

Peer Relationships of Deaf Children With Cochlear Implants: Predictors of Peer Entry and Peer Interaction Success

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This study investigated factors that affect the development of positive peer relationships among deaf children with cochlear implants. Ten 5- to 6-year-old deaf children with implants were observed under conditions varying peer context difficulty in a Peer Entry task. Results revealed better outcomes for deaf children interacting in one-on-one situations compared to interactions including two other hearing children and better performance among girls than boys. In addition, longer duration of implant use and higher self-esteem were associated with better performance on the Peer Task, which was in turn related to parental reports of children's social functioning outside the experimental situation. These findings contribute to the growing literature describing the benefits of cochlear implantation in the areas of communication and socialization, while pointing to interventions that may enhance deaf children's social competence.

Over 1 million children in the United States have a hearing loss and approximately 25,500 of them have received a cochlear implant (The National Institute on Deafness and Other Communication Disorders, 2009). As implantation criteria have relaxed (e.g., lower age at implant, lower levels of hearing loss) and improvements in implant technology have been made, the rate of implantation has accelerated, culminating in larger numbers of children with implants entering the school system. Exposure to hearing peers in the classroom presents deaf children with numerous opportunities for the development of positive relationships with hearing peers.

Meaningful social relationships with peers are associated with greater psychological well-being at all ages (Ladd, 2005). For young children, in particular, socialization with peers is a crucial area of development. Research has shown, for example, that children who had better peer relationships in preschool were more academically successful in kindergarten than less socially skilled children (Buhs, Ladd, & Herald, 2006). Positive peer interactions in preschool are associated with better school adjustment, successful emotion regulation, and maintaining positive peer relationships in the future (McElwain & Valling, 2005).

Peer Relationships in Deaf Children With Cochlear Implants

Although social relationships are crucial to children's future development, many deaf children have difficulties forming and sustaining relationships with hearing peers (Weisel, Most, & Efron, 2005). They have lower social status (Nunes, Pretzlik, & Olson, 2001) and report more loneliness than do hearing children (Kent, 2003; Most, 2007). For deaf children who attend mainstream classrooms, low speech intelligibility increases feelings of loneliness (Most). As more deaf children are placed in mainstream educational settings (Nikolarazi & Hadjidakou, 2006), they may face increasing difficulties in forming positive relationships with hearing peers. The resulting poorer social integration becomes a serious concern for parents, educators, and mental health professionals.

To date, very few studies have examined peer relationships of children with implants, and their results

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are inconsistent. In studies that use parent reports, children's social relationships and communication skills were reported to have improved as a result of implantation (Bat-Chava & Deignan, 2001; Bat-Chava, Martin, & Kosciw, 2005; Christiansen & Leigh, 2002). On the other hand, results of studies that use children's reports and behavioral observations are not as positive. Recent research using deaf children's reports shows that whereas younger children with implants (aged 5–9 years) experience the same levels of loneliness and peer acceptance as normally hearing children, older children (aged 9–14 years) report significantly lower perception of their own appropriate conduct and marginally greater loneliness than normally hearing children. In addition, the perception of loneliness is greater for children who received implants later in life (Schorr, 2006).

Peer Entry Behavior

One of the most powerful tests of social competence measures children's ability to enter a group of peers. This method is diagnostic because children typically find it difficult to enter a peer group and because it captures a crucial skill that provides children with access to further socialization opportunities (Cillesse & Bellmore, 2004; Putallaz & Gottman, 1981; Putallaz & Wasserman, 1989). Research with normally hearing children shows that the group context shapes the child's entry success in important ways; for example, groups comprised of less popular children, groups that are smaller, and all-girls' groups are typically the easiest to enter (Cillesen & Bellmore, 2002). As children age, they become gradually more skilled in entering and interacting with increasingly larger peer groups (Putallaz & Wasserman, 1989).

Only two previous studies assessed social skills of deaf children with implants using the peer entry paradigm. In one study, one third of children with implants failed to enter a group situation where a dyad of hearing peers was already interacting (Knutson, Boyd, Reid, Mayne, & Fetrow, 1997). The other study found that 27% deaf children with implants failed to enter a peer group of two hearing peers (triad entry) compared to 5% of hearing children who failed entry (Boyd, Knutson, & Dahlstrom, 2000). These two

studies established the feasibility of the Peer Task method for use with children with implants although suggesting that deaf children experience greater difficulty completing the entry task than normally hearing children.

