolers

	Mean Hearing (SD)	Mean DHH (SD)	t-test	p
	Empathy Questionnaire			
Emotion contagion	1.41 (.67)	1.57 (.80)	-1.26	.104
Attention others' emotions	2.49 (.67)	2.42 (.63)	.43	.333
Prosocial actions	2.12 (.81)	2.20 (.91)	-.53	.286
	Emotion Expression Questionnaire			
Emotion Recognition	2.86 (.56)	2.90 (.76)	2.75	.367
Emotion Regulation	1.43 (.41)	1.54 (.49)	6.35	.098

Unique contribution of emotion recognition and regulation

As shown in Table 4, emotion vocabulary was correlated to prosocial actions. Therefore, this factor was included in the hierarchical regression analyses. Table 5 shows the results of the hierarchical regression models. In the first step, group, emotion recognition, emotion regulation, and emotion vocabulary were entered. In the models for emotion contagion and for attention to others' emotions, no effects of emotion recognition, regulation and vocabulary were observed. Adding group interaction terms in the second step did not improve the model fits, suggesting that this lack of effects was similar between groups.

Table 4. Correlations between the three levels of empathy, hearing age, language related factors, and emotion vocabulary for the total group (DHH/Hearing).

	Emotion Contagion	Attention to Others Emotions	Prosocial Actions
Hearing Factors	- .02 (.05 / .04)	- .03 (-.05/ -.07)	.09 (-.18/ .22)
Hearing Age	- .02 (.05 / .04)	- .03 (-.05/ -.07)	.09 (-.18/ .22)
Hearing Device	.07 (-.08 / -)	- .01 (.13 / -)	.07 (-.18 / -)
Degree of Hearing Loss	.08 (-.04 / -)	- .03 (.13 / -)	.05 (.15 / -)
Language indices			
Emotion Vocabulary	.04 (.05 / .09)	.12 (.17 / .11)	.15* (.20 / .17*)
Language Comprehension	- .19 (-.34 / .02)	.04 (-.01 / .03)	.16 (.01 / .31)
Language Production	- .22 (-.32 / -.02)	-.01 (-.10 / -.01)	- .07 (-.25 / .20)
Language Pragmatics	.04 (.06 / .10)	.07 (.16/ -.00)	.14 (. 02/ .22)

* p < .05 ; ** p<.01;

In the model for prosocial action (Table 5) we observed effects of emotion recognition , b = .22, 95% CI [.03, .42], emotion regulation, b = -.32, 95% CI [-.59, -.05], and emotion vocabulary, b = .73, 95% CI [.08, 1.37]. These outcomes suggest that children with better emotion recognition, regulation and vocabulary show more prosocial actions. Adding group interaction terms did not improve the model fit

Table 5. Hierarchical regression analyses with emotion recognition, emotion regulation and emotion vocabulary

	Emotion Contagion			Attention to Others Emotions			Prosocial Actions		
	b	p	95% CI	b	p	95% CI	b	p	95% CI
Step 1		$R^2 = .023$			$R^2 = .029$			$R^2 = .088$**	
Group	.19	.199	[-.10, .49]	.03	.845	[-.25, .31]	.22	.190	[-.11, .55]
Emotion Recognition	.00	.961	[-.18, .17]	.13	.108	[-.03, .30]	.22	.026	[.03, .42]
Emotion Regulation	.16	.193	[-.08, .40]	-.01	.964	[-.24, .23]	-.32	.021	[-.59, -.05]
Emotion Vocabulary	.30	.311	[-.28, .87]	.39	.160	[-.16, .93]	.73	.027	[.08, 1.37]
Step 2		$\Delta R^2 = .021$			$\Delta R^2 = .009$			$\Delta R^2 = .006$	
Group	-1.00	.126	[-2.52, .31]	.41	.555	[-.95, 1.76]	-.36	.834	[-1.96, 1.25]
Emotion Recognition	-.11	.296	[-.31, .10]	.13	.189	[-.06, .32]	.16	.182	[-.07, .39]
Emotion Regulation	.11	.441	[-.17, .38]	.07	.593	[-.19, .34]	-.32	.047	[-.63, .00]
Emotion Vocabulary	.32	.280	[-.26 , .89]	.34	.217	[-.20, .89]	.72	.041	[.07, 1.37]
Group x Recognition	.36	.066	[-.02, .74]	.04	.816	[-.32, .41]	.23	.280	[-.20, .67]
Group x Emotion Regulation	.17	.559	[-.41, .75]	-.34	.228	[-.90, .21]	-.06	.812	[-.72, .59]

