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ORIGINAL PAPER

The Quality of the Parent-Child Relationship and Social Functioning in Deaf or Hard-of-Hearing and Typically Hearing Children

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Abstract

The parent-child relationship (PCR) is likely the first close bond most children form during childhood. Yet, hearing loss in early childhood can make these interactions, particularly regarding emotional bonding, challenging for parent-child dyads in which the parent is hearing. The aim of this study was to examine the PCR quality in Chinese deaf or hard-of-hearing (DHH) and typically-hearing (TH) children, and its relationship with children's social functioning. This study consisted of 103 Chinese DHH and 138 TH children aged 2 to 7 years (mean age = 4.82 years, SD = 1.21). Parents, who were all hearing, completed the Child-Parent Relationship Scale (positive interactions; conflict; dependency (Pianta et al., 1991) and both parents and teachers the Strengths and Difficulties Questionnaire (externalizing behaviors; social competence (Goodman, 2001). DHH children's parents reported similar levels of parent-child conflict and dependency as TH children's parents, but fewer positive interactions. This group difference disappeared when parents' socioeconomic status was controlled for. For all children, no association appeared between parent-child positive interactions and children's social functioning, but more parent-child conflict and dependency were associated with lower social competence and more externalizing behaviors. The results showed that PCR quality was consistent across all children and similarly linked to their social functioning. These outcomes shed light on the role of parent-child interactions in children's social functioning, underscoring the prominence of future research and early interventions. DHH children and their (hearing) parents and/or families with lower SES may benefit from more joint leisure activities to build positive bonding.

Highlights

- This study provides novel findings on preschool DHH children's attachment with parents, and its effect on social functioning.
- DHH children presented similar levels as their peers on conflict and dependency with their parents.
- DHH children and parents had fewer positive interactions (which was also linked to lower SES), which may be improved by increasing leisure activities for these dyads.

Keywords Parent-child attachment · Parent-child conflict · Social competence · Externalizing behavior · Hearing loss

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The parent-child relationship (PCR) is a reciprocal exchange of a combination of behaviors, feelings, and expectations unique to each parent-child dyad (e.g., Driscoll & Pianta, 2011; Rieffe et al., 2024). This sets a natural context in which parents model appropriate social behaviors, guide children in processing social information, and teach them to read social cues, all of which contribute to the development of children's social skills and functioning (Driscoll & Pianta, 2011; Eisenberg et al., 2001). This PCR starts even before birth and is the first social connection for children, forming the foundation for their future relationships (Bowlby, 1979). A unique aspect of the preschool age is that children gradually turn into an individual who can more actively engage in interaction with parents, but also with peers, internalize what is experienced, and through which they learn how to make sense of themselves and others (Pinto et al., 2015). Importantly, children also go through a critical phase in their development of social cognition and language/communication during this stage of life (Coyl et al., 2010). Therefore, during these preschool years in particular, parents focus more on their children's emotional and social skills, thus transmitting important social and cultural values (Bornstein et al., 2008).

However, this path may be less straightforward for deaf or hard-of-hearing (DHH) children born to hearing parents and raised in hearing communities, as they often have limited access to social interactions in predominantly hearing environments compared to their hearing peers (Rieffe et al., 2015). DHH children in hearing environments must rely on both visual and auditory cues to process information. For example, good lighting allows DHH children to clearly see the speaker's face, which is essential for better understanding and engagement in the conversation (Li & Prevatt, 2010). However, in noisy settings where multiple people are talking, it becomes challenging for DHH children to identify and locate the speaker and hear what is being said (Li & Prevatt, 2010). The challenges that DHH children experience daily in accessing the social world are often invisible and can cause misunderstandings during interactions with their hearing parents or missing out on overhearing family conversations (Ketelaar et al., 2022). Additionally, initial disruptions in the PCR can arise from frustrations and misunderstandings during communication between hearing parents and their DHH child (Barker et al., 2009; Brubaker & Szakowski, 2000). These challenges often occur when adapting to new routines or accessing support services, such as speech therapy, hospital checkups, and assistance with educational needs (Calderon & Greenberg, 2011).

Given that hearing loss affects around 1-1.7:1000 infants worldwide at birth (Dirks et al., 2016; Mehra et al., 2009), and that more than 90% of the DHH children are born to hearing parents (Most & Michaelis, 2012), it is crucial to further understand how hearing parents and DHH children form their bond. These hearing parents of DHH children may have limited knowledge about deafness, including available communication options that can be used with their child, and lack experiences with Deaf culture and the broader Deaf community (Calderon & Greenberg, 2011). Therefore, this study aimed to examine PCR quality in DHH and hearing children with their hearing parents, revealing both positive and negative qualities that could affect parent-child attachment. Moreover, this study also aimed to understand how these relationships can subsequently influence children's social functioning at this critical learning stage during the preschool years (Coyl et al., 2010).

Importance of the Parent-Child Relationship (PCR) and Child Attachment

From an early stage, a connection is formed between the parent and child. The nurturance of this bond starts from small non-verbal to verbal signals between the two, forming the base of all PCRs, also known as attachment (Bowlby, 1979). Bowlby and Ainsworth (1979), the pioneers of the attachment theory, highlighted how parent-child attachment influences children's perception of their parents' responsiveness and sensitivity. This in turn affects children's sense of the self and feelings of self-worth when interacting with others and forming relationships, regardless of friendships or romantic relationships (Ashori &Aghaziarati, 2023; Bowlby, 1979). A secure parent-child attachment forms a safe base for children to learn and practice their social skills such as sharing, being kind, and resolving conflicts with others (Bowlby, 1979). In contrast, an insecure attachment between parent and child characterized by low self-esteem, hostility, and disputes could teach children inappropriate ways to resolve problems or build tempestuous relationships with others (Badovinac et al., 2021; Lv et al., 2022; Zhang, 2010). Based on the attachment theory, Driscoll and Pianta (2011) proposed a model with three components to characterize the quality of PCR, consisting of parent-child positive interactions, parent-child conflict, and parent-child dependency. Notably, Driscoll & Pianta's model is focused on the parent's perceptions of parent-child attachment, addressing its multidimensional nature, as developed through daily interactions (also see Table 1 for a summary).

Parent-child positive interactions are evaluated by the extent to which the parents and children share a relationship that is characterized by security, reciprocal comfort, supportiveness, affection, and openness (e.g., Okorn et al., 2022; Pastorelli et al., 2016); they are in-tune with each other and value the relationship highly (Driscoll & Pianta, 2011). During positive interactions, parents and children are

Table 1 Summary of literature review on parent-child relationship (PCR) quality

PCR quality dimensions	Definition	Group differences in the literature	Association with children's social functioning
Parent-child positive interactions	Parent-child interactions characterized by security, reciprocal comfort, supportiveness, affection, and openness	*Parent reports on parenting behaviors*: DHH = TH *Observations on dyadic interactions*: DHH < TH	*Association with social competence*: - DHH: Positive - TH: Positive *Association with externalizing behaviors*: - DHH: None - TH: Negative
Parent-child conflict	Discordant parent-child interactions during which both parent and child display negative behaviors and affect towards each other	*Parent reports on child being more difficult, demanding, and showing more negative behaviors*: DHH > TH *Parent reports on verbal and physical punishment*: DHH = TH	*Association with social competence*: - DHH: No studies - TH: Negative *Association with externalizing behaviors*: - DHH: No studies - TH: Positive
Parent-child dependency	Child leans on the parent too often and is averse to separation, and parents overthink about their child in daily life	*Parent reports on overprotection*: DHH > TH	*Association with social competence*: - DHH: No studies - TH: Negative *Association with externalizing behaviors*: - DHH: No studies - TH: Positive

