Literacy Skills in Children With Cochlear Implants: The Importance of Early Oral Language and Joint Storybook Reading

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The goal of this study was to longitudinally examine relationships between early factors (child and mother) that may influence children's phonological awareness and reading skills 3 years later in a group of young children with cochlear implants ($N = 16$). Mothers and children were videotaped during two storybook interactions, and children's oral language skills were assessed using the "Reynell Developmental Language Scales, third edition." Three years later, phonological awareness, reading skills, and language skills were assessed using the "Phonological Awareness Test," the "Woodcock–Johnson-III Diagnostic Reading Battery," and the "Oral Written Language Scales." Variables included in the data analyses were child (age, age at implant, and language skills) and mother factors (facilitative language techniques) and children's phonological awareness and reading standard scores. Results indicate that children's early expressive oral language skills and mothers' use of a higher level facilitative language technique (open-ended question) during storybook reading, although related, each contributed uniquely to children's literacy skills. Individual analyses revealed that the children with expressive standard scores below 70 at Time 1 also performed below average (<85) on phonological awareness and total reading tasks 3 years later. Guidelines for professionals are provided to support literacy skills in young children with cochlear implants.

It is undisputed that children who are deaf are at risk for significant reading deficits (Marschark, 2007; Wauters, van Bon, & Tellings, 2006). In fact, many young adults who are deaf or hard of hearing perform below grade level in the areas of reading vocabulary and comprehension (Traxler, 2000). With greater opportunities for developing age-appropriate spoken language (Svirsky, Robbins, Kirk, Pisoni, & Miyamoto, 2000) and phonological awareness skills (James, Rajput, Brinton, & Goswami, 2007; James, Rajput, Brown, Sirimanna, Brinton, & Goswami, 2005), deaf children with cochlear implants have the potential to achieve higher levels of reading achievement than previously demonstrated by some children using hearing aids (Spencer, Tomblin, & Gantz, 1997; Vermeulen, van Bon, Schreuder, Knoors, & Snik, 2007). Several school-aged children with cochlear implants may even reach reading competencies commensurate with their hearing peers (Geers, 2003; Spencer, Gantz, & Knutson, 2004). Yet, even within cohorts of children, implanted fairly young, extreme variability was noted in reading skills with many elementary school-aged children and young adults with cochlear implants substantially lagging behind same-aged hearing students (James et al., 2007; Spencer, Barker, & Tomblin, 2003; Vermeulen et al., 2007). Although two studies have been published regarding phonological awareness with school-aged cochlear implant users (James et al., 2005, 2007), very little is known regarding phonological awareness skills in a group of younger children with cochlear implants. Variability in reading skills for this population of cochlear implant users may be, in part,

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due to children's early literacy skills and their literacy environment. The goal of this study is to identify early child and maternal factors that may explain the variability in children's later phonological awareness and reading abilities in order to better support emergent literacy family practices and to aid in designing new literacy programs for young deaf children with cochlear implants.

Emergent Literacy

Whitehurst and Lonigan (2001) refer to "emergent literacy skills" as children's preliterate skills typically acquired in the preschool years that develop into conventional literacy. Such skills include children's development of oral language, phonological awareness, and print knowledge (Whitehurst & Lonigan, 1998). Young children's vocabulary knowledge, for instance, plays a central role in learning to read (Senechal, Ouellette, & Rodney, 2006). The ability to understand and manipulate various sounds to make new words—phonological awareness—is also a strong predictor for later reading success in hearing children (Phillips & Torgesen, 2006) and potentially for deaf children, especially those children who are implanted early (<4 years) (James et al., 2007). Parents' provision of specific language techniques during joint book reading with their children can further facilitate language skills in hearing children (Pullen & Justice, 2003) and children who are deaf (Aram, Most, & Mayafit, 2006; DesJardin, 2006; DesJardin & Eisenberg, 2007; Fung, Chow, & McBride-Chang, 2005) and can support phonological awareness skills in hearing children with language delays (Ezell & Justice, 2005). A solid foundation in both oral language and phonological awareness skills is essential for later reading achievement in hearing children (Catts, Fey, Tomblin, Zhang, 2002; Kamhi & Catts, 2002; Philips & Torgesen, 2006; Shonkoff & Phillips, 2000).

Phonological Awareness and Reading in Hearing Children

Phonological awareness refers to the knowledge of sound structure and systematic patterns of oral language (Lonigan, Burgess, Anthony, & Barker, 1998). Children who are competent in phonological awareness tasks have the ability to understand and orally manipulate various sounds. Generally speaking, phonological awareness is thought to include rhyming, alliteration, word awareness, syllable awareness, and phoneme awareness (Ezell & Justice, 2005). This involves an understanding, or awareness, that a single-syllable word such as "hat," which is experienced by the listener as a single beat of sound, actually can be divided into three sounds (phonemic segmenting). Another phonological awareness skill is the ability to listen to three individual sounds (e.g., b–a–t) and blend them together sequentially to make words (phonemic blending). Research has indicated that the two most important skills for beginning readers are segmenting and blending (Jorm & Share, 1983; Share, Jorm, MacLean, & Matthews, 1984). The conscious awareness of phonemes sets the stage for children to discover the relationship between sounds and letters that will, in turn, facilitate the recognition of new words in print (Kamhi & Catts, 2002; Stahl, Duffy-Hester, & Stahl, 1998; Storch & Whitehurst, 2002).

Phonological awareness skills develop gradually over time from larger to smaller units during early childhood (Ziegler & Goswami, 2005). Although phonological awareness was once thought to be a skill that developed with the onset of literacy instruction, we now have substantial evidence indicating that even preschool children who have never received instruction in reading often have emerging phonological awareness skills (Foy & Mann, 2006; Lonigan et al., 1998). In fact, children typically demonstrate explicit awareness of syllables at 3 years of age and the ability to rhyme at 4 years of age (Carroll, Snowling, Hulme, & Stevenson, 2003). As preschool children mature, phonological awareness skills continue to develop even before the onset of literacy instruction in kindergarten (Foy & Mann, 2006). That is, children seem to acquire an increasing ability to notice, think about, and manipulate the phonemes in words as they attend school from kindergarten through early elementary school (Good, Wallin, Simmons, Kame'enui, & Kaminski, 2002; Gillon, 2004).

Several different types of early skill abilities and experiences have been suggested to influence children's phonological development. One such skill is children's oral language competencies. In a study by

Metsala (1999), children with the best receptive vocabulary also demonstrated better scores on an isolation task and a phoneme-blending task than children with weaker vocabulary skills. Similarly, Rvachew (2006) found that prekindergarten receptive vocabulary size explained a significant amount of unique variance in phonological awareness abilities at the end of kindergarten. Other research findings have indicated that expressive vocabulary skills better predict phonological awareness abilities (Cooper, Roth, Speece, & Schatschneider, 2002; McDowell, Lonigan, & Goldstein, 2007). Presumably, children with stronger oral vocabulary skills have a richer representation of word parts, and these represented segments facilitate growth in phonological awareness (Senechal & Le Fevre, 2002).

On the other hand, young children with limited oral language skills typically have difficulty with phonological awareness tasks, and consequently, demonstrate later challenges in reading achievement at the school-aged level (Catts et al., 2002; Ezell & Justice, 2005; Hoover, 2002; Stone, Stillman, Ehren, & Apel, 2004; Storch & Whitehurst, 2002; Wagner et al., 1997). The National Reading Panel (2001) report strongly suggests a causal relationship between phonological awareness and reading accuracy by showing that experimental manipulations of phonological awareness through direct training have a positive influence on the subsequent growth of reading acquisition. Although there has been some controversy over the direct impact that phonological awareness has on reading development (Castles & Coltheart, 2004), many intervention studies (Castiglinoni-Spalten & Ehri, 2003; Hecht & Close, 2002; Justice, Kaderavek, Bowles, & Grimm, 2005; Oudeans, 2003) and literacy programs designed to teach young hearing children phonological awareness skills have been shown to prevent substantial reading delays in these children (Lonigan, 2006; Senechal et al., 2006; Snow, Burns, & Griffin, 1998).