Interestingly, when parent reports and peer entry measures of the child's social functioning were compared (Boyd et al., 2000), parent report of child's sociability and observational measures of entry into a peer group were not related. This is similar to findings with hearing preschoolers where parent reports were not related to objective observations of preschoolers peer entry interactions (Brotman, Gouley, & Chesir-Teran, 2005). These results suggest that for both deaf and hearing young children, observation of peer entry and play interactions capture an aspect of child functioning not easily reported by parents or the children themselves. Because no observational studies of deaf children have been reported in the literature since the study by Boyd et al., and in light of advances in implant technology and changes in implantation criteria, an observational study of implanted children's peer interactions would provide much needed information on the relationship between implantation and socialization with hearing peers.

Predictors of Social Development

Language development is a strong predictor of social functioning in children. Children's ability to communicate well with others affects both the formation of close relationships with others and the development of a positive identity (Stinson & Whitmire, 2000). The difficulties that deaf children typically experience in socialization with hearing peers may be attributed to limited production of intelligible speech and speech comprehension, resulting in inadequate understanding of how others think and feel (Remmel & Peters, 2009; Schorr, Roth, & Fox, 2009), and to delays in metacognitive processes, such as problem solving and attention (Beer, Pisoni, & Kronenberg, 2009). In turn, deaf children's cognitive difficulties can affect the type and duration of typically developing play behavior. In one study, deaf children needed more support to sustain joint attention during interactions with peers and exhibited lower levels of symbolic (pretend) play

behaviors than their hearing peers matched for age and gender (Quittner, Leinbach, & Marciel, 2004). In another study, attentional abilities of deaf children lagged behind normally hearing children (Khan, Edwards, & Langdon, 2005).

Recent studies that examine the formation of emotional understanding based on visual and vocal cues demonstrate that children with implants have greater difficulty identifying vocal expressions of emotions compared to hearing peers (Schorr, Fox, & Roth, 2006). Another factor of interest that may contribute to deaf children's social difficulties is a lower level of self-worth and self-coherence, possibly arising from limited early communication and frequent social failure (Most, 2007; Schorr et al., 2006). These findings point to important relationships among language, cognition, and social relationships that are relevant to the development of deaf children using cochlear implants.

Auditory Perception, Speech, and Oral Language Development of Children With Implants

A growing literature demonstrates the positive effects of cochlear implants on auditory perception and speech and oral language development (e.g., Hayes, Geers, Treiman, & Moog, 2009; Waltzman, 2006). These benefits are moderated by several variables, including age at implant, duration of implant use, and mode of communication. In children with congenital or very early profound hearing loss, later age at implantation is related to poorer speech perception (Zwolan et al., 2004) and speech production (Geers, Moog, Biedenstein, Brenner, & Hayes, 2009; Robbins, 2006). Longer implant use is related to better oral language outcomes (Nicholas & Geers, 2006), and children implanted earlier seem to make faster progress (Lee & van Hasselt, 2005), likely due to age-dependent aural sensitivity (Connor et al., 2006). Children generally have better speech and oral language skills after cochlear implantation when they are exposed to spoken language (Spencer & Marschark, 2003), and children who use oral language exclusively usually make faster progress (Sarant, Blamey, Dowell, Clark, & Gibson, 2001). If implantation results in improved auditory perception and more advanced speech and oral language skills in young deaf children, this is

expected to result in a common system of communication between the deaf child and his or her hearing parents and peers, resulting in the promotion of skills necessary for positive peer relationships.

Self-esteem and Peer Relationships

Self-esteem is an attitude toward one's self that appraises the individual's perception of self-worth as compared to others (Brinthaupt & Erwin, 1992). Over the last decade, research has established the associations among children's self-esteem, socialization, and academic success, showing that low self-esteem may be associated with many personal and social variables, including school failure, depression, and social anxiety (Wei & Ku, 2007). In preschool-aged children, self-esteem is not yet integrated into a coherent perception of global self-worth. Instead, children's perceptions are domain-specific ideas of their *competence* regarding cognitive skills, physical competence, and peer and parent relations (Harter, 2001; Manning, Bear, & Minke, 2006). In turn, these self-appraisals have been found to demonstrate behaviorally as a global attitude of mastery, confidence, and curiosity across contexts (behaviorally presented self-esteem, Harter, 2001).

Self-esteem has a cyclical nature. It is first derived from one's observance of success and others' approval in various social situations and later fuels children's confidence (behavioral self-esteem) needed to master these situations (e.g., by initiating play with others and responding to others' initiations). The study of deaf children with implants makes possible conjectures about the accumulated effects of successful social interactions on the children's self-esteem, allowed by the child's increased auditory and communication skills. Gains in self-esteem, in turn, facilitate the child's attempts at increasingly more difficult peer tasks, such as joining an existing peer group and experiencing success.