Note. DHH: Deaf and hard-of-hearing children; TH: Children with typical hearing

observed to share their feelings and daily lives with each other, enjoy quality time together, and engage in activities that include laughing and playing games (i.e., secure attachment) (Okorn et al., 2022; Pastorelli et al., 2016). Furthermore, parents are more likely to foster sharing and kindness in their social interactions (Pastorelli et al., 2016; Pianta et al., 1991). While this positive interaction between DHH children and their hearing parents has been examined by several studies, most studies using parent reports have primarily focused on the behaviors of the parents, such as parental responsiveness, warmth, support, and understanding, rather than the reciprocal nature of the parent-child interaction. These studies showed that hearing parents with DHH children reported similar positive parenting behaviors as those with hearing children (Brubaker & Szakowski, 2000; Ketelaar et al., 2017; Stika et al., 2015). However, observation studies reported less reciprocity, joint engagement, and responsiveness within hearing parent-DHH child dyads (Barker et al., 2009; Dirks & Rieffe, 2019; Paradis & Koester, 2015). This disparity in findings indicates that to fully understand PCRs, it is important to examine reciprocal communication and interaction between the parent and child, rather than focusing solely on parenting styles or behaviors.

Parent-child conflict is characterized as discordant interactions (e.g., anger, punishment, child tantrums), during which both parent and child display negative behaviors and affect towards each other (e.g., McKee et al., 2007; Ostrov & Bishop, 2008; Theunissen et al., 2015). Certainly, some conflict can be beneficial for a family to learn and grow together, but excessive conflicts and tension can lead to insecure bonding (Bowlby, 1979). For many DHH children living in predominantly hearing environments, difficulties in communicating with their hearing parents could arise as these parents may not have sufficient knowledge or experience with deafness (Paradis & Koester, 2015). Hence, parents may also feel limited in the methods with which they can interact with their children, which can teach them what they did wrong and how their behavior affected others (Eyuboglu et al., 2021). Furthermore, some hearing parents may also start doubting their own parenting skills, as they adjust their expectations on their child after diagnosis, although evidence suggests some of these difficulties may dissipate at a later stage (Calderon & Greenberg, 2011). These factors aggregate potential reasons why conflict could build up in the relationship between DHH children and hearing parents more than in hearing children and their hearing parents. However, previous studies rarely directly measured conflicts in daily interactions between DHH preschool children and their hearing parents. Empirical studies on parental behaviors showed that hearing parents rated their DHH child as more difficult, demanding, and exhibiting more negative behaviors, compared to hearing peers (Barker et al., 2009; Sarant & Garrard, 2013; Spahn et al., 2003), whereas the levels of parental verbal and physical punishment were similar in both groups (Brubaker & Szakowski, 2000; Ketelaar et al., 2017). The higher chance of DHH children reacting negatively to their hearing parents could stem from the frustration in difficulty accessing their daily social environment, communicating their needs, and being misunderstood (Barker et al., 2009; Calderon & Greenberg, 2011).

Lastly, *parent-child dependency* is observed when the child leans on the parent too often and is averse to separation, whilst parents tend to excessively overthink about their child within their daily life (e.g., Clark & Ladd, 2000;

Locke et al., 2012). Too much dependency is maladaptive and can lead to insecure attachment for the child (Bowlby, 1979). When parents and children overly rely on each other for approval, validation, and emotional support, separation causes heavy emotional distress for both; as a result, children's chances of exploring the world and interacting with their peers can be limited (Bowlby, 1979). Although we found no current literature directly exploring the dependency in PCRs for DHH children, many hearing parents of DHH children are consistently reported being more protective of their children, compared to parents of hearing children (Eyuboglu et al., 2021; Pinquart, 2013). Parental overprotection is the degree to which parents are concerned about and strive to prevent disappointment and problems for their child; they also have a strong need to know what is happening internally for their child (Van Dijk et al., 2014). Parents of DHH children show a tendency to "take on" their child's problems, which may in turn limit DHH children's abilities to learn how to resolve problems themselves (Calderon & Greenberg, 2011). In addition, parent interviews reveal that some parents of DHH children spend a large portion of time participating in children's rehabilitation and educational needs, which leaves them less room for other work or personal activities (Park & Yoon, 2018).

Linking Quality of the PCR To DHH Children's Social Functioning

Social functioning is the ability to establish high-quality and mutually satisfying social interactions with others. To build up young children's overall social functioning, it is critical to integrate into a social circle and build successful and meaningful relationships with peers; but also, to be able to manage their outward behaviors (externalizing behavior) when the access to social interactions is interrupted or when encountering stressful situations (APA Dictionary of Psychology, 2018). Therefore, in this study we particularly focus on two key components of social functioning, which are social competence (prosocial behaviors/peer relations) and externalizing behavior (Welsh et al., 2000). The PCR is the feeding ground of information in building children's social functioning, as they learn many of these skills at home before they even enter the school (APA Dictionary of Psychology, 2018).

For young children to become socially competent, they must be able to evaluate social situations, recognize feelings and intentions of others, and – based on that evaluation - determine what is expected or required and react with appropriate social behaviors (APA Dictionary of Psychology, 2018). Yet, preschool DHH children often experience obstacles in their access to social participation due to a lack of sufficient support and appropriate accommodations in their environment. For example, DHH children can easily miss out information when it is not explicitly conveyed or when their attention is not directed to it. In an environment with background noises and/or multiple talkers, social participation can be even more challenging for DHH children (Broekhof et al., 2018; Rieffe et al., 2015). These barriers may hinder DHH children from learning social norms in their daily environment and developing socioemotional skills to their full capacity (Broekhof et al., 2018; Rieffe et al., 2015). Moreover, since children predominantly learn from their parents and model after them, parents lacking a full understanding of how to effectively communicate with their DHH child can also pose challenges for DHH children's social functioning (Calderon & Greenberg, 2011).

Many studies indicated lower levels of social functioning in DHH children than in hearing children. DHH children seem to exhibit more externalizing behaviors, which are outward behaviors in reaction to stressors, and are maladaptive, directed to another person(s) and/or the environment, such as inattention, temper tantrums, or aggressive behaviors when being provoked or feeling threatened; and lower social competence accompanied by fewer prosocial actions like sharing or comforting (Eyuboglu et al., 2021; Niclasen & Dammeyer, 2016; Zaidman-Zait, 2020). These externalizing responses in DHH children could stem from their uncertainty in social situations, a lack of understanding of what is happening around them, and frustration from miscommunication; all of which can lead to feelings of being misunderstood and frustration (Calderon & Greenberg, 2011).

Overall, prior research on the association between the PCR quality and children's social functioning focused mainly on hearing children, whilst there is still much to learn about this association in DHH children. First, regarding positive parent-child interactions, to the best of our knowledge, there has only been one explorative study on preschool DHH children, showing that positive parent-child interactions were related to better social competence (Sarant & Garrard, 2013), which is in line with the trend found in hearing children (Ferreira et al., 2016; Paulus et al., 2016; Nicols et al., 2019). It is also well established in hearing children that positive interactions with parents can protect children from developing externalizing behaviors (Zhang, 2010; Pianta et al., 1991). However, for preschool DHH children, this association is less clear in the literature. One study by Brubaker and Szakowski (2000) showed no relation between positive parent-child interactions and DHH children's externalizing behavior. The authors of this study argued that hearing parents with a DHH child possibly less often talk with their DHH child about socially appropriate behaviors and expectations.