Phonological Awareness and Reading in Deaf Children

Research studies investigating phonological awareness in populations of children who are deaf have focused primarily on school-aged deaf children who wear hearing aids. In order to measure phonological awareness, many research studies utilized tasks using printed or picture-based stimuli rather than oral-based measures. Generally speaking, although school-aged deaf children with hearing aids are able to perform phonological awareness tasks (syllable, rhyme, and phoneme), they demonstrate skills similar to younger hearing children (Gibbs, 2004; Hanson & Fowler, 1987; Miller, 1997; Most, Aram, & Andorn, 2006). A review of overall research in this area, although fairly limited, suggests that children with hearing loss seem to be at risk for poor phonological awareness skills, which are generally regarded as important for the acquisition of word decoding and consequently reading achievement in deaf children (for a more thorough review, see Harris & Beech, 1998; Moeller, Tomblin, Yoshinaga-Itano, Connor, & Jerger, 2007; Nielsen & Luetke-Stahlman, 2002; Paul, 1998).

Early oral language skills may be one factor that influences children's later phonological awareness in children who are deaf or hard of hearing. Findings from the study of Harris and Beech (1998) suggest that oral skills were positively related to phonological awareness and the early stages of learning to read in 5-year-old children with severe-to-profound hearing loss. Similar findings were found in school-aged children with hearing loss (Luetke-Stahlman & Nielsen, 2003). More specifically, the ability of the students to read was positively associated with their ability to understand word meanings and to blend phonemes and syllables successfully.

Contrary to strong evidence that suggests a positive link between phonological awareness and reading achievement in hearing school-aged children (Hoover, 2002; Lonigan, 2006), mixed results have been found in children who are deaf or hard of hearing. Although no relationship was found between these two literacy constructs for children with moderate hearing loss in the one published study with this population (Gibbs, 2004), other research findings suggest that deaf children who are good readers demonstrate better developed phonological awareness skills than poor readers who are deaf (Luetke-Stahlman & Nielsen, 2003; Nielsen & Luetke-Stahlman, 2002). More specifically, Luetke-Stahlman and Nielsen (2003) found that children who are deaf and scored highest on a passage comprehension task were also able to correctly substitute one phoneme for another to create new words more often than were readers with lower comprehension scores.

Phonological Awareness and Reading in Children with Cochlear Implants

To date, only two studies have directly investigated phonological awareness skills in children who are deaf and use cochlear implants (James et al., 2005, 2007). Both studies focused on school-aged children. It is important to note that all the children were attending public mainstream settings and receiving formal reading instruction. Neither study investigated children's early language and later phonological awareness skills. In a short-term longitudinal study consisting of 19 children (M = 8.4 years), James et al. (2005) showed that phonological awareness skills developed over a period of time and in the same sequence as that found in typically developing hearing children. Similar to hearing children, syllable and rhyme awareness preceded phoneme awareness for this particular group of children with cochlear implants. However, the children in this study performed equal to or worse than the hearing aid users with profound hearing losses on two out of three phonological awareness tasks. Findings from this study further confirm previous research on children with moderate hearing loss with hearing aids (Gibbs, 2004), suggesting no significant relationship between phonological awareness and reading tasks after controlling for children's vocabulary knowledge.

Although there have been mixed results, child factors (e.g., age at cochlear implantation) may also influence phonological awareness and reading outcomes for children with cochlear implants. Some researchers note a sensitive period for children to receive their cochlear implant for better spoken language (Kirk, Miyamoto, Ying, Perdew, and Zuganelis, 2002) and reading achievement (Archbold, Nikolopoulos, & O'Donoghue, 2006; Connor & Zwolan, 2004; James et al., 2007; Vermeulen et al., 2007). James et al. (2007) investigated whether the age at cochlear implant fitting had an impact on the degree to which deaf children were sensitive to the phonological structure of spoken language. The participants in this study were divided into two groups: earlier (2–3.6 years) and later (5–7 years) implanted children. Results suggest that as a group, the children fitted earlier had better performance outcomes on phonological awareness, vocabulary, and reading compared to their hearing peers. Conversely, Geers (2004) noted no significant relationships between child factors (e.g., socioeconomic status [SES] and age of identification) and children's language and reading outcomes. This article will explore the relationships between child (e.g., age and age at implant fitting) and maternal factors (e.g., household income and education level) that may influence children's phonological awareness and reading skills in order to provide a better understanding of the contributions those factors may have on literacy outcomes for a younger group of deaf children with cochlear implants.

Parental Contributions to Phonological Awareness and Reading

Parent–child joint book reading is an essential activity for later phonological awareness and reading achievement (Burgess, Hecht, & Lonigan, 2002; Hoover, 2002). Through caregiver–child storybook interactions or joint book reading, parents or caregivers can provide the necessary linguistic input to assist receptive and expressive language growth. This has been demonstrated with young preschool-aged children with hearing (Bergin, 2001; Bus, 2001; Ezell & Justice, 2005; Kassow, 2006; McKeown & Beck, 2006; Weizman & Snow, 2001), kindergarten children with hearing loss (Aram et al., 2006; DesJardin & Eisenberg, 2006), and specifically, preschool to early elementary school-aged children with cochlear implants (DesJardin & Eisenberg, 2007). Higher quality parent–child storybook interactions further prepare typically developing hearing children for school-aged reading tasks (Clingenpeel & Pianta, 2007; Justice & Pullen, 2003), such as word decoding and reading comprehension skills (Dieterich, Hebert, Landry, Swank, & Smith, 2004).

Observations of parent–child storybook reading interactions provide an important means for attaining key insights into parental use of specific facilitative language techniques. Whitehurst, Falco, Lonigan, & Fischel (1988) define explicit communicative techniques that parents employ to encourage children to take an active role during joint book reading (e.g., dialogic reading). Techniques such as open-ended question, recast, and expansion have been shown to support oral language skills in groups of preschool hearing children (Ard & Beverly, 2004; Bradshaw, Hoffman, & Norris, 1998; Ezell, Justice, & Parsons, 2000; McNeill & Fowler, 1999; Nelson, Camarata, Welsh, Butkovsky, & Camarata, 1996; Richards, 1994), children with specific language delays (Cleave & Fey, 1997; Lonigan, Bloomfield, Dyer, & Samwel, 1999; Pullen & Justice, 2003), and young deaf children (DesJardin & Eisenberg, 2007; Fung et al., 2005).

DesJardin and Eisenberg (2007) found that mothers' use of higher level facilitative techniques was positively related to language skills in preschool- and early school-aged deaf children with cochlear implants. In fact, after controlling for child factors (e.g., child age and length of cochlear implant use), recast emerged as a strong predictor variable for receptive language, whereas open-ended question was a significant predictor variable for expressive language. Although the findings do not suggest a cause and effect relationship, it could be the case that some mothers may have been using lower level techniques even when their children were ready, according to their language skills, for the use of higher level techniques. These particular higher level techniques encourage participation and conversation (e.g., a child's response) during storybook reading, eliciting more complex vocabulary and syntactic skills in young children (Pullen & Justice, 2003).

Conversely, certain types of language techniques during joint book reading may hinder children's language acquisition skills and reduce child-initiated communication during this activity. In particular, techniques tailored for children who demonstrate lower level language skills (e.g., closed-ended question), negatively affect language acquisition of preschool hearing children who are demonstrating use of two to three word phrases (McNeill & Fowler, 1999). More recently, findings from DesJardin and Eisenberg (2007) suggest that lower level techniques such as linguistic mapping, label, and directive hinder language development for young deaf children with cochlear implants who demonstrate more complex language structures (e.g., three or more word combinations). Hence, some variability in children's language acquisition may be attributed to parents' use of facilitative language techniques that do not reflect their child's particular language level.