* p < .05 ; ** p<.01

Differences and Similarities within the DHH group

To explore differences and similarities within the DHH group, further analysis were conducted between children with bilateral cochlear implants (n = 18; Mage = 57.17 months, SD = 10.22 months) and bilateral hearing aids (n = 10; Mage = 60 months, SD = 12.02). Results showed that CI and HA children differed in their hearing age (t = 2.13, p = .04), with children with CI having a higher hearing age (Mage = 41.5 months, SD = 9.30 months) compared to children with a HA (Mage = 32.60, SD = 12.75 months). No differences appeared regarding language indices, empathy levels, emotion recognition, emotion regulation and emotion vocabulary within the DHH group.

DISCUSSION

Empathy serves an important guidance for children's social interactions. Being empathic allows children to synchronize with others' emotional states, triggers concern and supporting behaviors, thus creating opportunities for social bonding, and for deeper interpersonal connections (Davidov et al., 2020; Hoffman, 1987, 2001). Although empathy is partially innate, social interactions shape how adaptive children put their empathy into practice over time. As it is widely known, social learning does not come easy to all children due to certain limitations or barriers in the (social) environment, as it is often a daily reality for DHH children, which in turn, could impact their empathy development, and which was the focus of this study. Our results partially confirmed our assumptions, whereas some unexpected findings also arised.

First, as expected, emotion contagion and attention to other's emotions did not differ between DHH and hearing children. Yet, unexpectedly, both levels of empathy were unrelated to emotion recognition or emotion regulation. Second, unexpectedly, DHH children showed equal levels of prosocial actions compared to their hearing peers. As expected, more prosocial actions were associated with better emotion recognition and emotion regulation in both groups. Third, as expected, language comprehension, production and pragmatics were unrelated to the three empathy scales. Yet, emotion vocabulary contributed to the prediction of prosocial actions in both groups. Additionally, hearing factors were unrelated to the three empathy levels. Implications of these findings will be further explored below.

Importantly, in the current study, all 3 levels of empathy were similar in DHH and hearing peers. Note that in previous studies, in which DHH children scored lower on prosocial actions compared to their hearing peers, a large percentage of the DHH children received hearing intervention only in one ear (33% in Netten et al., 2015; 20% in Tsou et al., 2021) and were implanted after 2 years of age (3.6 years in Netten et al., 2015; 2.5 years in Tsou et al., 2021), whereas all children in our sample were treated earlier and bilaterally (Table 1). This difference in the time and mode of intervention between samples, is a reflection of different views regarding early intervention of DHH children that changed over time. For many years the policies and insurance schemes for early hearing intervention were reserved for children over the age of two, and prioritized restoring the hearing of the more affected ear, which was seen as more cost-effective (Bond et al., 2009; Harrison et al., 2003; Van de Heyning et al., 2022). However, recent guidelines now not only advocate for intervention before 12 months of age for all DHH children, but also emphasize bilateral rehabilitation as the preferable intervention for DHH children with bilateral hearing loss offers better auditory and developmental improvements to DHH children, and some countries - but not all - have changed their policies accordingly (NICE, 2019; Van de Heyning et al., 2022).

Research has shown that DHH children who have access to early auditory restorative intervention show better outcomes in their language and neurocognitive development (Geers & Nicholas, 2013; Naik et al., 2021; Nikolopoulos et al., 1999). Although research has yet to look into the contribution of early versus later intervention for socio-emotional development of DHH children, it seems plausible to assume that early intervention promotes better access to children's social world, and thus better outcomes in their language development and other areas of development that require social learning. Furthermore, children with only unilateral hearing have lower speech perception, more difficulties in locating where sounds are coming from, and rely more on visual cues to gain access to social information, compared to children with bilateral hearing (see Gordon et al., 2013, for a review). All these factors might also hinder children's opportunities for social learning if the hearing environment is unaware of these often invisible barriers and thus unable to take precautions and facilitate also DHH children with better access to their social world. Considering that preschoolers' social interactions during recess are rarely one-on-one, and occur in areas with noisy backgrounds, the social participation of DHH children with a single hearing device could have been even more affected compared to

children with bilateral hearing (Gordon et al., 2013; Grieco-Calub & Litovsky, 2010; Salloum et al., 2010).