Second, in studies conducted with hearing children, more frequent parent-child conflicts and higher levels of dependency related to lower social competence and more externalizing behavior in children (Cussen et al., 2012; Climie & Mitchell, 2016; Michiels et al., 2010). Yet, to our knowledge, no studies have examined how parent-child conflicts and parent-child dependency may relate to social functioning among DHH children specifically. This was based on our literature searches in Web of Science (October 2025) using combinations of the terms: deaf and hard-of-hearing children, parent-child conflict, dependency, and social functioning, which yielded no relevant empirical studies. Therefore, thus far no concrete evidence is available to suggest the difference in how PCR quality is linked to children's social functioning between DHH children and their hearing peers.

Present Study

The relationship between children and their parents plays a critical role in children's development of social functioning, and further understanding on this area for DHH children is needed. Specifically, more attention should be given to the different dimensions of parent-child interactions that influence the emotional bond between them. Moreover, the majority of the existing literature is based on evidence from Western samples, which might not be applicable to other cultural contexts, highlighting the need for more research from different cultural perspectives.

In China, according to the Second National Sample Survey on Disability (2006), approximately 137,000 children aged 0–6 years had hearing loss at that time. China has an established early hearing detection and intervention system. National newborn hearing screening enables most children with hearing loss to be diagnosed within the first few months of life. Families of affected children are eligible for government-subsidized early intervention services, including financial assistance for hearing aids, cochlear implants, and rehabilitation training. As a result, many children begin using hearing devices around one year of age and enter rehabilitation programs shortly thereafter. For children whose only disability is hearing loss and who receive timely and consistent intervention, it is common to transition into mainstream kindergartens or early education programs after about one year of intensive rehabilitation. Early intervention services are available at local, provincial, and national centers.

The present study, which is part of a larger project on the socioemotional development of DHH and typically hearing (TH) preschoolers in China (Li et al., 2025a, 2025b; Yuen et al., 2022), should be considered exploratory. Rather than formally testing hypotheses, we examined associations between PCR quality and children's social functioning within a convenience sample of families attending one rehabilitation center, where most of the DHH children received a hearing aid (HA) and/or cochlear implant (CI) and had a mild hearing loss when aided. First, we examined the extent to which the quality of the PCR (i.e., positive interactions, conflict, and dependency) differed between DHH and TH groups. Using the Child Parent Relationship Scale (Pianta et al., 1991; CPRS), which includes items that address the behaviors of both parents and children, we addressed these aspects based on parent perceptions (Loots & Devise, 2003). It was expected that the (all hearing) parents with DHH children would report fewer positive parent-child interactions (Holt et al., 2020), and higher levels of parent-child conflict and dependency compared to parents with TH children (Barker et al., 2009; Eyuboglu et al, 2021; Pinquart, 2013; Sarant & Garrard, 2013).

Second, we examined the extent to which the quality of the PCR is associated with DHH and TH children's social functioning (i.e., social competence, and externalizing behavior). It was expected that more positive parent-child interactions would relate to higher social competence in both DHH and TH children (Sarant & Garrard, 2013), and to fewer externalizing behaviors only for TH children (Pianta et al., 1991). For DHH children, based on a study by Brubaker and Szakowski (2000) which included a large sample of families with the same age-range of children (3–7 years old in their study), we expected no relation between positive parent-child interactions and externalizing behaviors in DHH children. Moreover, based on the current literature, we expected that more parent-child conflict and higher dependency would be related to lower social competence, and more externalizing behavior in both groups (Climie & Mitchell, 2016; Cussen et al., 2012; Michiels et al., 2010). We expected the strength of these associations to be stronger in DHH children than in TH children, based on our predictions that DHH children would present with higher levels of parent-child conflict and dependency.

Methods

Participants

One hundred and three DHH and 138 TH children aged 2 to 7 years (mean = 4.82, *SD* = 1.21), their hearing parents, and their teachers were recruited from a school that is embedded within a hearing and speech rehabilitation center in China Rehabilitation Research Center for Hearing and Speech Impairment. Inclusion criteria for DHH children were (1) pre-lingual hearing loss (before their third year of age), with a minimum of

40 decibels hearing loss in the better ear; (2) normal cognitive functioning (as indicated by teachers or medical doctors at the center, and non-verbal intelligence scores); (3) no additional disorder or disabilities; (4) having hearing parents.

The majority of the DHH children in this study had severe to profound hearing loss (80%) when unaided. After receiving a hearing aid (HA) and/or a cochlear implant (CI), the mean aided hearing threshold of the better ear was 34.8 dB HL, with 92% of the children falling within the range of mild hearing loss. Most DHH children received at least one CI (68%) at a mean age of 2.1 years; among them, 18% had bilateral CIs, and 47% had a CI in one ear and a HA in the other, which they wore on a regular basis (see Table 2 for participant characteristics and Appendix A for more details about the hearing profile of the DHH children). Notably, we applied cognitive functioning as an explicit inclusion criterion because delays in this area could influence children's social behaviors, making it difficult to interpret the outcomes of interest in this study. This approach is inline with earlier studies on DHH children's social-emotional functioning, where children with lower cognitive functioning are typically excluded to ensure the results reflect the role of hearing status rather than global developmental delay (e.g., Ketelaar et al., 2017; Netten et al., 2018; Tsou et al., 2021).

Non-verbal intelligence scores of DHH and TH children were obtained from the records of the center, where the children were tested by either the Griffiths Mental Development Scales (Tso et al., 2017) or the Hiskey-Nebraska Test of Learning Aptitude (Yang et al., 2011). These two different scales were age equated using their developmental quotients to obtain a score for each participant. DHH children did not differ from TH children in the non-verbal intelligence scores (see Table 2). In addition, for DHH children only, receptive and expressive language skills were assessed upon entry to the center using the Look & Talk and Listen & Recognize subtests from the Standards and Methods of Auditory & Language Skill Assessment (Lu & Qin, 2018). These language assessments were used to document DHH children's developmental level at entry but were not included as study variables.

TH children in the center typically do not have special needs. They were included in the study when they met the following criteria: (1) normal cognitive functioning (as indicated by teachers at the center and non-verbal intelligence scores); (2) no disorder or disability; (3) having hearing parents.

Originally, 252 children had been approached to join this study, but six children were two standard deviations below the mean for the non-verbal IQ score, and five other children had DHH parents, which did not fit the inclusion criteria of this study and were thus excluded. Therefore, 241 participants were eventually included in the analysis of this study. The included sample ($n=241$) and the excluded sample ($n=11$) differed only in the level of maternal education, where the included sample had mothers who achieved slightly higher levels of education than the excluded sample, $t(238)=2.12$, $p=.035$. Additionally, DHH and TH children differed on the three SES variables, i.e., their mother's education, $t(239)=3.78$, $p<.001$, father's education, $t(239)=3.22$, $p<.001$, and household income, $t(239)=8.34$, $p<.001$, where TH children had a higher SES (see Statistical Analyses for how this was controlled for in this study).

DHH children typically attend the program at the center for one year. At the time of data collection, it was common in China for young DHH children to temporarily relocate and attend intensive, year-long rehabilitation programs at higher-level centers, even though doing so often required additional financial resources and logistical support. The participating rehabilitation center in this study is a national-level institution. Many families had moved from other regions to access its specialized services during their child's early intervention period. After completing the program, families typically returned to their hometowns and enrolled their children in local kindergartens or continued follow-up rehabilitation near home.