Although parental language techniques seem to improve children's language, less is known about how those same techniques during joint storybook reading relate to children's literacy skills. Recent intervention experiments have been designed to investigate parental facilitation of phonological awareness and reading skills during joint book reading for children with delayed language (Justice et al., 2005; Whalon, Hanline, & Woods, 2007). Justice et al. (2005) investigated the feasibility and outcomes of a parent-implemented phonological awareness intervention for young hearing children with specific language impairment. Children in the experimental group who were provided with rhyme and alliteration training tasks in a 10-week intervention program performed better on phonological awareness posttests (rhyme awareness only) than children who received an alternate vocabulary-building training task during the intervention.

To our knowledge, only one study investigated the relationships between joint book reading activities and literacy outcomes in children who are deaf. Aram et al. (2006) investigated 30 Israeli mothers and their kindergarten children with hearing loss (range from mild to profound). All the children used sensory aids, and 11 children were cochlear implant users. The mean age of identification was 29 months, and although not stated, the children most likely received their cochlear implants over 3 years of age. Findings from this study suggest that joint book reading (coded as interactive reading and the use of Wh questions) predicted children's phonological awareness (one subtest of phoneme awareness only) beyond that of children's age and degree of hearing loss. The present investigation furthers our understanding of the relationships between early child factors (e.g., age, age at implant, and language skills) and maternal factors (e.g., facilitative language techniques) that may contribute to several aspects of phonological awareness and reading skills in a younger implanted group of deaf children with cochlear implants.

Purpose of the Study and Research Questions

The purpose of this longitudinal study was to examine the unique contributions of children's early language skills and mothers' facilitative language techniques during storybook reading on later literacy skills in a group of young deaf children with cochlear implants. The following questions were addressed:

1. What is the strength of the relationships between children's receptive and expressive language skills at Time 1 (T_1) and their literacy outcomes 3 years later at Time 2 (T_2)?
2. Are mothers' facilitative language techniques during storybook interactions at T_1 associated with their children's later phonological awareness and reading abilities at T_2, and
3. What specific early child (age, age at implant, and language skills) or maternal factors (family income, education level, and facilitative language techniques) contribute to literacy outcomes for this population of young deaf children with cochlear implants?

Methods

Participants

The mothers and children were recruited from a list generated from a prior investigation at T_1 (DesJardin & Eisenberg, 2007) at the Children's Auditory Research and Evaluation (CARE) Center located at House Ear Institute in Los Angeles, CA. The CARE Center serves families and children from birth to 18 years, providing a range of services that include diagnosis of hearing loss and audiological follow-up services. Children who are deaf and wear cochlear implants are seen annually for ongoing services.

Mothers. Sixteen mother–child dyads participated in this longitudinal study (50% of the participants from the DesJardin & Eisenberg, 2007 study). There were no significant differences in demographic variables (e.g., age, education level, marital status, number of children, and number of weekly work hours outside the home) between the mothers who participated in this study and the mothers who chose not to participate, except for family income $F(1, 31) = .155, < .001$. The mothers in this study had significantly higher family income than the mothers who chose not to participate. It is important to note that several families stated why they were not able to partake in this study; seven families moved from the area and two families stated that they could not participate due to the children's school obligations. As displayed in Table 1, the average age for mothers at T_2 was 41.1 years (range 32–48). Mothers were primarily Caucasian (75.0%), all spoke English as their primary language (100.0%) and the majority had some college experience (81.4%).

Children. All the children presented with bilateral profound sensorineural hearing loss, were multichannel cochlear implant users and were enrolled in a preschool or school-aged program. As per their medical charts, none of the children had an additional disability or known developmental delay. As part of the inclusion criteria for this study, all the children used spoken English as their primary (and only) mode of communication.

As shown in Table 2, children ranged in age from 2.7 to 6.3 years ($M = 4$ years, 4 months) at T_1. Three years later at T_2, children ranged in age from 5.7 to 9.3 years ($M = 7$ years, 5 months). With such a range in ages, it is reasonable to assume that the older children may have had more exposure to literacy activities than the younger children and that mothers may talk differently to younger versus older children. It could also be the case that mothers may use certain language techniques depending on their child's language

Table 1 Demographic characteristics of mothers at T_2 ($N = 16$)

Mothers' characteristics	Mean (*SD*, range)
Age	41.1 years (4.42, 32–48)
Education level	Elementary 1 (6.3%)
	High school 2 (12.5%)
	College experience 9 (56.3%)
	Postgraduate 4 (25.1%)
Household annual income	\$15,000–\$29,000 = 0 (0.0%)
	\$30,000–\$49,000 = 3 (18.8%)
	\$50,000–\$74,000 = 2 (12.5%)
	\$75,000–\$100,000 = 3 (18.8%)
	>\$100,000 = 8 (50.0%)
Marital status	Married 15 (93.8%)
	Divorced 1 (6.3%)
Ethnicity	Caucasian 12 (75.0%)
	Latino 3 (18.8%)
	Asian-American 1 (6.3%)
Primary home language	English 15 (93.8%)
	Spanish 1 (6.3%)

Table 2 Demographic characteristics of children at T_1 and T_2 ($N = 16$)

Characteristics of children	Mean (*SD*, range)
Age at testing T_1	53.0 months (12.60, 32–76)
Age at testing T_2	89.6 months (12.28, 68–112)
Gender	Girls 9 (56.3%) Boys 7 (43.8%)
Age at identification	9.8 months (6.71, newborn to 22)
Age at hearing aids	11.9 months (6.90, 2–24)
Age at cochlear implant	25.9 months (6.93, 12–39)
Length of cochlear implant use (T_1)	26.1 months (10.98, 12–44)
Length of cochlear implant use (T_2)	63.4 months (10.68, 48–82)
Age at enrollment in early intervention	12.1 months (7.41, 2–27)
Degree of hearing loss (in better ear)	Severe to profound 3 (18.8%) Profound 13 (81.3%)
Aided pure-tone average with cochlear implant activation	26.8 dB hearing level (HL) (7.16, 15–40 dB HL
Primary mode of communication (T_1)	Auditory–oral 13 (81.3%) Auditory–oral with sign 3 (18.8%)
Primary mode of communication (T_2)	Auditory–oral 16 (100.0%) Auditory–oral with sign 0 (0.0%)
RDLS: receptive language age (T_1)	31.1 months (9.48, 16–45)
RDLS: expressive language age (T_1)	30.0 months (8.24, 17–47)
OWLS: receptive language age (T_2)	62.1 months (18.31, 29–84)
OW LS: expressive language age (T_2)	56.4 months (15.91, 32–84)

abilities. Therefore, our data analyses controlled for child age and language age. These two variables are among the main controlled variables in studies of the development of children with hearing loss (e.g., Aram et al., 2006; Fung et al., 2005; Pipp-Siegel, Sedey, Van leeuwen, & Yoshinaga-Itano, 2003). It should also be noted that despite the wide range in chronological age, there was less variability in language age (i.e., language skills), with all children being at language ages that were appropriate for interactive joint book reading or dialogic reading techniques (Zevenbergen & Whitehurst, 2003).

As a group, the children were identified with a hearing loss at 9.8 months (range newborn to 22 months) and received their cochlear implant at 25.9 months of age (range 12–39 months). Eight children had been fitted with their cochlear implant between the ages of 1.0 and 2.0 years ($M = 20.9$ months). The other eight children were fitted later, between the ages of 2.2 and 3.3 years ($M = 30.9$ months). In order to explore the effect of age at implant on children's outcome variables, we divided the participants into two groups: earlier (<2.0 years) and later (>2.0 years) implanted children. It is important to note, however, that as a whole group, children in this study were considered early implant recipients when comparing definitions of the term, early, in prior recent studies (Aram et al., 2006; James et al., 2007).