Studies show that children with a hearing loss often demonstrate low self-esteem compared to normally hearing children, regardless of whether they attend mainstream or specialized school settings (Weisel & Kamara, 2005). The less-developed ability of deaf children to act and interact effectively with significant others early in life may negatively affect the normal

developmental processes of self-esteem construction. In turn, as deaf children proceed into later childhood and face greater and more diverse social demands, they may struggle to meet these challenges (Hatamizadeh, Ghasemi, Saeedi, & Kazemnejad, 2008; Jambor & Elliott, 2005; Kent, 2003).

To date, there is little data on self-esteem of children with implants, and the results are inconsistent. In one study, children with implants aged 5–8 years were found to have slightly higher self-esteem than their hearing peers, especially in the domain of maternal acceptance, whereas older children's (aged 9–15 years) scores were somewhat lower than those of hearing peers, particularly in a domain of appropriate conduct (Schorr et al., 2006). Another study, examining adolescents with and without implants, concluded that school placement played a larger role than implant status, illustrated by the finding that adolescents who attended mainstream schools had marginally higher levels of self-esteem compared to students attending deaf schools (Leigh, Maxwell-McCaw, Bat-Chava, & Christiansen, 2009).

To better understand the mechanisms guiding social competence among cochlear implant users, this pilot study focused on the role of self-esteem levels in the formation of satisfactory deaf–hearing interactions. Using structured observations of peer play, as well as assessment of children through child and parent reports, this study investigated the associations among an implant-related variable (length of implant use), psychological variables (self-esteem and its subdomains), and ability to interact with hearing peers under two levels of difficulty.

Methods

Participants

Ten 5- to 6-year-old children with congenital severe-to-profound hearing loss with no additional disabilities who have used a cochlear implant for at least a year were recruited for this study. All children were recruited through the Cochlear Implant Center at New York University Medical Center. The sample consisted of eight girls and two boys, ages 5 years 1 month to 6 years 10 months, with an average age of 5 years 10 months. Six children (60%) were White,

two identified as Asian (20%), and two were of a mixed racial background (20%). Most children ($N = 8$; 80%) attended mainstream schools; two children (20%) attended a school for deaf and hard-of-hearing children. All children received supportive speech services and none of the children used sign language. Seventy percent of their parents rated their experiences with the cochlear implants as “extremely satisfactory” and 30% as “satisfactory.” The children received their implants between the ages of 10 months and 4 years 11 months, with an average age at implant of 1 year 10 months. At the time of the study, they have used the implant for a period of time between 1 year 11 months and 4 years 10 months, with an average duration of use of 3 years 11 months.

In addition to the primary participants, six hearing children were recruited through personal contacts to serve as “host peers” during the Peer Task, a 30-min play session measuring the children's social skills (Boyd et al., 2000; see also Peer Task in Measures section). The sample consisted of three girls and three boys, ages 5 years 2 months to 6 years 10 months, with an average age of 5 years 4 months. Most of the children were White ($N = 5$; one child identified as biracial). At each research session, the hearing and deaf children were matched on age, gender, and social-economic status, and the hearing children completed the same assessments as the deaf children. Three of the normally hearing children attended more than one Peer Task session; for those participants, only first-time observations were used in the following analyses.

Procedure

Peer task. The Peer Task is a procedure previously used with young deaf children with cochlear implants (Boyd et al., 2000; Knutson et al., 1997). Originally developed as a behavioral measure of hearing children's social competence (Putallaz & Gottman, 1981), it has been particularly useful as a tool for examining deaf–hearing interactions. In our study, the deaf participants were observed in interaction with age- and gender-matched children with normal hearing (host peers) to assess the deaf children's success in entering a peer group, acceptance by hearing peers, and the quality of peer interaction. Two levels of difficulty

were established based on group size: in the first condition, the deaf child interacted with one normally hearing peer for 30 min (Dyad condition, $N = 5$). In the second and more difficult condition, the deaf child entered a group of two normally hearing children who had already interacted together for 5 min, and all three children continued to interact for another 25 min (Triad condition, $N = 5$).

Participants were invited to the Cochlear Implant Center where they completed all measures in a single session lasting about 1.5 hr. Upon their arrival, the children and their parents were greeted by the researchers and led to an observation room equipped with a one-way mirror. While their parents stayed outside the room, the children were seated at a play table with age- and gender-appropriate toys (such as coloring books, play-doh, construction toys, plastic animals, Polly Pockets, etc.). They were introduced to each other and asked to play for a little while. No other instructions were given to the children to ensure the play proceeded in the most naturalistic fashion possible. The play session was videotaped, with the camera capturing all nonverbal as well as verbal behavior (both facial expressions and speech) of the participants. Although the children could see the camera, they did not pay attention to it and did not seem affected by the idea of being observed.