The center-affiliated kindergarten offered integrated and DHH only classes. The integrated classes consist of mostly TH children and DHH children who are almost on par with TH children after hearing and speech rehabilitation. The integrated classes follow a curriculum similar to a typical kindergarten, with some DHH children receiving additional individual rehabilitation classes depending on their needs. For the children in the DHH only classes, they also follow a curriculum similar to a typical kindergarten, but they attend daily individual rehabilitation classes that follow five specific categories: hearing perception, language comprehension and expression, speech production, cognitive development, and social communication skills.

Teachers in the center all have a background in special education and/or rehabilitation, and they receive advanced training to work with DHH children as soon as they started working at the center. Teachers provide regular feedback on the DHH children's class performance to the rehabilitation experts. Recruiting both groups from the same educational setting allowed us to hold constant key environmental factors (e.g., classroom structure, teacher training, educational philosophy). The rehabilitation program itself was not the goal of investigation of this study. Rather, our aim was to explore how PCRs and children's socioemotional functioning were related among DHH and TH children within this shared context.

It should be noted that rehabilitation at the Centre follows a family-centered approach based on the principle that parents are the primary agents of their child's rehabilitation. Parents of DHH children are therefore expected to

Table 2 Characteristics of the Sample (N=241)

	DHH (*n*=103)	TH (*n*=138)
Personal Characteristics		
Age, years, mean (*SD*)	4.82 (1.43)	4.82 (1.02)
Gender, *n* (%)		
Male	60 (58.3)	65 (47.1)
Female	43 (41.7)	73 (52.9)
Non-verbal intelligence score[e], mean (*SD*)	0.4 (0.8)	0.5 (0.8)
Unknown, n (%)	17 (16.5)	12 (8.7)
***Socioeconomic Status**, n (%)*		
Maternal Education** [b]		
Primary	1 (1.0)	3 (2.2)
Secondary	25 (24.3)	20 (14.5)
Tertiary	62 (60.2)	60 (43.5)
Postgraduate	10 (9.7)	51 (37.0)
Unknown	5 (4.9)	4 (2.9)
Paternal education* [b]		
Primary	0	2 (1.4)
Secondary	30 (29.1)	21 (15.2)
Tertiary	53 (51.5)	64 (46.4)
Postgraduate	14 (13.6)	47 (34.1)
Unknown	6 (5.8)	4 (2.9)
Net household income** [c]		
<€20,000	55 (53.4)	27 (19.6)
€20,000-€40,000	18 (17.4)	36 (26.1)
€40,000-65,000	6 (5.8)	33 (23.9)
€65,000-€130,000	5 (4.9)	16 (11.6)
>€130,000	0	4 (2.9)
Unknown	19 (18.4)	22 (15.9)
Hearing Characteristics		
Age of Identification, years, mean (*SD*)	1.12 (1.25)	
Hearing device, *n* (%)		
CI (cochlear implant; unilateral / bilateral)	3 (2.9) / 19 (18.4)	
CI and HA (hearing aid)	48 (46.6)	
HA only	24 (23.3)	
Others or unknown	9 (8.7)	
Age of 1sthearing device, years, mean (*SD*)	2.9 (1.3)	
Total duration of hearing device, years, mean (*SD*)	2.4 (0.6)	
HA use, years, mean (*SD*)		
Age at HA fitting	1.8 (1.3)	
Duration of HA use	3.0 (1.2)	
CI use, years, mean (*SD*)		
Age at implantation	2.1 (1.3)	
Duration with (first) CI use	2.7 (1.0)	
Degree of hearing loss, *n* (%)		
Mild: 26-40dB	0	
Moderate: 41-60dB	9 (8.7)	
Severe: 61-80dB	19 (18.4)	
Profound: > 81dB	63 (61.2)	
Unknown	12 (11.7)	
Hearing thresholds, dB, mean (SD)		
Unaided hearing threshold (better ear)	88.1 (16.7)	
Unaided hearing threshold (worse ear)	96.4 (12.8)	
Aided hearing threshold (better ear)	34.8 (10.6)	
Aided hearing threshold (worse ear)	44.6 (17.0)	
Preferred mode of communication, *n* (%)		
Spoken language only	89 (85.4)	

Table 2 (continued)

	DHH (*n*=103)	TH (*n*=138)
Sign-supported Chinese	11 (10.7)	
Sign language only	0	
Unknown	3 (2.9)	
Language score[d], mean (*SD*)		
Language production (age in months)	19.6 (13.6)	
Unknown, *n* (%)	27 (26.2)	
Language reception (age in months)	28.9 (19.5)	
Unknown, *n* (%)	35 (34.0)	

Note: DHH = deaf and hard-of-hearing; TH = typical hearing; HA=hearing aid; CI=cochlear implant

[d] All language scores of the DHH sample were corrected by age and reflect developmental stage (months)

[e] IQ scores were evaluated using different IQ test tools, and were age-corrected and recoded based on their deviations from the grand population mean in the normative data: -2 = 2 *SD* below the mean; -1 = 1 *SD* below the mean; 0 = within 1 *SD*; 1 = 1 *SD* above the mean; 2 = 2 *SD* above the mean

** $p<.001$, * $p<.05$ between DHH and TH children

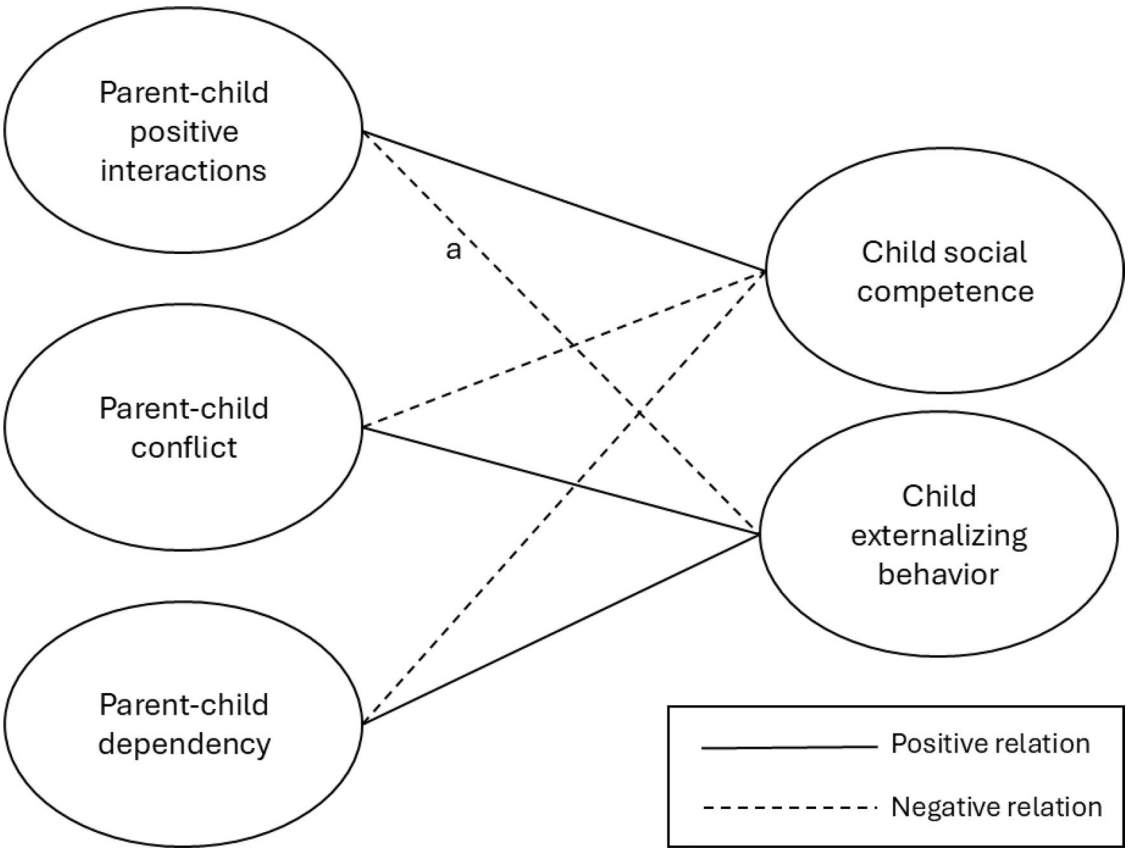

Fig. 1 Hypothetical Model for the relation between the quality of the PCR and children's social functioning. Note [a]for TH children. As for DHH children, based on the limited knowledge, we hypothesized no relations between positive parent-child interactions and externalizing behavior, or at least a less strong relation compared to TH children