At T_1, children's mean receptive and expressive oral language skills were 2.6 years (range 1.3–3.8) and 2.5 years (range 1.4–3.9), respectively. At T_2, children's receptive and expressive language skills were 5.2 years (range 2.4–7.0) and 4.7 years (range 2.7–6.8), respectively (see Table 2). Thus, children's language skills at both time points were lower than their chronological age, yet were commensurate to or higher than their length of implant use (T_1, $M = 2.2$ years; and T_2, $M = 5.3$ years).

Measures at T_1

Reynell Developmental Language Scales, third edition. The Reynell Developmental Language Scales, third edition (RDLS-III) (Reynell & Gruber, 1990) are individually administered tests of verbal comprehension and expressive language skills for young children (1.0– 6.11 years). The RDLS-III uses toys (e.g., car and doll), pictures of objects (e.g., flower and chair), and real objects (e.g., cup and spoon) to elicit responses from the child. The two primary scales derived from the RDLS-III are verbal comprehension and expressive language. The 67 items on the verbal comprehension scale tap into children's receptive language skills. The expressive language scale also includes 67 items. The three subscales, structure, vocabulary, and content, are ordered developmentally with respect to the emergence of the language abilities they tap; however, there is substantial overlap in the continuing development of each aspect of expressive language. The two scales of the RDLS-III have been widely used in research with pediatric cochlear implant users (DesJardin & Eisenberg, 2007; Stallings, Gao, and Svirsky, 2002; Svirsky et al., 2000). Raw scores were converted to standard scores computed on the basis of normative data from children with normal hearing.

Mother–child storybook interactions. As part of a prior study at T_1 (DesJardin & Eisenberg, 2007), mothers and children were videotaped for 20 min during storybook reading tasks. Mothers were provided with two children's books, *What Next, Baby Bear!* (Murphy, 1983) and *Frog, Where Are You?* (Mayer, 1969). *What Next Baby Bear!* is a relatively short, colorfully illustrated book that contains a fantasy narrative about a little bear's preparations for a trip to the moon. *Frog Where Are You?* is a short wordless picture book about a pet frog who escapes from a jar, after which a sequence of misadventures befall a boy and his dog as they search for and eventually find the missing frog. The mothers were asked to interact with their children using the storybooks as they would typically do at home. Both books have been used in studies of children with hearing (Berman & Slobin, 1994; Weizman & Snow, 2001) and children who are deaf and hard of hearing (DesJardin, 2006; DesJardin & Eisenberg, 2007).

Measures at T_2

At time point two, not all the children were below the age for RDLS-III administration (<6.11 years). Yet, all the children were above the age for Oral and Written Language Scales (OWLS) administration (>3 years). Therefore, in order for sufficient data analyses, the children were administered the verbal portions of the OWLS. Two children were not administered the OWLS within the 2-week time frame of the literacy testing, and thus, were eliminated ($N = 14$).

Oral Written Language Scales. The OWLS (Carrow-Woolfolk, 1995) is a broad-based measure of communication that assesses comprehension and use of connected language in such formats as picture selection and sentence completion. The OWLS consists of three scales (i.e., Listening Comprehension, Oral Expression, and Written Expression); however, for this study, only the oral portions were administered. The skills of oral language are assessed using the Listening Comprehension Scale (LCS) and the Oral Expression Scale (OES). The LCS assesses the child's understanding of spoken language. On this scale, the clinician reads a verbal stimulus aloud and the child selects a picture that best represents the verbal stimulus. The OES assesses the child's understanding and use of spoken language. The clinician reads aloud a verbal stimulus, and the child responds to a visual/verbal stimulus by answering questions, completing a sentence, or producing sentences. In addition, the OWLS measure cognitive–academic language proficiency required in the general education classroom and is a better predictor of reading comprehension than Peabody Picture Vocabulary Test (Dunn & Dunn, 2007; Luetke-Stahlman & Nielsen, 2003). Raw scores on the OWLS were converted to standard scores with norms comparing the child's language skills to those of hearing children at the same age (standard score = 100; standard deviation [*SD*] = 15).

Phonological Awareness Test. The Phonological Awareness Test (PAT) (Robertson & Sattler, 1997) serves as a tool to measure children's ability on eight phonemic awareness tasks: rhyming, segmentation, isolation, deletion, substitution, blending, graphemes, and decoding. For this study, six tasks were selected (rhyme, segmentation, isolation, deletion, blending, and graphemes). The test was developed in response to the overwhelming research on emergent literacy development of young children with hearing that has concluded that there is a strong positive correlation between children's phonological and phonemic awareness and their success with reading. Raw scores were converted to standard scores and age equivalents based on normative data from children with normal hearing. Standard scores for each subtest and a total mean standard score (averaging the six subtests) were used for data analyses.

Woodcock–Johnson-III Diagnostic Reading Battery. The Woodcock–Johnson-III Diagnostic Reading Battery

(WJ-III DRB; Woodcock, Mather, & Schrank, 2004) is a comprehensive measure of reading achievement that corresponds to the five essential components of "Reading First" at either the cluster or test level. The subtests include word attack, letter–word identification, oral vocabulary, reading vocabulary, and passage comprehension. The WJ-III DRB is an individually administered, norm-referenced assessment (ages 4 and >90 years). Raw scores, standard scores, and their age equivalents are derived from normative data from typically developing children with hearing. Standard scores for each subtest and for total brief reading (letter–word and word attack) and basic reading (letter–word and passage comprehension) were used in the data analyses.

Procedure

Prospective participants (N = 32) from a previous study (DesJardin & Eisenberg, 2007) were sent an invitation letter and a stamped addressed postcard. Those interested in participating in the study completed the postcard and returned it to the first author. The videotaped session at T_1 was conducted in a comfortable room at the CARE Center for 10 min. Interactions were videotaped using a digital camera (Canon Optura 30) hidden behind a one-way mirror. The parent wore a SHURE Brothers, Inc., Wireless Microphone (ID DD4L11) and was seated directly next to the child (on the cochlear implant side). An omnidirectional boom microphone fixed to the wall of the room also was connected to the camera. Following the videotaping, the first author or a speech–language pathologist from the CARE Center assessed the children's receptive and expressive language skills using the RDLS while mothers completed a demographic questionnaire.

Three years later at T_2, the first author or a speech–language pathologist from the CARE Center evaluated the children's receptive and expressive language skills using the OWLS. Either on the same day or in a separate session, occurring within 2 weeks of the language evaluation, the first author assessed the children's phonological awareness and reading skills using the PAT and WJRB-III, respectively. All tests were administered orally and in the standardized format for hearing children. The duration of each test session was 30–45 min. Breaks were provided to the child as needed between testing sessions.

Data Preparation

Transcription and coding. All mother and child speech and other vocal utterances were transcribed in full by the first author, using the Codes for the Human Analysis of Transcripts transcription system (MacWhinney, 2000). The analysis was refined to capture the mothers' natural spontaneous vocabulary separately from the vocabulary drawn from the narrative book. Each of the mothers' utterances was coded as one of 10 facilitative language techniques using a previously published coding instrument (DesJardin & Eisenberg, 2007). As defined in Table 3, there are four techniques that are considered higher level techniques. These techniques are essential for developing more complex language once children are combining words together (open-ended question, recast, expansion, and parallel talk). The technique, recast, has been defined in several different ways (Conti-Ramsden, 1990; Fey, Krulik, Loeb, & Proctor-Williams, 1999; Nelson et al., 1996). Within each definition, recasts can take on a variety of forms. However, for this study, we only measured one form of recast, the act of recasting into a question format. We coded the transcripts in this way in order to distinguish the technique, recast, from the technique, expansion, to specify which technique may better influence children's literacy outcomes (see Table 3). As shown in Table 4, there are six techniques that are considered lower level techniques. These support young children who are at the one-word stage of language development (imitation, label, closed-ended question, linguistic mapping, directive, and comment). None of the children in this study was at a language age necessary for lower level techniques at T_1 (receptive language ages ranged from 1.3 to 3.8 years; expressive language ages ranged from 1.4 to 3.9 years). Proportional scores of each facilitative language technique were calculated and used in the analyses so as not to penalize less talkative, yet very responsive mothers. Accordingly, proportional scores were calculated by dividing the total number of each language technique by the overall number of mothers' linguistic attempts.