While the children played in the observation room, their parents completed The Child Behavior Scale and a *Demographic Questionnaire* (self-report). After the play session, the children completed a self-esteem measure (The Pictorial Scale of Perceived Competence and Social Acceptance [PSPCSA]; Harter & Pike, 1984) with the assistance of an interviewer. The families were thanked for their participation and each child received a small toy in return for their visit.

Measures

The Child Behavior Scale (CBS). Parents of deaf children completed this measure designed to assess children's prosocial, withdrawn, and aggressive behaviors (Ladd & Profilet, 1996). Of the original six subscales, we included two subscales that are most relevant to this study: *Asocial with Peers* and *Excluded by Peers*. Parents rated the children's behaviors using

a 3-point scale: 1 = doesn't apply, 2 = applies sometimes, 3 = certainly applies. This measure has been used previously with deaf children (van Eldick, 2004).

Self-esteem. Self-esteem was measured by PSPCSA (Harter & Pike, 1984). This 24-item instrument prompts children (aged 4–7 years) to reveal feelings about their own performance in four domains: perceived (a) physical and (b) cognitive competence and perceived (c) peer and (d) maternal acceptance. Each item consists of two statements, and the statements are accompanied by a drawing that represents that statement nonverbally, making this instrument particularly suited for use with deaf children. A modified version of this scale was previously used in a study of children with cochlear implants (Nicholas & Geers, 2003). In our study, a full version of the PSPCSA was used, with satisfactory internal consistency (deaf sample Cronbach's $\alpha = .67$; hearing sample $\alpha = .71$).

Peer Task Measures. Each play session was videotaped and later coded by at least two independent coders, with an interrater reliability rate of 89%. The scores generated by coding were used to develop two indices of peer engagement, the *Interaction Quality Index* (IQI) and the *Prosocial Behavior Index* (PBI).

Interaction Quality Index (IQI). The overall quality of peer engagement was rated using a behavioral scale developed by Miller et al. (2003): 1 = conflict (verbal disagreements or physically aggressive acts); 2 = solitary nonplay (unengaged in play: spacing out, wandering around room); 3 = solitary constructive (independent play); 4 = social attention (monitoring peer play but not entering into it); 5 = interaction (talking; playing with same toy back-and-forth with the other child); and 6 = collaborative play (mutual game with rules). The onset and offset of these behaviors were recorded to obtain a total amount of time (in minutes) spent in each activity. These durational scores were combined into a single IQI score (IQI total) in which all durational scores were weighted in terms of quality of engagement (with higher level activity receiving greater weight; for example, conflict = $\times 1$ and collaborative play = $\times 6$) and summed across each participant. All durational scores were adjusted for

differences in total interaction time by condition (30 min in the Dyad condition and 25 min in the Triad condition). In addition to these measures, rates of verbalization, vocalization, pointing, leaning, touching, and handling of objects were coded. Because these did not yield any additional information, the ratings of these behaviors were omitted from the final analyses.

The Prosocial Behavior Index (PBI). This index was developed to describe behaviors that contributed to successful peer interactions. It was based on behavior rating protocols used by Boyd et al. (2000) in a previous Peer Task study. The index included nine questions rated on a Likert scale: (a) peer group entry (1 = no attempt, 3 = easy entry); (2) entry bids (1 = none; 3 = frequent); (3) success of entry bids (1 = received no response; 3 = received a full response); (4) response rate to entry bids (1 = gave no response, 3 = full response); (5) new play initiations (1 = none, 3 = frequent); (6) success of new play initiations (1 = received no response; 3 = received a full response); (7) response rate to play initiations (1 = gave no response, 3 = full response); (8) response appropriateness (1 = not at all appropriate, 3 = very appropriate); and (9) communication breakdown (3 = no breakdown, 1 = breakdown without repair). A total score was calculated by averaging all scale items.

To establish the validity of the two new behavioral indices, intercorrelations were calculated among IQI, PBI, and the parents' ratings of children's social behaviors (CBS, 1996), with the resulting correlation coefficients ranging from moderate to high. The two new social indices were highly correlated ($r_{\text{IQI-PBI}} = .83$, $p = .001$). The PBI was marginally correlated with the parents' ratings of children's social behaviors (reverse scored; $r_{\text{PBI-CBS}} = -.59$, $p = .07$), and the IQI was marginally correlated with the parents' ratings ($r_{\text{IQI-CBS}} = -.54$, $p = .10$), suggesting that the new measures tap into similar but distinct areas of behavior.

In addition to these measures, a Demographic Questionnaire recorded the children's race/ethnicity, and parents' education and income, to evaluate the comparability of the deaf and hearing samples and to identify statistical covariates.