learn and apply rehabilitation knowledge and skills to support their child's development throughout daily routines at home. They receive training in multiple formats. The Centre offers group training sessions, where rehabilitation teachers deliver lectures and demonstrations to groups of parents, as well as classroom observation, where parents observe their child's individual rehabilitation sessions, learn how therapists apply techniques and engage the child, and sometimes participate directly in structured activities to practice these skills. Furthermore, the Centre also facilitates home-based guidance, in which rehabilitation teachers visit families to provide individualized coaching on how to use everyday materials (e.g., household items, toys, or books) to promote rehabilitation in natural settings. The content of

parent training parallels the focus areas of children's rehabilitation, targeting the five domains mentioned above.

This study is conducted within a larger scale project examining social-emotional functioning in DHH Chinese children. Notably, although the sample used in this study might be similar to those in the previously published studies (Li et al., 2025a, 2025b; Yuen et al., 2022), this study marks the first to use this project's data to examine PCR quality and investigate its effect on children's social functioning.

Measures

Child Parent Relationship Scale (CPRS): Quality of Parent-child Relationship

This parent-report measure evaluates the parent's perception of the PCR through the reporting of the feelings and behaviors of both the child (3-12 years) and the parent during interactions (CPRS; Pianta et al., 1991). This 26-item measure is based on the attachment theory and the Attachment Q-Set. Three scales in this questionnaire are parent-child positive interactions (10 items; e.g., "I share an affectionate, warm relationship with my child"), parent-child conflict (12 items; "dealing with child drains my energy"), and parent-child dependency (4 items; "reacts strongly to separation from me"). Parents scored on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The CPRS was previously translated into Chinese and was deemed appropriate for use in the Chinese population (Zhang & Chen, 2010). The internal consistencies were adequate (see Table 3). Note that the parent-child dependency scale has a relatively low Cronbach's alpha (.56). We considered it acceptable because (i) an additional check on the average inter-item correlation showed a value of .23, which was within the acceptable range (.15-.50; Clark & Watson, 1995); (ii) the scale has only 4 items while covering different dependency-related behaviors of both parents and child, which was expected to result in a lower alpha (Berger & Hänze, 2015; Taber, 2018).

Strengths and Difficulties Questionnaire (SDQ): Children's Social Functioning

The SDQ was used to examine the social functioning of the preschoolers in this study. It has been used on children aged 1.5 years and older in the current literature (e.g., Gustafsson et al., 2016; Wiefferink et al., 2012). In this study, we used the validated Chinese version (Lai et al., 2010). It contains a total of 25 items scored on a 3-point scale: 0 = not true, 1 = somewhat true, 2 = certainly true. There are five scales with five items each to identify emotional and behavioral problems in children: Conduct Problems (e.g., "fights with others"), Hyperactivity-Inattention (e.g., "restless or easily distracted"), Emotional Symptoms (e.g., "many worries and often unhappy"), Peer Problems (e.g., "picked on or bullied"), and Prosocial Behavior (e.g., "considerate of others' feelings"). Following previous studies (e.g., Ketelaar et al., 2013; Wiefferink et al., 2012), we formed two indices for social functioning for the purpose of this study: Prosocial Behavior and Peer Problems (negatively formulated items were reverse coded) were combined to form an index for social competence; Conduct Problems and Hyperactivity-Inattention were combined to form an index for externalizing behavior. Both parents and teachers of the participating children were asked to fill out this questionnaire, and the internal consistency was adequate (Table 4). Both the parent and teacher reports were utilized in this study.

Procedure

Before data collection, the research protocol was approved by the ethics committee of Leiden University and by the China Rehabilitation Research Center for Hearing and Speech Impairment (CRRCHSI). Parental consent was obtained by the center prior to testing. The CPRS, the SDQ, and a background information questionnaire on the family characteristics and children's personal and hearing characteristics were administered online, and parents filled them out in one sitting. Teachers also filled out the SDQ and provided other information such as IQ and language scores.

Statistical Analyses

All the statistical analyses were carried out on the IBM SPSS 26.0 version. For the first research question, independent *t*-tests were conducted for the group differences in the quality of the PCR. For the second research question, two hierarchical regression models were built with the group as the moderator in each model, to examine the extent to which the quality of the PCR (i.e., positive interactions, conflict, and dependency) was related to children's social functioning (i.e., social competence and externalizing behavior). In these models, the age (centered) and group variables (coded as 0 = TH, 1 = DHH) and the PCR variables were included in Step 1. Interactions between the quality of PCR variables and group were entered into the regression models only in Step 2.

Moreover, for each of the social functioning variables, the scores obtained from parent and teacher reports were averaged to form a composite score and added into the regression models as the dependent variable. We utilized both parent and teacher reports to integrate both perspectives and correlations between parent- and teacher-reported scores are shown in Appendix A. Also, adding the teacher report to

the parent report compared to having the parent report alone prompted similar outcomes (refer to Appendix B).

Among the 241 children who participated, 231 (96%) children's parents returned the parent reports, while 181 (75%) children's teachers returned the teacher reports. 171 (71%) children had data from both parent and teacher reports. The method multiple imputation (MI) was utilized to handle the missing data. This technique examines the correlations between the participants' characteristics before filling in missing data to minimize bias and increase statistical power (Azur et al., 2011). The MI technique can be applied to data that is "missing completely at random (MCAR)" or "missing at random (MAR)". Thus, we checked the missing data pattern with Little's MCAR test, which was significant ($\chi2 = 1022.22$, df = 937, $p = .027$), showing the data were not MCAR. We further checked if the data could be MAR, by examining if the data were missing for known reasons (Woods et al., 2024). We found that the reasons for the missingness were indeed known to us: some parents (19 DHH, 22 TH) did not wish to report their income; the COVID-19 pandemic prevented the early intervention center from conducting the non-verbal intelligence tests in some children (17 DHH, 12 TH); and the missing reports of the SDQ resulted from teachers who may have been too busy during the data collection period, the majority of who were teachers of DHH classes (48 DHH, 12 TH). Given these, we assumed that the data were MAR and proceeded with the MI method. For the MI technique, ten imputation sets were created as suggested by Graham (2009), and age, hearing status, gender, non-verbal intelligence test scores, net household income, both parents' education level, and all the study variables were included in the estimation of imputed values (Azur et al., 2011). Pooled results from MI were reported for all the analyses conducted in this study.

