Analogous and Distinctive Patterns of Prelinguistic Communication in Toddlers With and Without Hearing Loss

Anat Zaidman-Zait
University of British Columbia

Esther Dromi
Tel Aviv University

Purpose: This study was conducted to compare the prelinguistic communicative abilities of toddlers with hearing loss and without hearing loss during the 2nd year of life and shortly before the emergence of productive single-word lexicons.

Method: The participants were 28 toddlers with hearing loss who participated in an early intervention program and 92 toddlers with normal hearing at similar language levels and close chronological ages. The assessment consisted of the Hebrew Parent Questionnaire—Communication and Early Language (HPQ-CEL; E. Dromi, H. Ben-Shahar-Treitel, E. Guralnik, & D. Ringwald-Frimerman, 1992) that guided parents’ observations of their toddlers in 6 contexts at home. Parents reported on a range of prelinguistic communicative abilities.

Results: Profile analysis indicated that the 2 groups used a remarkably similar overall profile of prelinguistic behaviors. Interrelationships among behaviors were noticeably similar, too. Two communication properties unique to toddlers with hearing loss were relatively lower spontaneous use of words and reduced involvement in triadic book reading interactions. In addition, the associations between use of words and gestures in toddlers with hearing loss were slightly different from the toddlers with normal hearing, and the range of innovative gestures that they produced was greater.

Conclusion: The remarkable similarity between the 2 groups support the feasibility of adopting goals and principles known to hold true in typical development for fostering communication in toddlers with hearing loss.

KEY WORDS: deafness, communication strategies, parents, linguistics, infants and toddlers

At the outset of the second year of life and shortly before the emergence of conventional words, typically developing toddlers with normal hearing demonstrate impressive communicative abilities when interacting with adults. Extensive scientific research has endeavored to describe the richness of prelinguistic systems in hearing toddlers (see reviews in Dromi & Ringwald-Frimerman, 1996; Reddy, 1999).

In hearing toddlers, nonverbal communication systems manifest themselves in various domains. In the visual domain, toddlers follow the gaze of others and can identify which external object is the focus of adults’ attention (Butterworth & Jarrett, 1991; Carpenter, Nagell, & Tomasello, 1998). In the vocal domain, toddlers produce canonical babbling and long sequences of jargon babble that sound like adult speech (Dromi, 2002; Stoel-Gammon, 1998). Joint attention comprises the major developmental achievement that emerges toward the end of the first year of life and may be regarded as the crown of prelinguistic development. Adult–child visual interactions, which during the first 9 months of life involve either
social transactions or physical manipulation of objects, now become integrated. The coordination of social and object schemes represents a qualitative change in infants’ cognition (Adamson, 1995; Adamson & Chance, 1998; Sugarman, 1978, 1983). Following this developmental achievement, infants begin to show an ability to collaborate with adults in joint attention and in joint action, and they start to establish collaborative picture book viewing and mutual play with objects (Carpenter et al., 1998; Markus, Mundy, Morales, Delgado, & Yale, 2000; Mundy, Kasari, Sigman, & Ruskin, 1996; Ninio & Bruner, 1978).

Pointing also constitutes a highly significant means for enhancing collaboration with adults. Toddlers use pointing to direct others’ attention to an external object or event that is the focus of their attention. Research on the emergence of pointing has demonstrated that pointing is closely linked to the establishment of reference and, hence, considerably enhances the rate of learning conventional words (Caprici, Iverson, Pizutto, & Volterra, 1996; Caselli, 1990; Caselli & Volterra, 1990; Dromi, 1987; Dromi & Ringwald-Frimerman, 1996, 1998; Iverson, Caprici, & Caselli, 1994).