Results

Peer Task: Differences in Peer Interactions of Deaf and Hearing Children

Table 1 summarizes Peer Task scores of the deaf children in the Dyad and Triad conditions and the hearing children's scores collapsed across conditions. Comparisons between the deaf and hearing samples were

Table 1 Peer behaviors of deaf and hearing children by play condition

Children with implants			Hearing children
Mean number of minutes* (<i>SD</i>) /Mean Likert score (<i>SD</i>)	Dyad (<i>N</i> = 5)	Triad (<i>N</i> = 5)	Across conditions (<i>N</i> = 6)
Verbalization*	15.00 (8.54)	8.80 (7.29)	11.86 (8.11)
Social attention*	7.60 (8.73)	8.00 (5.43)	11.23 (9.15)
Solitary constructive*	1.00 (1.41)	3.00 (4.47)	0.33 (0.81)
Interaction*	10.20 (7.82)	8.00 (7.58)	7.63 (9.16)
Collaborative play*	1.20 (2.68)	1.00 (1.41)	0.26 (0.65)
Peer group entry	2.46 (0.86)	2.06 (1.01)	2.33 (0.73)
Entry bids	2.60 (0.54)	1.60 (0.89)	2.33 (0.81)
Success of entry bids	2.40 (0.89)	1.60 (0.89)	2.20 (0.44)
Response to others' bids	2.40 (0.54)	1.80 (0.83)	2.50 (0.50)
New play initiations	2.40 (0.89)	1.80 (1.09)	2.33 (0.81)
Success of initiations	2.75 (0.50)	1.80 (1.09)	2.20 (0.44)
Response to initiations	2.75 (0.50)	2.00 (1.0)	2.60 (0.54)
Response appropriate	2.50 (0.57)	1.80 (1.09)	3.00 (0.00)
Communication breakdown	2.25 (0.68)	2.23 (0.86)	3.00 (0.00)
PBI total	2.31 (0.78)	1.82 (0.88)	2.40 (0.52)
IQI total	91.6 (11.10)	87.00 (13.98)	86.76 (11.10)

* $p < .05$.

conducted only on the peer group entry measure, using deaf children's Dyadic entry scores ($N = 5$) and hearing children's entry scores collapsed across conditions ($N = 6$). This comparison was possible because the hearing children who served as hosts were always paired with one child during the first 5 min of the session, thus participating in Dyadic entry in either group size condition. The rest of the Peer Task scores could not be compared because they were collected under nonequivalent conditions or because group cell sizes were too small.

The results showed that Dyadic peer group entry, requiring participants to join one unfamiliar child in play, presented no difficulty for most children in our sample. We compared the five deaf children in the Dyad condition (paired with one hearing child) and the six hearing children (paired with one hearing or one deaf child) and found no significant differences in their entry behaviors. Of the five deaf children, three completed peer entry with no difficulty, one experienced some difficulty, and one child failed to enter the peer group. Of the six hearing children, two completed entry, three experienced some difficulty, and one child did not enter, $\chi^2(2, N = 11) = 1.11, ns$.

There were no significant differences between the deaf and hearing children's scores on the measure of self-esteem or any of its subscales.

The Effects of Group Size on Deaf Children's Peer Entry and Play Behaviors

Comparing deaf children with implants across group size suggested that they were more successful when socializing in one-on-one peer situations than when approaching an already established dyad of unfamiliar hearing peers. Table 1 depicts the means and *SDs* of observed peer behaviors of deaf children in the Dyad and Triad conditions, using all subscales of the IQI and PBI and a measure of verbalization. In the Dyad condition, in which one deaf and one hearing child played for 30 min, deaf children scored consistently higher on all prosocial behavior indicators (PBI) than in the Triad condition in which they joined an "established" dyad of hearing peers after 5 min of play. Specifically, the Triad condition made it marginally

more difficult for deaf children to initiate entry bids (entry bids: $M_{Dyad} = 2.60, M_{Triad} = 1.60, \chi^2(2, N = 10) = 4.33, p = .11$) and to respond appropriately to bids (response appropriateness: $M_{Dyad} = 2.50, M_{Triad} = 1.80, \chi^2(2, N = 10) = 4.95, p = .08$). All other PBI indicators showed no significant differences across group size although the magnitude of mean differences was in the same direction, favoring the children in the Dyad condition. It is also important to note that the sizes of the Dyad and Triad groups were particularly small ($N = 5$) to detect anything but large differences between the group's outcomes. The marginally significant differences reported here reflect large effect sizes: entry bids Cramer's $\phi = .65$; response appropriateness Cramer's $\phi = .70$.