Additionally, given the significant group difference in the socioeconomic status (SES) variables (see Table 2), we ran and reported all the analyses with and without controlling for the SES (see Tables 4 and 3). To control for the SES, we used the inverse probability of treatment weighting (IPTW) statistical method to balance out the three SES variables across the groups (Chesnaye et al., 2022). This method relies on estimations of the probability of exposure to the treatment condition for each particular individual and using these predicted probabilities as weights in subsequent analyses to control for the confounders. This method is widely used in other observational studies (e.g., Foster & Pearson, 2012; Kalb et al., 2021). Logistic regression was first conducted to estimate the probability of being part of the DHH or TH group (i.e., a propensity score) with all SES variables (maternal/paternal education and income) included in the model. Next, weights were computed for each individual as a 1/propensity score for the DHH group and 1/(1 − propensity score) for the TH group. To avoid having extreme weights, stabilization and truncation were applied by multiplying the weights with the proportion of the DHH/TH children in the whole sample, and by trimming off the values smaller than the 1st and larger than the 99th percentiles.

Results

Group Differences

The outcomes of the independent *t*-tests are presented in Table 4. Parents reported that DHH and TH children had similar levels of parent-child conflict, $t(239) = -0.15$, $p = .882$, and dependency, $t(239) = -1.24$, $p = .217$. Parents of DHH children reported having fewer positive interactions with their child than parents of TH children, $t(239) = 3.36$, $p < .001$. Yet, this group difference disappeared after the SES variables were balanced across the groups using the IPTW method.

Relations between the Quality of the PCR and Children's Social Functioning

Table 3 contains the hierarchical regression outcomes for the relation between the quality of the PCR and children's social functioning. Also, see Appendix C for correlations between the study variables. In the regression models for social competence and externalizing behavior, only Step 1 was significant. This denotes that the same trend was found in the relation between the quality of the PCR and children's social functioning for both groups. For all children, it was found that more dependency ($b = -0.064$, $p = .010$) between parents and child related to lower social competence, whilst more conflict ($b = 0.11$, $p < .001$) and dependency ($b = 0.082$, $p < .001$) were associated with more externalizing behavior for all children. No other significant relations were found. In addition, after rerunning the analyses with SES variables balanced across the groups, more parent-child conflict was related to less social competence ($b = -0.15$, $p = .023$), and again more parent-child conflict ($b = 0.36$, $p < .001$) and dependency ($b = 0.32$, $p < .001$) were related to more externalizing behavior. No other significant relations were found (see Table 3).

Discussion

This study aimed to examine the quality of the PCR in DHH and TH children and their hearing parents, and its relations with DHH and TH children's social functioning, based on Bowlby and Ainsworth's attachment theory. Despite our expectations of group differences based on previous literature (Barker et al., 2009; Eyuboglu et al, 2021; Pinquart,

Table 3 Regression analyses between PCR quality and children's social functioning variables (Pooled and weighted Results)

	Social competence		Externalizing behavior	
	b	*p*	b	*p*
Unweighted results				
Step 1	R^2 = 0.15**		R^2 = 0.17**	
Intercept	1.71	**< 0.001**	0.17	0.335
Group	-0.13	**< 0.001**	0.06	0.102
Age	0.00	**< 0.001**	0.00	0.760
Parent-child positive interactions	-0.00	0.933	-0.03	0.407
Parent-child conflict	-0.03	0.328	0.11	**< 0.001**
Parent-child dependency	-0.06	**0.010**	0.08	**< 0.001**
Step 2	ΔR^2 = 0.02		ΔR^2 = 0.00	
Intercept	2.06	**< 0.001**	0.13	0.573
Group	-0.95	**0.009**	0.16	0.662
Age	0.00	**< 0.001**	0.00	0.746
Parent-child positive interactions	-0.08	0.119	-0.03	0.603
Parent-child conflict	-0.05	0.137	0.12	**0.001**
Parent-child dependency	-0.05	0.097	0.08	**0.006**
Parent-child positive interactions x group	0.20	**0.017**	-0.01	0.863
Parent-child conflict x group	0.08	0.203	-0.02	0.814
Parent-child dependency x group	-0.05	0.345	-0.00	0.933
Weighted results				
Step 1	R^2 = 0.17**		R^2 = 0.15**	
Intercept	1.75	**< 0.001**	0.25	0.158
Group	-0.18	**< 0.001**	0.08	**0.014**
Age	0.00	0.101	0.00	0.239
Parent-child positive interactions	-0.01	0.721	-0.03	0.422
Parent-child conflict	-0.08	**0.007**	0.12	**< 0.001**
Parent-child dependency	-0.03	0.193	0.05	**0.034**
Step 2	ΔR^2 = 0.01		ΔR^2 = 0.00	
Intercept	1.97	**< 0.001**	0.23	0.299
Group	-0.75	**0.035**	0.16	0.667
Age	0.00	0.076	0.00	0.347
Parent-child positive interactions	-0.05	0.317	-0.05	0.352
Parent-child conflict	-0.07	**0.038**	0.11	**0.001**
Parent-child dependency	-0.06	**0.047**	0.08	**0.005**
Parent-child positive interactions x group	0.09	0.259	0.04	0.625
Parent-child conflict x group	-0.01	0.938	0.03	0.665
Parent-child dependency x group	0.07	0.132	-0.09	0.061

Note. Group was coded as 0 = Typically hearing; 1 = Deaf or hard-of-hearing. Change in R^2: *p < .05, **p < .001

*p (2-tailed) < .05; **p (2-tailed) < .001

[a] pooled results after multiple imputation. [b] pooled results after multiple imputation and weighted by socioeconomic status

2013; Sarant & Garrard, 2013), outcomes in this study showed that parents of DHH and TH children reported similar levels of conflict and dependency with their children. In both groups, more parent-child conflict and dependency were related to more externalizing behaviors and lower social competence in the children. Yet, DHH children and their hearing parents reported fewer positive interactions compared to TH children and their parents; however, this outcome disappeared after SES was balanced across groups. In both groups, the level of positive interactions was unrelated to social competence and externalizing behaviors. Implications of these findings will be discussed below.

An unexpected but positive outcome of this study was that – based on parent reports - DHH children and their hearing parents scored similarly on measures of conflict and dependency as TH children and their parents. These results were observed among DHH children enrolled in a family-centered rehabilitation program that provides early and consistent support to families. The findings likely reflect associations among family and child relationship variables within a supportive early-intervention context. These findings are consistent with prior research, which has shown that early family-centered and inclusive programs for DHH children are associated with improvements in parent-child communication, social

Table 4 Psychometric properties and mean scores (Standard Deviation) for all variables

	N items	Scale	Cronbach's α	Mean (SD)		t value[a]	t value[b]	Cohen's d [a]	Cohen's d[b]
				DHH	TH				
Parent-child relationship (PCR)									
Positive interactions	10	1–5	0.71	4.0 (0.4)	4.2 (0.4)	3.36**	1.55	0.43	0.20
Conflicts	12	1–5	0.85	2.1 (0.6)	2.1 (0.7)	−0.15	0.06	-0.035	0.008
Dependency	4	1–5	0.56	3.2 (0.7)	3.1 (0.8)	-1.24	-1.55	-0.16	-0.20
Social competence									
Teacher reports	10	0–2	0.83	1.2 (0.3)	1.4 (0.4)	4.55**	6.20**	0.80	0.80
Parent reports	10	0–2	0.66	1.4 (0.3)	1.5 (0.3)	1.64	2.74*	0.21	0.36
Composite scores (Teacher & Parent)	10	0–2	0.83	1.3 (0.2)	1.4 (0.3)	3.95**	5.94**	0.67	0.77
Externalizing behavior									
Teacher reports	10	0–2	0.84	0.6 (0.3)	0.5 (0.4)	-2.36*	-3.13*	-0.46	-0.41
Parent reports	10	0–2	0.74	0.6 (0.3)	0.6 (0.3)	−0.98	−0.76	-0.13	-0.099
Composite scores (Teacher & Parent)	10	0–2	0.83	0.6 (0.2)	0.5 (0.3)	-2.07*	-2.52*	-0.37	-0.33

competence, and behavioral adjustment (e.g., Holt et al., 2020 ; Ingber & Dromi, 2010). Additionally, it should be noted that 65% of the DHH children had bilateral hearing devices, and early and intensive intervention for hearing may also facilitate DHH children's interactions with their parents. Unfortunately, these factors were not directly investigated in our study, thus warranting further research.