At about the same time that first words emerge, toddlers also begin to use referential gestures for communication. Caselli and Volterra (1990) introduced the distinction between deictic gestures (such as showing, reaching, giving, and pointing) and referential gestures, which are used as symbolic manual labels for objects and actions. In most western cultures, the early referential gestures that children produce include those that indicate bye-bye, bravo, no, sleep, phone, hat, and hungry (Dromi & Ringwald-Frimerman, 1996). The literature shows that the development of referential gestures closely resembles the course of meaning acquisition of conventional words, in terms of underlying processes of differentiation as well as decontextualization (Caselli & Volterra, 1990; Dromi, 2003). Toddlers produce referential gestures to denote the referents themselves and to demonstrate their representational abilities to encode meanings. Several studies have revealed that early referential gestures are initially embedded in everyday routinized activities, as their use is linked to the child’s early social experiences in communicating with the primary caregivers (Caselli, 1990; Zaidman-Zait, 2001; but see also Goldin-Meadow & Mylander, 1984). The production of symbolic gestures appears to support the learning of conventional words, as it scaffolds the course of their accumulation over time and enhances semantic differentiation (Acerdolo & Goodwyn, 1990; Caselli, 1990; Caselli & Volterra, 1990).

Prelinguistic behaviors, which hearing toddlers use for establishing intentional communication during the transitional period to formal speech, constitute a prerequisite for the emergence of later symbolic capabilities and dictate the timing and the rate of further lexical learning (Adamson, 1995; Carpenter et al., 1998). Despite the significant body of literature regarding the importance of prelinguistic behaviors in hearing toddlers, this investigation has been limited in young toddlers with hearing loss. To date, only a few studies have examined particular non-verbal behaviors in isolation, such as vocalizations, gestures, joint attention, and pragmatic functions (Lederberg, 2003; Yoshinaga-Itano & Stredler-Brown, 1992). One explanation for the paucity of information regarding prelinguistic communication in toddlers with hearing loss relates to the fact that early identification of infants with hearing loss has become a clinical reality only in the last few years (Yoshinaga-Itano, 2003). A decade ago, in a meta-analysis on the efficacy of early identification and early intervention with young children who are born deaf to hearing families, Bess and Paradise (1994) reported that they could not locate a single published study on developmental outcomes of intervention programs that began during the first year of life.

In more recent reports on the efficacy of early identification and early intervention, researchers have claimed that the average age for identifying hearing loss and the corresponding age for onset of intervention decreased significantly in the United States and outside North America in recent years (Calderon & Naidu, 2000; Sass-Lehrer & Bodner-Johnson, 2003; Vohr, Carty, Moore, & Letourneau, 1998; Yoshinaga-Itano, 2003). The implementation of universal newborn hearing screening legislation in many states in the United States and in other countries has modified the practice of early intervention (Yoshinaga-Itano, 2003), and, indeed, in many studies, this term refers only to therapy that begins before 6 months of age. Research has shown that hearing loss identification and intervention within the first months of life are the primary predictors for successful language outcomes, with a significant distinct advantage to those children placed in habilitation programs during the first 6 months of life (Calderon & Naidu, 2000; Moeller, 2000; Yoshinaga-Itano, 2003).

The dramatic shift in hearing screening technology presents new opportunities for young children with hearing loss and their families. Children with hearing loss no longer miss the window of opportunity for developing communication and language in the first 2 years of life (Lederberg, 2003; Yoshinaga-Itano, 2003). Clinicians and deaf educators working with toddlers who have hearing loss can now introduce prelinguistic communicative skills as important goals for early intervention. Parents of infants and toddlers with hearing loss can benefit from counseling that highlights the major characteristics of prelinguistic communication in young children with hearing loss (Dromi, 2003).

The goal of the present study was to characterize the prelinguistic communicative system in a group of toddlers...
with hearing loss who participated in a family-centered intervention program during the first and second years of life. We sought to explore similarities and differences in how toddlers with and without hearing loss convey communicative intents shortly before they begin to develop productive lexicons that exceed a few words.

Previous research studies on prelinguistic communication in children who are born with hearing loss to hearing parents captured communicative behaviors mainly in preschool-aged participants. Most studies had matched small groups of children with hearing loss with hearing controls, either on the basis of chronological age (e.g., Nicholas, 2000; Nicholas & Geers, 1997) or on the basis of language level alone (Dromi, 2003; Nicholas, Geers, & Kozak, 1994). To create a study group of participants with hearing loss and to conduct comparisons between that group and a group of hearing children is highly challenging from a methodological point of view. Any group of participants with hearing loss is characterized by a great deal of heterogeneity with respect to background variables. Children who have hearing loss vary with respect to severity of hearing loss, age of hearing loss identification, beginning age of amplification, and many language intervention characteristics such as philosophy, intensity, and frequency as well as the extent to which parents collaborate with professionals in implementing the program at home (Ingber, 2005). These constraints explain the small sample size of participants with hearing loss found in some studies and the fact that participants with hearing loss are often compared with hearing children who are much younger in age.