In the Dyad condition, only one deaf child failed to enter (20%), whereas in the Triad condition, two children failed to enter (40%). The IQI also showed consistent differences in the level of engagement achieved across conditions, although none of these reached statistical significance. On average, in the Dyad condition, deaf children spent almost twice as much time (15 min) verbalizing than in the Triad condition (8.8 min) and they spent most of the play session interacting or collaborating with their peers (Interaction and Collaborative Play combined score: Dyad = 11.4 min; Triad = 9 min). In contrast, in the Triad condition, deaf children were more likely to engage in solitary activities (social attention and solitary constructive combined score: 11 min) than in the Dyad condition (8.6 min).

Predictors of Peer Competence of Deaf Children With Implants

The parents' ratings of children's social competence (CBS; collected from parents of deaf children only) were correlated with the children's observational scores but were not related to children's self-esteem or other predictors of peer success, such as duration of implant use. Therefore, parent ratings were used only to establish the validity of observational coding (the IQI and PBI; see Measures section).

Gender. Gender was a strong predictor of peer competence in this study. Both deaf and hearing girls

Table 2 Intercorrelations among study variables (controlled for gender) in deaf children with implants ($N = 10$)

	Interaction Quality	Prosocial Behaviors	Self-esteem	Cognitive Competence	Maternal Acceptance	Physical Competence	Peer Acceptance
Duration of CI	.74*	.69*	.85**	.81**	.70*	.25	.42
Interaction Quality	—	.71*	.89**	.89**	.45	.64 [†]	.39
Prosocial Behaviors		—	.72*	.68*	.81**	.11	.28
Self-esteem Total			—	.80**	.57	.62 [†]	.62 [†]
Cognitive Competence				—	.60 [†]	.35	.17
Maternal Acceptance					—	-.19	-.05
Physical Competence						—	.61 [†]
Peer Acceptance							—

** $p < .01$, * $p < .05$, [†] $p < 1.00$.

displayed consistently higher rates of peer competence and prosocial behaviors than boys. Most of the 11 girls in the study (hearing and deaf girls, $N = 7$, 64%) entered the peer situation with no difficulty, whereas only one (9%) deaf girl failed entry. In contrast, none of the five (hearing and deaf) boys entered without difficulty: two boys (40%) entered with difficulty, and three (60%) did not enter at all (peer entry gender effect: $\chi^2(2, N = 16) = 6.92, p < .05$). Similarly, gender differences were seen across all indicators of peer competence (hearing and deaf PBI total score, $t(14) = -2.57, p < .05$; IQI total score, $t(14) = -3.44, p < .01$) and children's self-esteem as measured by the PPCSA ($t(14) = -2.40, p < .05$). Therefore, in all subsequent analyses, gender effects were statistically controlled. Table 2 provides the intercorrelations (controlled for gender) among study variables for the deaf children's sample, consisting of implant-related variables (duration of implant use), total scores on Peer Task indices (IQI and PBI), and the Self-esteem Total scale and its subscales (Maternal Acceptance, Cognitive Competence, Social Acceptance, Physical Competence). The significance of these effects is described below.

Duration of cochlear implant use. The duration of cochlear implant use and age at implantation emerged as strong predictors of deaf children's social competence after controlling for gender. Because the two variables are highly correlated (the younger the deaf child at implantation, the longer he or she used the implant at the time of the study, $r = -.91, p < .001$, an effect made even stronger by a narrow age range in our sample), only effects of the duration of implant use

are reported here. Deaf children who used their implants longer scored higher on Interaction Quality (IQI), spending more time in interactive and collaborative modes of play with their hearing peers ($r_{\text{controlled for gender}} = .74, p < .05$) while also exhibiting more prosocial behaviors measured by the PBI ($r_{\text{controlled for gender}} = .69, p < .05$). In particular, duration of implant use was associated with deaf children's greater rate of Peer Task entry success ($r_{\text{controlled for gender}} = .80, p < .01$). These effects remained robust even after controlling for both gender and group size (Dyad or Triad condition).

Self-esteem. Deaf children's self-esteem, measured by the four subdomains of the PPCSA (Harter & Pike, 1984), was highly correlated with children's social competence during the Peer Task. Controlled for gender effects, higher scores of self-esteem across domains (PPCSA total score) were associated with higher scores on Interaction Quality ($r_{\text{gender controlled}} = .89, p = .001$), higher rates of Prosocial Behavior ($r_{\text{gender controlled}} = .71, p < .05$), and higher rates of peer group entry ($r_{\text{gender controlled}} = .65, p = .05$). Girls obtained higher scores on the self-esteem measure than boys (girls $M = 82.12$, boys $M = 68.50$; $t(8) = -2.37, p < .05$). Of particular interest was the significant effect of duration of implant use on two subdomains of self-esteem: the children's perception of cognitive competence ($r_{\text{gender controlled}} = .81, p < .01$) and perception of maternal acceptance ($r_{\text{gender controlled}} = .70, p < .05$), such that children who used the implant longer had more positive perceptions of their cognitive competence and maternal acceptance. Cognitive competence and maternal acceptance perceptions were also

strongly associated with children's peer competence across socialization measures.