On the other hand, we observed a group difference in positive parent-child interaction when the families' SES was not accounted for. This outcome might suggest that DHH children and their parents and/or families with lower SES can additionally benefit from adding more purposeful leisure activities into the program. Leisure activities can be a means for DHH children and their parents to jointly nurture a strong emotional bond, creating more positive experiences and memories together (Holt et al., 2020), rather than only spending time together on education, rehabilitation, and hospital visits. Although encouraging families to spend more pleasant leisure time together may be beneficial for promoting positive parent-child interactions, in practice this can be challenging, especially for parents of DHH children, who are often heavily involved in daily therapeutic activities and rehabilitation homework (Park & Yoon, 2018). This leaves both parents and their DHH children with limited time and energy for unstructured, enjoyable moments. To address this challenge, it is important for our society and policy makers to provide support, such as reducing parental burdens through accessible services, financial assistance, and community resources, thereby freeing time for leisure and quality family time. Meanwhile, intervention programs might also consider integrating more playful and enjoyable parent-child activities into their design, so that therapeutic sessions take place in a positive atmosphere that supports both skill-building and family bonding.

Furthermore, previous research has suggested that DHH children pay attention to and experience the same emotions as TH children, yet they are unable to act upon them in most circumstances (Tsou et al., 2021). Adding to the mix, some hearing parents of DHH children may still lack confidence and the appropriate parenting skills (Koester & Lahti-Harper, 2010). These circumstances could be potential explanations for DHH children and hearing parents obtaining lower scores on positive interactions. However, for this sample, it seems that parents with higher SES can mitigate this effect on the PCR. Thus, this study further provides evidence that SES can influence parent and child interactions, such as the access to activities, resources, and knowledge for parents when adapting to having a DHH child (e.g., Cano, 2022). Parents on the lower spectrum of SES indeed struggle more with obtaining the best services for their DHH child in a timely manner. This difficulty can cause additional stress in the PCR, a factor that medical professionals and teachers should be mindful of (e.g., Cano, 2022; also see Appendix B).

Despite the possible explanations discussed above, we should also consider that the absence of group differences in PCRs may reflect a true similarity in how parents and children interact across DHH and TH families in this context. The preschool years might be too early for differences to emerge strongly. Moreover, cultural parenting values in China, such as strong parental involvement and emphasis on harmonious family relationships, may promote similar patterns of parent-child interactions regardless of children's hearing status. The availability of early intervention services may have further reduced potential disparities. These possibilities highlight the need for future research to investigate whether the present findings are specific to our sample or reflect a more general trend in Chinese families.

Finally, our results further suggest that fewer negative aspects (conflict and dependency) in PCRs may positively affect children's social functioning. However, we must emphasize that we did not confirm the expected link between positive parent-child interactions and children's social functioning in families with DHH and TH children. Possibly, positive parent-child interactions could contribute to more

expressions of positive emotions and improved subjective feelings among children (Ketelaar et al., 2017). However, social functioning investigated in the current study focused primarily on the negative dimensions of social competence, such as externalizing problems and peer conflicts. Future studies may identify whether positive parent-child interactions can promote other areas of social-emotional functioning in young DHH and TH children, thereby broadening our understanding of the different facets of parent-child interactions and their influence on child development.

Limitations and Future Research

This study provided some exploratory findings on how the quality of the PCR relates to DHH children's social functioning. This study further stresses the important role that parents play in preschool children's social development both at home and in the school environment. Despite the relevance of the outcomes of this study, certain limitations must be noted and a framework for future studies can be given. The cross-sectional nature of this study limits the insights into the directionality of the relation between the quality of the PCR and children's social functioning, as past research has already shown children can develop their social-emotional skills over the lifespan (Most & Michaelis, 2012). Additionally, the missing data were assumed 'missing at random' during Multiple Imputation hence one should take note of the generalizability of the study findings beyond our sample (Pedersen et al., 2017; Woods et al., 2024). Furthermore, we averaged parent and teacher reports to create composite scores of children's social functioning. While this approach reduced reporter bias and provided a broader estimate of children's functioning across home and school contexts, it may also have masked important context-specific differences. In our analyses, we found that combining parent and teacher scores produced similar results compared to using parent reports alone. Nonetheless, to capture a more nuanced picture of children's social functioning, future studies may consider examining parent and teacher reports separately.

Importantly, the DHH population is heterogeneous, and individual differences may be present, such as the degree of hearing loss and the type of intervention program. Specifically, all children within this study received intervention, with at least one CI or HA (hearing aid), with which they showed mild-to-moderate hearing loss. Thus, our findings may not be applicable to children with other hearing profiles. For example, when hearing parents interact with their deaf child using sign language, more nonverbal interaction strategies might be applied to build emotional bonds (see Vaccari & Marschark, 1997 for a review). Parents of children born with mild vs. severe hearing loss could also have different types of stress and expectations for their children (Pipp-Siegal et al., 2002), which potentially affect PCR quality. It would also provide additional context to our outcomes if we had asked parents how often their DHH child wore their HAs or turned on their CIs, which would be an important issue to address in future research. What is also worth noting is that only DHH children without other additional disorders or disabilities were included in this study. We set this as an inclusion criterion to focus on the effect of hearing loss. However, DHH children may have syndromes that result in additional support needs (Núñez-Batalla et al., 2023). This could affect the dynamics of parent-child interactions and potentially their PCR quality that was not captured in the current study.

Furthermore, all children had hearing parents. There are studies that emphasize how children who grow up with DHH parents may fare slightly better than those with hearing parents, as DHH parents already have the knowledge base to communicate successfully with their DHH children (Koester & Lahti-Harper, 2010). This study also did not collect information on parents' mental health conditions, which may also potentially influence these children's behavior and development (Kamis, 2021). It should also be noted that the parents of TH children had a higher SES than the parents of DHH children in this study. While we addressed this difference by analyzing the data with and without the SES controlled for, there could still be potential biases that could not be ruled out, because parental educational levels and household income could intrinsically affect how parents interact with their child (e.g., Bornstein & Bradley, 2014; Cano, 2022). Moreover, although we found a group difference in positive parent-child interaction when the SES was not accounted for, this outcome should be interpreted with caution as it may simply reflect the differences in the SES rather than how parent and child interact. Future studies could take these issues into account.