Table 3 Descriptions and examples of higher level facilitative language techniques during joint storybook reading

Higher level facilitative language techniques	Descriptions	Examples
Parallel talk	Caregiver provides a description about what the child is directly looking at in the storybook	Child is looking directly at a picture of a little bear sitting on the moon and caregiver says, "Little bear is ready for his picnic on the moon."
Open-ended question/phrase	Caregiver provides a question in which the child can answer using more than one word	Caregiver says, "What is happening in this picture?" or "What do you think will happen on the next page?"
Expansion	Caregiver repeats child's utterance by maintaining the child's word order with or without adding new information or words	Child says, "Froggy, go." and the caregiver says, "Froggy is going to jump in the water!"
Recast	Caregiver restates the child's utterance into a question format	Child says, "Little bear going up in the sky!" and the caregiver says, "Why is little bear going up in the sky? or "Little bear is up in the sky?"

Reliability. To establish interrater reliability of transcription and maternal language techniques, a speech–language pathologist from the CARE Center transcribed in full and coded 20% of the videotaped data (three random videotapes). A word-by-word calculation yielded a high reliability between transcribers, ranging from 92% to 95% agreement for mothers' and children's intelligible spoken utterances. A line-by-line analysis revealed high agreement between coders ranging from 90% to 94% reliability for mothers' facilitative language techniques.

Results

Descriptive Analysis

Table 5 presents mean standard scores (*SD*s), and minimum and maximum scores for children's receptive and expressive language skills and literacy measures at T_2.

Preliminary Analysis

Pearson product correlations were conducted to investigate the strength of the relationships between mother

Table 4 Descriptions and examples of lower level facilitative language techniques during joint storybook reading

Lower level facilitative language techniques	Descriptions	Examples
Imitation	Caregiver repeats child's preceding utterance	Child says, "frog" and mother says, "yeah, frog."
Label	Caregiver provides a label for a picture in the storybook	Mother says, "That is a moon."
Closed-ended question	Caregiver asks a question in which the child can only answer with one word	Mother asks the child, "Is that the bear?" or "Do you like that book?"
Linguistic mapping	Caregiver interprets the child's intended message by using the context as a clue. Child uses a preceding utterance that is not recognizable as an approximation of a word	Child pushes the book away and vocalizes—mother says, "all done."
Directive	Caregiver tells the child to do something or commands a behavior	"Come here," "read the word," "turn the page," "listen to me," and "look right here."
Comment	Caregiver states a comment to keep the conversation going or to positively reinforce the child	"You got it!," "That's right," "Very good," "Let's see," "wow!"

Table 5 Mean standard scores on language and literacy measures at T_2 ($N = 16$)

Language and literacy measures	Mean (*SD*, range)
OWLS receptive language ($N = 14$)	74.38 (18.00, 41–108)
OWLS expressive language ($N = 14$)	73.81 (19.69, 46–117)
Phonological awareness subtests	
Rhyming	82.13 (25.89, 35–114)
Segmentation	86.31 (21.46, 50–117)
Isolation	89.88 (23.43, 50–129)
Deletion	83.63 (25.00, 45–126)
Blending	75.31 (29.39, 42–125)
Graphemes	96.94 (20.35, 48–123)
PA total mean score	86.01 (22.06, 48–121.3)
Woodcock–Johnson Reading Battery subtests	
Word attack	95.69 (23.34, 50–134)
Letter–word identification	100.63 (18.28, 72–134)
Oral vocabulary	91.06 (18.11, 53–127)
Reading vocabulary	103.06 (12.96, 82–123)
Passage comprehension	93.56 (17.71, 68–128)
Basic reading composite	97.09 (17.51, 70–131)
Brief reading composite	98.09 (19.16, 71.5–134)

(e.g., maternal age, family income, and education level) and child (e.g., age and age at implant) demographic variables and literacy outcomes in order to control for those variables in the regression analyses. No significant associations emerged for mother factors and literacy outcomes. However, significant relationships emerged between one child factor (age at T_2) and children's brief ($r = .74$, $p < .01$) and basic ($r = .67$, $p < .01$) reading standard scores. Thus, child age was controlled for in the regression analyses pertaining to reading.

Independent sample *t*-tests were computed to investigate differences between groups (earlier vs. later implanted children) on all demographic variables that may contribute to later literacy abilities. No significant differences emerged between groups in terms of mother (e.g., age, family income, and education level) and child (age, age at hearing aids, and language skills) factors and phonological awareness and reading skills. In addition, independent sample *t*-tests revealed no significant differences between groups in terms of any of literacy variables: phonological awareness total mean standard score $F(1, 14) = .281$, not significant (ns); brief reading $F(1, 14) = .517$, ns; and basic reading $F(1, 14) = .366$, ns. Although the differences were not significant, earlier implanted children's standard scores ($N = 8$) were slightly higher in the areas of phonological awareness (early, 98.5; and later, 89.2) and basic reading (early, 101.4; and later, 100.3). In contrast, later implanted children's mean scores ($N = 8$) were slightly higher in brief reading (early, 95.8; and later, 97.4).

Results Organized by Research Question

"Research Question 1: What is the strength of the relationships between children's receptive and expressive language skills at T_1 and their literacy abilities 3 years later at T_2?" Pearson product correlations were conducted to investigate the strength of the relationships between children's language abilities and literacy skills. As shown in Table 6, a significant association emerged between children's expressive language skills as measured by RDLS at T_1 and phonological awareness abilities 3 years later in the subskill areas of rhyming ($r = .65$, $p < .01$), segmentation ($r = .77$, $p < .01$), isolation ($r = .63$, $p < .01$), deletion ($r = .53$, $p < .05$), and blending ($r = .53$, $p < .05$). Likewise, children's receptive and expressive language skills as measured by the OWLS at T_2 were positively related to children's phonological awareness subskill areas of rhyming ($r = .57$, $p < .05$; and $r = .65$, $p < .01$, respectively), segmentation ($r = .55$, $p < .05$; and $r = .50$, $p < .05$, respectively), and deletion ($r = .52$, $p < .05$; and $r = .53$, $p < .05$, respectively). No significant relationships emerged between children's receptive language skills as measured by the RDLS at T_1 and phonological awareness at T_2 and receptive/expressive language skills as measured by the OWLS at T_2 and phonological awareness skill areas of isolation, blending, and graphemes.