Discussion

This pilot study examined the relationship among duration of cochlear implant use, deaf children's self-esteem, and ability to socialize with normally hearing peers under two conditions of difficulty. The results showed that 5- to 6-year old deaf children who had used implants for at least 1 year had no difficulty socializing with hearing peers in one-on-one situations but socialized less easily when faced with an already established dyad of unfamiliar hearing peers. In addition, the results suggested associations among duration of implant use, children's self-esteem, and their performance on the Peer Task. These relationships support the growing literature describing the benefits of cochlear implantation both in the areas of communication and socialization while pointing to the interactive nature of these factors in children's development (Bat-Chava et al., 2005; Schorr et al., 2009).

We found unexpected effects of gender that surpassed in importance all other variables in predicting peer competence across groups. Such effects have been often described in literature on gendered peer play, showing that girls are expected to be more active and prosocial with their peers, whereas boys' acceptance by other boys is not related to prosocial behaviors (Cillesen & Bellmore, 2004). Similarly, in same-sex peer groups, normally hearing girls accomplish peer entry more easily than boys, probably because they are more readily included by their female peers (Putallaz & Wasserman, 1989; Zaratany, Brunschot, Meadows, & Pepper, 1996). Although potentially useful in interpreting peer socialization effects, our finding is limited by a small sample size and unequal numbers of boys and girls included in our study. Therefore, gender effects in deaf children's peer competence should be further confirmed by future studies.

Deaf Children's Peer Competence in Dyads Versus Triads

The results of this study echoed previous reports by parents, suggesting that children with implants may

experience difficulties in large social settings (Bat-Chava & Deignan, 2001). This effect may be due to two factors: the greater difficulty on the part of the deaf child to attend to multiple conversations conducted simultaneously compared to one-on-one interactions (the acoustic effect) and the greater social difficulty arising from the need to join an existing group of peers and maintain play behaviors with two instead of one peer (the social effect). Because all children experience greater difficulty joining already established peer groups, or the social effect (Putallaz & Wasserman, 1989), it seems that deaf children may experience additional levels of difficulty by facing the combined effects of the social and acoustic challenges.

Although our study did not compare the deaf children's triad performance to a hearing control group (all of our hearing children acted as hosts rather than Peer Task entrants), a study by Boyd et al. (2000) conducted a Triad peer entry deaf-hearing comparison with 6- to 7-year-old children with implants. In their slightly older sample of 29 children, 27% failed to enter the peer group of hearing peers compared to 5% of hearing children who failed entry. In our study, 40% of deaf children failed Peer Task entry, a result comparable to Boyd et al.'s, considering that the children in our sample were younger and that age plays a significant role in peer entry success (Boyd et al., 2000; Putallaz & Wasserman, 1989). However, to confirm that deaf children with implants face difficulties during triad entry greater than those faced by children with normal hearing, a study using a larger sample of children is needed to clarify the relative contribution of hearing loss, age, gender, and group size to children's Peer Task performance.

Unlike previous observational studies, we found positive relationships between parents' ratings of their children's social competence and the results of behavioral observations using the Peer Task method. Specifically, the PBI, measuring behaviors contributing to peer success such as play initiations and appropriate responses, was negatively correlated with the combined CBS score (Asocial with Peers and Excluded by Peers) completed by the parents. This finding may be attributed to the young age of our participants: at preschool and Kindergarten ages, the deaf children's social activities were likely to be closely

monitored by their parents, contributing to the parents' knowledge of their children's social skills. In addition, parents of deaf children in our sample can be characterized as more closely involved in the children's everyday lives than parents of children with no disabilities. This is due to an increased need for assistance and advocacy that often improves deaf children's outcomes (Sarant, Holt, Dowell, Rickards, & Blamey, 2009).

Relationships Among Cochlear Implant, Self-esteem, and Peer Competence

Despite the relatively small size of our sample, duration of implant use emerged as a strong predictor of the social competence of deaf children. These results contribute to the large body of literature describing the increased efficacy of the implant after prolonged use (e.g., Hayes et al., 2009). However, the association between implant use and social competence has not been previously demonstrated using observational measures of socialization (e.g., in Boyd et al., 2000). With the IQI and PBI developed in this study, which capture the complexity of peer play behaviors, it may become easier to identify the progress that deaf children with implants are making in the area of social competence and the difficulties they are still facing. For example, we found that deaf children had a particular difficulty with entry bids.