Finally, the intensive family-centered early intervention programs that the DHH children in this study received may also have contributed to the positive outcomes. Especially as these programs put a large emphasis on successful communication between parent and child, results from studies based on (potentially stressed out) parents and children not in these programs may paint a very different picture. In addition, the measures used may not have been sensitive enough to capture subtle group differences in daily interactions or context-specific behaviours. Among them, the reliability of the parent-child dependency scale was relatively low (Cronbach's alpha = 0.56). While this was expected and considered acceptable given that this scale has a small number of items and covers behaviors of both parents and child (Berger & Hänze, 2015; Taber, 2018), this part of the results should be interpreted with caution. Furthermore, although the CPRS measure examines both parents' and children's behaviors

towards each other during interactions, ultimately the measure is taken only from the perspective of the parents, whereas children's perspective in this regard is lacking. Although the preschool children within this sample were still too young to fill out these questionnaires themselves, observation studies that focus on parent-child interactions might shed more light on children's experiences. It is therefore important that future studies also explore DHH children and their families from different rehabilitation centers and programs for cross-comparison, as our sample hails from one program with set policies that may differ from others.

Conclusions and Implications

This study revealed many new important factors in how Chinese DHH children and their families fare in China, especially in terms of parent-child attachment (Bowlby, 1979). In this sample, PCRs of preschool DHH children are comparable in many respects to those of their TH peers, the former only having fewer positive interactions with their hearing parents than TH children. In addition, DHH preschool children in this study followed the same trend as their hearing peers in the relation between the quality of the PCR and children's social functioning.

The outcomes could be related to the supportive attitudes of the families that agreed to participate in this study, as they were already fully committed to their DHH child's development and the program by moving away from their hometown to attend. The youngest started the program at one year and above, which is known to have a stronger developmental impact on children and contributes to children feeling more at-ease attending school with other peers in similar situations.

Moreover, there are benefits that can be reaped from the rehabilitation center's program on enhancing hearing parent-DHH child's interactional quality and emotional bond. The program includes onsite medical hearing experts and special family-centered classes, which enable parents and children to practice important reciprocal communication and social skills together, and to build mutual understanding, trust, and overall confidence. Furthermore, this program may also enable parents to build a stronger community sense and gain social support from the other parents in the class.

Overall, programs like these, aiming at improving social-emotional skills for young children with hearing loss and communication with their families, may prioritize including leisure activities for parents and children in the class schedule, as these have been proposed to enhance positive parent-child interactions in previous studies (e.g., Holt et al., 2020). More positive parent-child interactions are known to encourage secure attachments. Previous literature suggests that parents with higher SES may possess the knowledge to nurture their children more effectively (e.g. Cano, 2022). Therefore, policymakers may need to explore the possibility of providing more financial support for families with DHH children. Having a well-rounded program with adequately trained teachers can further strengthen such early interventions, which are proving to be helpful in nurturing healthy social-emotional functioning in DHH children and can also help in building better relationships with their parents, teachers, and peers.

Appendix A

Distribution of the hearing-related variables in the DHH sample.

	N	Range	Mean	Median	SD	Skewness	Kurtosis
Unaided hearing threshold (better ear)	90	50–120	88.1	92.5	16.7	-0.5	-0.8
Unaided hearing threshold (worse ear)	89	54–120	96.4	100.0	12.8	-1.1	1.6
Aided hearing threshold (better ear)	84	10–90	34.8	35.0	10.6	2.1	8.9
Aided hearing threshold (worse ear)	83	20–100	44.6	40.0	17.0	1.7	2.8
Age at HA fitting	84	0.1–6.0	1.8	1.5	1.3	0.8	-0.1
Duration of HA use	84	0.2–6.1	3.0	2.8	1.2	0.2	0.4
Age at implantation	68	0.4–5.2	2.1	1.7	1.3	0.8	-0.2
Duration of (first) CI use	68	0.4–5.0	2.7	2.5	1.0	0.4	-0.2

Note. DHH = deaf and hard-of-hearing; SD = standard deviation; HA = hearing aid; CI = cochlear implant

Appendix B

Correlations of Social Functioning Between Parent (PR) and Teacher Reports (TR)

Pearson's *r* coefficient for all children (DHH/TH children)

	Social Competence (PR)	Externalizing Behavior (PR)
Social Competence (TR)	0.39**(0.44**/0.35**)	−0.09(-0.05/-0.08)
Externalizing Behavior (TR)	−0.30**(-0.28**/-0.30**)	0.37**(0.36**/0.37**)

**$p < .01$; *$p < .05$. PR = parent report, TR = teacher report

Appendix C

Regression Analyses Between the PCR Quality and Children's Social Functioning Variables (Parent report) (Pooled and Weighted Results)

	Social competence		Externalizing behavior	
	b	*p*	b	*p*
Unweighted results				
Step 1	R^2=0.15**		R^2=0.19**	
Intercept	1.33	**<0.001**	0.47	**0.020**
Group	-0.03	0.422	0.01	0.861
Age	0.00	**0.001**	-0.00	0.532
Parent-child positive interactions	0.13	**0.003**	-0.11	**0.012**
Parent-child conflict	-0.09	**0.004**	0.15	**<0.001**
Parent-child dependency	-0.06	**0.028**	0.08	**0.004**
Step 2	R^2=0.02		ΔR^2=0.01	
Weighted results				
Step 1	R^2=0.20**		R^2=0.17**	
Intercept	1.42	**<0.001**	0.35	0.084
Group	-0.07	**0.024**	0.02	0.667
Age	0.00	**0.008**	0.00	0.886
Parent-child positive interactions	0.11	**0.005**	-0.07	0.093
Parent-child conflict	-0.13	**<0.001**	0.16	**<0.001**
Parent-child dependency	-0.03	0.243	0.06	**0.023**
Step 2	R^2=0.01		ΔR^2=0.01	

Note Group was coded as 0=Typically hearing; 1=Deaf or hard-of-hearing

Change in *R2: *p<.05, **p<.001.* Group interaction terms added in Step 2 did not significantly improve the model, and thus only the results of Step 1 were reported

Appendix D

Correlations Between all Study Variables

	Pearson's *r* coefficient for all children (DHH/TH children)				
	Positive Interactions	Conflict	Dependency	Social Competence (PR & TR)	Externalizing Behavior (PR & TR)
Positive Interactions	-	−0.20** (-0.23*/-0.19*)	0.18** (0.29**/0.14)	−0.00 (0.07/-0.13)	−0.09 (-0.06/-0.06)
Conflict	-	-	0.38** (0.37**/0.39**)	−0.15* (-0.12/-0.17)	0.36** (0.37**/0.35**)
Dependency	-	-	-	−0.23** (-0.25*/-0.19*)	0.32** (0.33**/0.31**)
Age	−0.10 (-0.08/-0.12)	−0.05 (-0.09/-0.01)	−0.01 (-0.09/0.06)	0.16* (0.22*/0.15)	0.010 (-0.06/0.06)
Maternal Education	0.28** (0.28**/0.22*)	−0.17** (-0.16/-0.18*)	−0.15* (0.00/-0.23**)	0.21** (0.02/0.22*)	−0.22** (-0.01/-0.27**)
Paternal Education	0.27** (0.28**/0.22*)	−0.15* (0.19/-0.13)	−0.18** (-0.01/-0.27**)	0.25** (0.04/-0.20**)	−0.26** (-0.08/0.30**)
Income	0.34** (0.31**/0.25**)	−0.08 (-0.16/-0.03)	−0.11 (0.09/-0.21*)	0.16* (0.03/0.01)	−0.20** (-0.06/-0.17)

Note: Fisher's r-to-z transformation did not show any significant differences in strengths between the groups

**p < .01; *p < .05. PR= parent report, TR= teacher report

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Data Availability Data is available upon request after publication.

Declarations

Ethical Approval This was obtained from the University Ethics Board prior to beginning the study.

Consent to Participate/Publish All participants in the study filled out an informed consent form beforehand.

Conflict of Interest The authors declare no competing interest

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