In terms of children's reading abilities, children's expressive language skills as measured by the RDLS at T_1 were positively related to children's word attack ($r = .67$, $p < .01$), letter–word identification ($r = .71$, $p < .01$), and reading vocabulary ($r = .71$, $p < .01$) 3 years later (see Table 6). Similarly, a positive relationships were found between children's receptive and

Table 6 Relationships between children's language (T_1 and T_2) and literacy skills

	Language T_1		Language T_2	
Children's literacy skills	Receptive	Expressive	Receptive	Expressive
Phonological awareness				
Rhyming	.36	.65**	.57*	.65**
Segmentation	.37	.77**	.55*	.50*
Isolation	.30	.63**	.41	.36
Deletion	.29	.53*	.52*	.53*
Blending	.27	.53*	.30	.41
Graphemes	.15	.31	.43	.39
Total mean standard score	.33	.63**	.51*	.52*
Reading				
Word attack	.40	.67**	.51*	.61*
Letter–word identification	.25	.71**	.48	.63**
Oral vocabulary	.24	.43	.37	.37
Reading vocabulary	.42	.71**	.51*	.49
Passage comprehension	.16	.35	.43	.59*
Basic reading composite	.23	.68**	.47	.63**
Brief reading composite	.36	.75**	.54*	.67**

Note. Basic reading = letter–word and passage comprehension; brief reading = letter–word and word attack.
*$p < .05$. **$p < .01$.

expressive language abilities as measured by the OWLS at T_2 and word attack ($r = .51$, $p < .05$, and $r = .61$, $p < .05$ respectively), letter–word identification ($r = .49$, $p < .05$, and $r = .63$, $p < .01$ respectively), and reading vocabulary ($r = .51$, $p < .05$, and $r = .49$, $p < .05$) at T_2. Furthermore, children's expressive language skills as measured by the OWLS at T_2 were positively related to children's passage comprehension ($r = .59$, $p < .05$). No significant relationships emerged for children's receptive language as measured by the RDLS at T_1 and any literacy variables.

"Research Question 2: Are mothers' facilitative language techniques during storybook interactions at T_1 associated with their children's later phonological awareness and reading abilities at T_2?" A series of Pearson product correlations were conducted to investigate the strength of the relationships between mothers' techniques at T_1 and children's literacy skills at T_2. Table 7 presents a strong positive relationship between one higher level technique (open-ended question) and phonological awareness mean standard score ($r = .50$, $p < .05$). Conversely, a significant negative association was evident between a lower level technique, linguistic mapping, and children's phonological awareness ($r = -.52$, $p < .05$).

In terms of reading, positive relationships emerged between the language technique, recast, and reading subskill areas of oral vocabulary ($r = .53$, $p < .05$) and

Table 7 Relationships between mothers' early facilitative language techniques and children's later literacy skills

Facilitative language techniques	PA mean score	Word attack	Letter–word identification	Oral vocabulary	Reading vocabulary	Passage comprehension
Parallel talk	.03	.09	.04	.04	.12	.03
Expansion	.02	.18	.01	.20	.08	.12
Recast	.26	.20	.18	.53*	.52*	.32
Open-ended question	.50*	.39	.48*	.12	.40	.50*
Linguistic mapping	−.52*	−.17	−.53*	−.12	−.50*	−.26
Closed-ended question	−.32	.17	.34	−.13	.14	.03
Imitation	.34	.36	.43	.14	.35	−.26
Label	.15	−.11	.01	.38	.17	.04
Directive	−.16	−.19	.03	−.14	−.07	−.03
Comment	−.21	−.13	−.08	−.26	−.10	−.11

*$p < .05$.

Table 8 Summary of the regression model for children's phonological awareness total mean standard score

Stepwise regression models	R	R^2	Change in R^2	Significance in F change
Model 1				
Expressive language at T_1	.631	.398		.009
Predictors for final model	β		p	
Expressive language at T_1	.631		.044	
Expressive language at T_2	.259		.310	
Open-ended questions at T_1	.121		.452	

reading vocabulary ($r = .52$, $p < .05$). Significant positive relationships emerged between open-ended question and reading subskill areas of letter–word identification ($r = .48$, $p < .05$) and passage comprehension ($r = .50$, $p < .05$). Conversely, significant negative associations were evident between linguistic mapping and reading subskill areas, letter–word identification ($r = -.53$, $p < .05$), and reading vocabulary ($r = -.50$, $p < .05$) (see Table 7).

"Research Question 3: What specific early child (age, age at implant, and language skills) and maternal factors (family income, education level, and facilitative language techniques) contribute to literacy outcomes for this population of young children with cochlear implants?" Due to the fact that children's language skills and mothers' facilitative language techniques are significantly related (DesJardin & Eisenberg, 2007), it is important to know the unique contribution of each. Independent variables that were positively related to children's phonological awareness (expressive language and open-ended question at T_1; receptive and expressive language at T_2) and reading subtest areas of letter–word identification and passage comprehension (child age, expressive language, and open-ended question at T_1 and receptive and expressive language at T_2) in the previous correlation analyses were included in the stepwise hierarchical multiple regressions. Because children's receptive and expressive standard scores as measured by the OWLS at T_2 were significantly correlated ($r = .81$, $p < .01$), we chose to use the expressive language score in the regression analyses.

Phonological awareness. For children's phonological awareness mean standard score as the outcome variable, children's expressive language skills at T_1 (RDLS) and T_2 (OWLS) were entered sequentially in block 1 and block 2 and maternal facilitative technique (open-ended question) was entered in block 3. As displayed in Table 8, children's expressive language at T_1, accounted for 39.8% of the variance for children's phonological awareness skills.

Basic reading. For children's total basic reading (word attack and letter–word identification) score as the outcome variable, child age at T_2 was entered in block 1, children's expressive language skills at T_1 (RDLS) and T_2 (OWLS) were entered in block 2 and block 3, respectively, and maternal facilitative technique (open-ended question) as block 4. Child age at T_2 accounted for 45.8% of the variance in children's basic reading skills, with children's expressive language and mothers' use of open-ended questions at T_1 accounting for an additional 21.0% and 9.3% (see Table 9).

Individual analyses were conducted to further explore children's expressive language skills and mothers' facilitative techniques at T_1 and literacy outcomes 3 years later. As illustrated in Table 10, participants are listed in order from highest to lowest expressive language standard score at T_1 as measured by the RDLS. Generally speaking, children who had expressive language standard scores at 70 or higher at T_1 also performed at or better than average (SS = 85 or 1 *SD* above the mean) on all literacy skills 3 years later at T_2. Conversely, children who had expressive language standard scores below 70 also had literacy standard scores below average (SS = 85 or 1 *SD* below the mean).

In addition, individual analyses of mothers' techniques showed variability between higher level and

Table 9 Summary of regression models for children's basic reading standard score

Stepwise regression models	R	R^2	Change in R^2	Significance in F change
Model 1				
Child age at T_2	.677	.458		<.01
Expressive language at T_1	.817	.668	.210	<.01
Open-ended questions at T_1	.889	.682	.093	<.05
Predictors for final model	β		p	
Child age (T_2)	.392		<.05	
Expressive language (T_1)	.540		<.01	
Open-ended questions (T_1)	.365		<.05	
Expressive language (T_2)	.280		ns	

lower level techniques utilized during storybook interactions. A total proportional score for higher (recast, open-ended question, parallel talk, and expansion) and lower level (label, imitation, directive, closed-ended question, comment, and linguistic mapping) techniques was computed by adding the proportional scores. Mothers of the children with larger standard scores also seemed to use more higher level facilitative techniques, whereas mothers of children with lower standard scores utilized proportionately more lower level techniques.