Unlike older studies, we found no differences in self-esteem levels of deaf and hearing children, a trend recently corroborated by a study of deaf children aged 8–16 years, whose self-esteem scores were similarly equivalent to their hearing peers' scores (Loy, Warner-Czyz, Tong, Tobey, & Roland, 2010). However, within-group analyses revealed that deaf children's self-esteem scores were strongly associated with performance on the Peer Task (regardless of group size), while also being correlated with duration of implant use. Similarly, the role of perceived maternal acceptance, a self-esteem subscale strongly correlated both with duration of implant use and social outcomes in our study, has been noted in the literature. Parents serve as primary socializing agents to their deaf children, as evidenced, for example, by the positive effects of having deaf parents on deaf children's self-esteem

(Bat-Chava, 1993; Edwards & Crocker, 2008). Schorr et al. (2006) suggested that among hearing mothers who experience the cochlear implant process with their deaf children, sometimes a particularly strong feeling of being "tuned-in" develops between a mother and her child, which may help the child achieve a positive self-image.

Study Limitations and Future Directions

There are several caveats regarding our findings. First, our sample size was small; although the effects found were large enough to inspire confidence in their validity, more research with larger groups of children is needed to support and possibly extend these results. Another major limitation of this study is the absence of a comparison group of hearing children tested in the Triad condition. Because all children encounter more difficulty entering larger groups, a comparison group of hearing children is needed to clarify whether deaf children with implants socialize equally or less well than hearing children across group size. In addition, because the hearing children in this study attended more than one testing session, their familiarity with each other may have made it more difficult for the unfamiliar deaf child to enter. Finally, although some of our findings show that deaf children with implants may be very adept at interacting with unfamiliar hearing peers, at least within small group settings, these results need to be interpreted with caution. Eighty percent of the deaf children in our sample experienced some degree of communication breakdown. Our observations suggest that often the distinction between a successful play session and an unsuccessful one was the child's ability to cope with communication breakdowns and repair them, sometimes with the help of the hearing playmates.

Studying children's competence across social situations accomplished two goals: (a) identifying particular group dynamics that arise in children's play settings to determine how these affect the participation of children with implants and (b) identifying the conditions in which deaf children face obstacles so that interventions may be designed and implemented. Our findings, although limited by a small sample size, establish the presence of social skills the children with

implants display in one-on-one social situations in which they seem to perform as well as their hearing peers. These findings, in turn, suggest possibilities of building on these skills to improve deaf children's social competence in larger groups that may present them with more social difficulty.

Research shows that children's social skills may be enhanced by targeted interventions, especially in the areas of peer entry and cooperative play (e.g., Brown, Odom, & Conroy, 2001; Putallaz & Gottman, 1981). For example, Timler and her colleagues reviewed strategies for peer entry and cooperative play training among language-delayed preschoolers, demonstrating the efficacy of such early interventions that aim to prevent peer interaction problems in later years (Redmond & Timler, 2007; Timler, Olswang, & Coggins, 2005). Although still under development, recent interventions with children who have language impairments show great promise, especially when using both teacher and peer-modeled training disrupting the "negative social spiral" that may move less socially adept children further away from their peer groups.

Future research should explore in greater detail the dynamics of making entry bids, responding to bids by others, and achieving cooperative play in the overall ecology of children's normative play (Cillesen & Bellmore, 2002). For example, no study has examined the outcomes of a peer entry situation in which the deaf child is one of the hosts: Would the newly entering hearing child become more favored by the other hearing child over the original deaf playmate? A related focus may examine the progression of peer interactions over time; with practice, both deaf and hearing playmates may become more adept at coping with communication difficulties. Peer Task situations should be studied also in more naturalistic environments; for example, children's behavior could be observed at playgrounds or preschool settings, to achieve more generalizable results.

The focus on children's negotiations of social and communicative demands should be combined with attention to the specific peer contexts that children with implants face at different stages of development. Our research following one cohort of children with implants for 9 years suggests that communication skills appropriate to a younger age may no longer be

adequate at later ages, especially for children who do not display great confidence around hearing peers (Bat-Chava, Esposito, & Martin, 2009). Other studies (Schorr et al., 2006) found that older deaf children's levels of self-esteem may decrease compared to younger children, owing perhaps to the new challenges faced in the more complex social worlds of adolescents, in which increasing peer group size may also play a role. We can ask the question, does peer success accumulated during the younger years contribute to later self-esteem, serving as a buffer in these more demanding social situations? If so, identifying optimal conditions for self-esteem building together with other factors affecting social competence of deaf children with implants may open rich opportunities for interventions.

Conflicts of Interest

No conflicts of interest were reported.

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