A few studies have reported that, similarly to much younger hearing children, preschoolers with hearing loss use visual gaze, vocalization, pointing, and gesture as means for establishing intentional communication (Curtiss, Prutting, & Lowell, 1979; Dromi & Ringwald-Primerman, 1996; Lederberg, 2003). Day (1982) reported that a 3-year-old child with deafness expressed the same range of communicative intentions as hearing children of the same chronological age, but he failed to concurrently use formal language as an information-getting or information-giving device, whereas hearing children use linguistic means for communication at that age.

Nicholas et al. (1994) compared the communicative abilities of children with hearing loss with those of younger hearing children who were matched for language level. In this comparison, the participants with hearing loss demonstrated a wider range of communicative intentions than did the hearing participants who were a year and a half younger. In a comparative study of 36-month-old orally trained children with deafness and same-age hearing children, Nicholas and Geers (1997) found that the two groups used the same range of communicative functions but differed significantly in the quantity and proportional usage of these functions. Children with deafness used directives much more often than other functions, whereas hearing children most frequently used responses and statements. The deaf and hearing groups differed not only with respect to the relative distribution of communicative functions but also with respect to modality. The hearing group used speech significantly more than any other modality, whereas the participants with hearing loss used speech, gestures, and vocalizations to the same extent.

Nicholas (2000) compared the range of communicative functions as well as the distribution of language forms by analyzing language samples of 5 children per age group at 6-month intervals in children with and without hearing loss. The age range of her participants was from 12 to 54 months. Nicholas reported that between 12 and 36 months of age, the hearing children produced larger vocabularies, utterances of longer length, and greater syntactic complexity than did the children with hearing loss. Between ages 36 and 54 months, the growth function of communication attempts stabilized, as did the formal linguistic structures. In this sample, none of the children who were deaf reached a language level that was above the level of 36-month-old hearing children, and the different communicative functions did not show an increase over time. The children with hearing loss produced responses, statements, questions, directives, and imitations more or less equally throughout time. As the language gap increased between the children with hearing loss and their hearing age-peers, clear differences emerged between the two groups’ utilization of various communicative intentions.

Several studies on communication patterns between hearing mothers and their children with hearing loss revealed difficulties faced by the mothers in adapting to the very unique visual needs of their young children (Jamieson, 1994a, 1994b, 1998; Jamieson & Pederson, 1993; Koster, Karkowski, & Traci, 1998; Prendergast & McCollum, 1996; Spencer & Gutfreund, 1990; Swisher, 1992). For example, in a longitudinal study, Meadow-Orlans and Spencer (1996) measured instances of coordinated joint attention in infants and their mothers during free play. The infants comprised four groups: (a) hearing mothers and hearing babies, (b) hearing mothers and babies who were deaf, (c) mothers who were deaf and babies who were deaf, and (d) mothers who were deaf and babies who were hearing. The results demonstrated that mother’s hearing status contributed to the level of coordinated joint attention at 9, 12, and 18 months. The group of babies with hearing loss who had hearing mothers performed worst in joint attention tasks at all three ages. When both mothers and babies were deaf, significantly more time in coordinated joint attention was recorded in comparison with all other groups. Prendergast
and McCollum (1996) reported similar results: shorter duration of coordinated gaze in 8 mother–child dyads who were mismatched with respect to hearing (child with deafness and hearing mother) compared with 8 matched dyads (both mother and child were deaf). The child participants in this study were 8–28 months of age.

Dromi (2003) conducted a study of prelinguistic communication in a large group of 48 preschool children with hearing loss who ranged in chronological age from 8 to 49 months. That study was descriptive and did not include a comparison group of hearing participants. Parent-report data in that study indicated that the main behaviors proposed in the literature for describing hearing babies’ communication, at the beginning of the second year of life, appropriately characterized prelinguistic communication in much older children with hearing loss. Unlike in hearing children, pointing of children with hearing loss correlated with early emerging prelinguistic behaviors, and the use of gestures did not correlate with the use of words. Dromi (2003) proposed that children with hearing loss substitute pointing and collaboration with adults for words and sentences and, therefore, demonstrate a unique pattern of prelinguistic communication.