Discussion

Emergent literacy perspective highlights the importance of children's early language competencies and their literacy environments for later reading success. The main goal of this longitudinal study was to investigate the unique contributions of children's early language skills and mothers' facilitative language techniques during storybook reading to children's later phonological awareness and reading skills. We also examined early child (e.g., age and age at cochlear implant fitting) and mother (e.g., age, family income,

Table 10 Individual analyses of early mother and child factors (T_1) and later literacy skills (T_2)

Child	CI dB	Age at CI	Age T_1	Language age T_1	Language standard scores (SS) (percentile) T_1	Lower level T_1	Higher level T_1	PA mean T_2	Brief reading T_2	Basic reading T_2
1	33.3	12*	32	22	86 (19)	1.0	1.93	121.3	133.0	127.0
2	15.0	22*	60	47	86 (19)	1.29	2.32	93.3	113.5	104.0
3	40.0	18*	60	35	74 (5)	0.91	2.01	80.7	101.0	96.0
4	25.0	19*	41	30	73 (5)	0.92	2.08	92.5	95.0	115.0
5	30.0	26	38	26	72 (4)	0.94	2.00	108.8	134.0	131.0
6	25.0	24*	40	27	70 (3)	1.11	1.89	111.7	117.0	112.0
7	30.0	24*	49	37	70 (3)	1.0	2.0	105.7	110.0	107.0
8	25.0	28	52	30	70 (3)	0.95	2.11	91.3	95.0	92.0
9	15.0	27	39	23	67 (2)	0.73	2.25	104.2	92.0	84.5
10	30.0	39	63	43	67 (2)	1.13	1.85	92.5	97	85.5
11	30.0	23*	59	25	64 (<1)	1.85	1.0	69.0	80.0	78.5
12	15.0	36	61	24	64 (<1)	2.34	1.0	73.8	83.0	85.5
13	25.0	27	70	17	64 (<1)	1.46	1.50	51.7	71.5	84.0
14	25.0	36	60	24	64 (<1)	2.09	1.8	47.8	81.0	70.0
15	30.0	24*	48	39	63 (<1)	2.16	.83	69.7	87.0	84.5
16	35.0	28	76	31	58 (<1)	2.04	.96	61.3	75.5	85.5

Note. CI dB = four frequency average with cochlear implant; lower level = proportion of mothers' lower level facilitative techniques (closed-questions, imitations, comments, directives, and linguistic mapping); higher level = proportion of mothers' higher level facilitative techniques (parallel talk, recasts, open-ended questions, and expansions); PA = phonological awareness mean standard score; brief reading = mean score for letter–word identification and word attack skills; basic reading = mean score for letter–word identification and passage comprehension; asterisk denotes younger implant group (<24 months).

and education level) factors that may contribute to children's literacy outcomes. Our major finding revealed that after accounting for child factors (age, age at implant, and length of implant use), children's early expressive language explained some of the variance in children's phonological awareness skills. Additionally, after accounting for children's early expressive language skills, mothers' use of open-ended questions contributed to children's later basic reading skills.

Phonological Awareness Skills

Consistent with previous findings with populations of hearing children (Cooper et al., 2002; Ezell & Justice, 2005; McDowell et al., 2007; Phillips & Torgesen, 2006; Senechal & Le Fevre, 2002), early expressive oral language skills were positively related to children's later phonological awareness abilities (rhyming, segmentation, isolation, deletion, and blending). Presumably, children with stronger vocabulary and syntax skills as measured by RDLS have a richer representation of word parts, and these represented segments facilitate growth in phonological awareness. Similarly, children's language skills as measured by the OWLS at T_2 were significantly related to rhyming, segmentation, and deletion skills. It could be the case that the OWLS measure different aspects of phonological awareness than the RDLS. Nevertheless, these particular phonological awareness skills are thought to be the most important skills for beginning readers (Share et al., 1984; Storch & Whitehurst, 2002). Further regression analyses confirmed the predictive role of early expressive language skills on later phonological awareness. Thus, variability in children's early expressive language competencies could explain some of the variability shown in recent research investigating phonological awareness skills in school-aged children with cochlear implants (James et al., 2005, 2007).

Similar to prior research with hearing children (Britto, Fuligni, & Brooks-Gunn, 2006), mothers' linguistic interactions with their children were also related to children's phonological awareness skills. Mothers' use of one higher level technique (open-ended question) during joint book reading at T_1 was positively related to children's phonological awareness total mean score. Conversely, one lower level technique, linguistic mapping, was inversely related to children's phonological awareness. Regression analyses further delineated the unique contribution of children's early expressive language and mothers' language techniques on children's phonological awareness abilities. In contrast to the findings from Aram et al., (2006), mothers' use of questioning during joint book reading, although related, did not emerge as a predictor for children's phonological awareness skills after accounting for children's early expressive language abilities.

Reading Skills

Similar to hearing children (Catts et al., 2002; Ezell & Justice, 2005; Hoover, 2002; Senechal et al., 2006; Stone et al., 2004; Storch & Whitehurst, 2002; Wagner et al., 1997) and deaf children with hearing aids (Paul, 1998; Harris & Beech, 1998; Nielsen & Luetke-Stahlman, 2002), early expressive language skills were strongly related to children's reading skills in the areas of word attack, letter–word identification, and reading vocabulary. Likewise, children's later receptive and expressive language skills were positively associated with all of the children's reading subskill areas, except oral and reading vocabulary (r = .37, ns; and r = .49, ns). This most likely did not reach significance due to the small number of participants in the study. Young children's early language abilities seem to play a central role in learning to read for young children with cochlear implants.

Mothers' use of facilitative language techniques was also related to children's reading abilities. Mothers' use of a higher level technique, recast, was positively related to oral and reading vocabulary, whereas an open-ended question was positively related to letter–word identification and passage comprehension. These particular language techniques encourage conversation and provide children with a variety of words, which in turn facilitates reading-related tasks (Landry & Smith, 2006). Conversely, linguistic mapping, a technique most frequently used with very young children or children at lower language levels, was inversely related to children's reading subskill areas of letter–word identification and reading vocabulary. This is not surprising because it is a technique often used by a parent when their child produces an unintelligible word or phrase (Yoder, McCathren, Warren, & Watson, 2001). Research evidence suggests that this particular language technique be used with children at the one-word stage of language development (Girolametto, Bonifacio, Visini, Weitzman, Zocconi, & Pearce, 2002) and none of the children in this study was at the one-word stage of language development at T_1. For children who demonstrate higher level spoken language skills (e.g., three or more word phrases), these techniques may reduce children's opportunities to learn a variety of words and thus limit their vocabulary development (DesJardin & Eisenberg, 2007). Further regression analysis delineated the unique contribution of children's early language skills and mothers' techniques to their later reading abilities. Similar to young hearing children with language delays (Ezell & Justice, 2005), early expressive language skills and mothers' use of open-ended questions during joint storybook reading emerged as predictor variables for children's later basic reading skills.

Individual analyses provided additional information regarding the variability among participants in terms of their expressive language skills at the time of entry into the study and later phonological awareness and reading abilities. Children with expressive language standard scores at or above 70 at T_1 demonstrated phonological awareness and reading skills at or above average (>85) 3 years later. Conversely, children who demonstrated expressive language standard scores below 70 at T_1 performed lower than average (<85) in the areas of phonological awareness and reading. An ample amount of research suggests that hearing children who enter kindergarten with significant delays in expressive language skills perform much lower on later phonological awareness (Walley, Metsala, & Garlock, 2003) and reading-related tasks (Catts et al., 2002; Hoover, 2002; Senechal et al., 2006).

Moreover, individual analyses illustrated variability in mothers' facilitative language techniques. Mothers of the children with higher standard scores in expressive language at T_1 used more higher level facilitative techniques, whereas mothers of children with lower standard scores in expressive language at T_1 utilized more lower level techniques. It cannot be ruled out that mothers may have been tailoring their techniques to their children's language level. Nevertheless, it is also possible that mothers' use of lower level techniques did not sufficiently support their children's language level. We believe that it may be the latter because the children's expressive language ages at T_1 ranged from 17 to 31 months. This is a critical language age range when children are starting to put two to three word utterances together and may have required higher level techniques to support their emerging language skills (DesJardin & Eisenberg, 2007; Fey et al., 1999; Lilly & Green, 2004).