While language production, comprehension and pragmatics were unrelated to the three empathy levels, emotion vocabulary was positively associated with prosocial actions, over and above children's levels of emotion recognition and regulation, respectively. Compared to the other language indices used in this study, emotion vocabulary goes beyond general language skills, because it more specifically targets children's understanding and use of emotions and mental states (Ketelaar et al., 2015). Especially the use of a mental states vocabulary is a clear indication that children can distinguish between different perspectives on reality, or a so-called Theory of Mind (Ketelaar et al., 2015; Peterson, 2004; Premack & Woodruff, 1978). Prosocial actions may become more effective when they are not idiosyncratic, as usually observed in very young children, but instead based on the needs of the person in distress, which indeed requires Theory of Mind (Qiu et al., 2024).

LIMITATIONS AND FUTURE DIRECTIONS

The current study compared DHH and hearing preschoolers' empathic skills and their association with emotion recognition and emotion regulation. Our findings allowed us to understand that DHH children who receive early hearing intervention bilaterally do not differ from their peers regarding the aforementioned emotion skills, which stress the idea that early, and adequate, intervention can serve children with better access to their social world, thus increasing their opportunities for social learning. Nevertheless, some considerations are needed when interpreting our results.

First, our results may not be generalized to all DHH children, as this group is very heterogeneous. DHH children in our group all received early and bilateral intervention and used oral language as their primary method of communication, which means that they benefited from more restorative and therapeutic interventions than DHH children with other characteristics (e.g., with mild/moderate/unilateral hearing loss; or receiving intervention in one ear only). Thus, differences in the DHH samples may lead to different developmental paths, as for example is suggested by our finding regarding prosocial actions. Thus, future studies may further examine the impact of unilateral or bilateral implantations on children's access to social learning, group dynamics and their prosocial

development in particular. Additionally, we need to consider that the socioemotional aspects focused on our study might develop and manifest differently in DHH children who are exposed to natural sign language from early ages, and have other DHH peers and adults in their social network, as they might be less likely to face the barriers that DHH children in the current study face, regarding exposure to social learning and social participation in the peer group. Therefore, we suggest that future studies recruit a larger sample size, including a more heterogeneous group of DHH children, thus allowing us to better understand how this variability impacts empathy, emotion recognition and emotion regulation, and the associations between them.

Second, our study was cross-sectional, which prevents us not only from drawing any causal relations, but also from understanding whether our outcomes maintain stable over time or are only applicable to the preschool ages. We suggest that future studies apply a longitudinal approach, thus allowing us to understand the developmental trajectory and over-time associations between empathy, emotion recognition and emotion regulation.

Third, the main variables of this study (i.e., empathy, emotion recognition and emotion regulation) were all collected through parent reports, thus we had a single-informant design. Previous studies have shown that caregivers of children from clinical groups can be more biased when reporting on their child's emotional competence, which could have influenced reports from our DHH children. Therefore, future studies should collect data from different methods and informants (e.g. playground observations, tasks, teacher reports), to reduce possible bias on the results.

Fourth, this study focused on children's emotional functioning, and we discussed the importance of access to the social environment for children to develop these aspects to their full potential. Yet, these opportunities are not equal for DHH and hearing children if adaptations are not made to better facilitate DHH children, i.e. special paneling or tiles to provide better acoustics. Future studies could combine aspects in the built and / or social environment and examine how certain adaptations provide better access for different children.

CONCLUSION AND CLINICAL IMPLICATIONS

The current study shows a positive scenario of DHH preschoolers in comparison to their hearing peers. Although the DHH children in our study showed lower language abilities than their hearing peers, they showed similar levels on the three emotion skills (i.e. empathy, emotion recognition, and emotion regulation). Furthermore, no differences appeared regarding language and emotional functioning between CI and HA users. This suggests that DHH preschoolers, regardless of their type of intervention, need more support regarding their general language abilities, and - for example - they might need better hallways or classrooms so that also DHH children can participate in small talk with their peers during the informal time in school, similar to their hearing peers. Yet, it is important to note that the DHH children seem able to overcome their hindered linguistic access to the social world, and match their hearing peers on their emotional competence. The fact that all DHH children in our study received early hearing intervention bilaterally might have contributed to these positive outcomes and give DHH children better opportunities for social learning. Nevertheless, it is equally important to focus on possible adaptations to children's environment needed to facilitate opportunities for social learning.

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