Although findings from this study offer essential information regarding early predictors of literacy skills for children with cochlear implants, a few limitations must be addressed. First, a larger population and more diverse samples of mothers and their children are needed in order to provide a better understanding of the relationships between these early factors in families for whom English is not their first language or are at lower income levels than the participants in this study. The mothers who elected to participate in this study from the larger cohort of mothers from the previous study (DesJardin & Eisenberg, 2007) differed significantly in terms of their family income level. Extant literature indicates that SES is one of the strongest predictors of phonological awareness (Lonigan et al., 1998; McDowell et al., 2007), amount of parent daily storybook reading with children (Raikes et al., 2006), and reading achievement (National Assessment of Educational Progress, 2005). It is also important to consider cultural aspects that may influence children's reading outcomes, such as literacy practices in the home (McNaughton, 2006). There was limited cultural diversity in this study that prohibited us from considering the possible cultural aspects that may influence children's reading outcomes. Furthermore, the majority of children who participated in this study were considered early implant recipients. Thus, there was less variability within the sample in terms of age of when the children received their cochlear implant than would be found in the general pediatric cochlear implant population. Although variability was limited in terms of implant age, there may have been more variability in chronological age than would be ideal. Future studies should examine children within a smaller age range and who have similar amounts of exposure to reading.

Additionally, the children in this study, like all children with cochlear implants, were most likely enrolled in various early intervention and school-age programs. Within the kinds of programs offered, mothers may have received a range of information on how to support their children's language and reading development outside of the intervention or school setting. Additionally, professionals may have targeted auditory development in these intervention programs by focusing on detecting, identifying, and producing individual sounds, which may have indirectly facilitated phonological awareness development. Thus, these children may have had more direct and indirect instruction related to phonological awareness and other literacy skills than their same-aged hearing peers. This must be considered when comparing how these children performed in relation to hearing peers. Indeed, their delays in comparison to their hearing peers may be even more significant considering that these delays exist despite possible direct and indirect emphasis on this area of development.

Lastly, another limitation is the use of different language tests at T_1 and T_2. The manuals for the RDLS and the OWLS do not provide information on the correlation between the two tests. However, we can assume, as with any two language tests, that the measures are not perfectly correlated. A specific example is the difference in content on the expressive portions of the two tests, with the OWLS being more heavily weighted on syntactic knowledge than the RDLS, which is heavily weighted on semantic knowledge. Thus, we might expect that the correlations between language and other measures at T_1 would differ from the correlations between language and other measures at T_2 based on the variance that can be attributed to test differences.

Implications for Intervention

Recent cutting edge research (Dickinson & Neuman, 2006) and emergent literacy intervention programs for hearing children (Britto et al., 2006; Chow & McBride-Chang, 2003; Justice & Kaderavek, 2004) emphasize the value of enhancing emergent literacy development in young children to prevent reading difficulties. National emergent literacy initiatives (e.g., "Early Reading First, Good Start—Grow Smart") and the National Research Council (e.g., National Association for the Education of Young Children 1998 position statement) (Shonkoff & Phillips, 2000) highlight child and family factors that support children's emergent literacy development and future reading achievement. Successful readers are those children who have a strong foundation in oral language skills and are provided with multiple opportunities for quality joint storybook reading. Our study reveals that these child and family factors are critical for young deaf children with cochlear implants.

It is essential that professionals convey to parents and caregivers the importance of emergent literacy development for their young children with cochlear implants. Similar to young hearing children, children with cochlear implants who acquire strong oral language skills (semantics, syntax, and phonemic awareness) before obtaining the fundamental literacy skills (phonological awareness and reading) will be at an advantage for literacy success (Dickinson, McCabe, & Essex, 2006). Conversely, as the findings of this study suggest, children with cochlear implants who display large language deficits in their early years are at a greater risk of being delayed readers. It is essential that children have near to age-appropriate spoken language abilities during the preschool and early school years on which to build further literacy skills.

Children's oral vocabulary development prior to formal literacy acquisition is a significant predictor for phonological awareness skills and future reading achievement (for an in-depth discussion, see Senechal et al., 2006). Well-designed literacy programs with explicit language and literacy instruction for parents will be needed in order to support those children who demonstrate significant oral language delays in the early years postcochlear implantation. Families will need to learn how to support their child's oral language development through various natural communication exchanges and incidental listening activities on a daily basis (Ezell & Justice, 2005). When words are used in meaningful contexts, a child with a cochlear implant is more likely to store those words in the mental lexicon in order to retrieve it at a later time (Nevins & Garber, 2005). For example, parents and caregivers can take advantage of a learning moment by offering synonyms for known words (enormous for big), superordinate terms for basic level words (fruit for apple, banana, and grapes), and subordinate terms for common words (lollipop for candy).

As in populations of children with specific language challenges (Justice et al., 2005), phonological awareness may not be a natural outcome of shared storybook reading interactions. Explicit teaching to the phonological structure of language may be required to accelerate children's phonological awareness skills. Explicit does not refer to drill-like activities but rather the structuring of engaging, meaningful, and enjoyable activities that help children to actively attend to the phonological structure of oral language. Professionals, such as teachers of the deaf and speech–language pathologists, need to incorporate oral language experiences that include phonological awareness activities into their language therapy sessions. For instance, the development of phonological awareness can be incorporated into activities that manipulate sound patterns in the language, such as rhymes in children's poetry and songs. Various storybooks such as "Dear Zoo" (Campbell, 2007) and "Is Your Mama a Llama?" (Guarino, Kellogg, & Madigan, 2006) provide children with a variety of vocabulary words (e.g., fierce, heavy, or fragile) and important concepts (e.g., rhyming words) that are not likely used in their everyday environments. Furthermore, a teacher or therapist may target a phonological skill area (e.g., isolation, deletion, or segmentation of sounds) and create an activity to highlight that specific skill, such as encouraging a child to clap the number of sounds in the word "spoon." These kinds of activities provide opportunities for children to manipulate the sounds that they hear and link the sounds together to make new words and phrases, which ultimately supports reading acquisition (Philips & Torgesen, 2006).

It is also important for parents to play an active role during joint storybook reading with their child in order to support their children's reading readiness skills (Britto et al., 2006; Clingenpeel & Pianta, 2007). Unfortunately, young deaf children are less exposed to literacy interactions than their hearing peers (Luetke-Stahlman, 1998) and many parents of children who are deaf or hard of hearing do not obtain the necessary information from professionals regarding reading interaction techniques (Heineman-Gosschalk & Webster, 2003). Reading aloud to children once they have access to sound begins the process of vocabulary development that should contribute to future reading success in school. Similar to hearing children (Ezell & Justice, 2005; Landry & Smith, 2006), children with cochlear implants will require multiple opportunities to listen to books (Kaderavek & Pakulski, 2007), with caregivers who provide their children with appropriate language-rich interactions to ensure the most beneficial use of storybook time. As young children develop more complex vocabulary and syntactic structures of language, the use of higher level language techniques by parents, such as open-ended question, will be important for optimizing not only children's communicative competencies (DesJardin & Eisenberg, 2007) but also later reading skills. A speech–language pathologist or teacher of the deaf can provide suggestions on and demonstrate the use of facilitative language techniques within joint storybook reading activities that are likely to have a positive influence on language and reading acquisition (for more specific suggestions, see Pullen & Justice, 2003).

Families need multiple sources of information to learn ways to enhance their children's literacy learning. A one-time course for parents may not provide sufficient support (Harrington & Nikolopoulos, 2002; McNeill & Fowler, 1999). There are many resources and lists of developmentally appropriate storybooks to read to children on the Internet (e.g., Beginning with Books Center for Early Literacy) and in early literacy reference materials (Bannister, Preston, & Primozich, 2006; Ezell & Justice, 2005; Linder, 2004; Pullen & Justice, 2003; Vukelich, Christie, & Enz, 2002; Zevenbergen & Whitehurst, 2003) that professionals in the field can share with caregivers and early childhood educators. Families will also need ongoing guidance during storybook reading interactions with positive constructive suggestions to make better use of language and literacy time. With this added supplement to well-designed preschool- and school-aged programs for hearing children, children with cochlear implants will be in a better position to apply those emergent literacy skills to their experiences during formal reading instruction.

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