As Nicholas et al. (1994) argued, continued use of mainly prelinguistic means for communication by preschool children with hearing loss makes it impossible to single out cognitive from linguistic factors when explaining differences between children with hearing loss and typically developing children with normal hearing. The present study was designed to overcome this difficulty by matching participants according to language level and by relatively narrowing the range of their chronological age. As explained below, all participants in this study were prelinguistic and were younger than 2 years of age at the time of data collection.

Another difficulty in comparing the nonverbal communication of children with and without hearing loss relates to the choice of methodology. Researchers have differed in their selection of nonverbal behaviors to be investigated, the methodology for data collection, and the analytic framework for data coding. Some researchers have analyzed communicative functions as they occurred during natural interactions between children with hearing loss and their mothers in a semi-structured play session (Nicholas, 2000; Nicholas & Geers, 1997); others closely analyzed gaze behaviors in a laboratory setting (Butterworth & Jarrett, 1991; Carpenter et al., 1998; Morissette, Ricard, & Gouin-Decarie, 1995); and other researchers conducted home visits and described communicative attempts in natural observations (e.g., Mohay, Milton, Hindmarsh, & Ganely, 1998). Solid comparisons between children with and without hearing loss should be controlled for at least four variables: (a) participants’ ages, (b) participants’ language levels, (c) contexts of observation, and (d) methods for data collection and analysis. The present study addressed these methodological issues by using a parent-report instrument for the assessment of communication and language behaviors at home.

In 1991, Camaioni, Castelli, Longobardi, and Volterra developed a structured Italian questionnaire that is unique as it guides parents to actually collect data on their children’s communicative behaviors at home. Parents observe their children in six everyday and common play and care contexts (see detailed description in the Method section). Dromi, Ben-Shahar-Treitel, Guralnik, and Ringwald-Frimerman (1992) translated Camaioni et al.’s (1991) parent questionnaire from Italian into Hebrew and slightly modified it for the assessment of prelinguistic behaviors in preschool children with deafness, adding to it a list of early produced signs (Dromi, 2003). This questionnaire, the Hebrew Parent Questionnaire–Communication and Early Language (HPQ-CEL), is unique in that it provides a closed set of responses for the parents on each question that guides an observation context. This makes the instrument easy for implementation with parents of varying educational and socioeconomic backgrounds. In previous studies, researchers found evidence for the instrument’s reliability and validity (see Method section). In addition, Ben-Itzhak and Levin (2001) documented that parents expressed positive attitudes toward the home administration of the HPQ-CEL. Parents’ response rates in past research studies with this instrument were very high among parents of children with hearing loss who participated in intervention programs (questionnaire return rates averaged higher than 90%) and, as expected, were lower in studies among parents of hearing children (averaging 33–40%; Dromi, 2003; Zaidman-Zait, 2001).

The present study addressed the theoretically intriguing question of whether prelinguistic toddlers with hearing loss exhibit the same profile of parentally reported communicative behaviors in their second year of life as prelinguistic toddlers with normal hearing. Careful analysis of similarities and divergence among the two groups is essential for selecting intervention goals and for the development of effective strategies to promote language learning in prelinguistic toddlers whose hearing loss is identified early in life and who receive language habilitation that is rooted in developmental philosophy.

**Method**

**Participants**

The sample described here consisted of 28 toddlers with hearing loss and 92 hearing toddlers. All were born to hearing parents in monolingual Hebrew-speaking Israeli families.
Table 1. Characteristics of participants with hearing loss.

<table>
<thead>
<tr>
<th>Participant number</th>
<th>Gender</th>
<th>Age (in months)</th>
<th>Words produced</th>
<th>Hearing loss</th>
<th>Age at diagnosis (in months)</th>
<th>Age (in months) at onset of intervention</th>
<th>Communication in educational program</th>
<th>Communication at home</th>
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Note. ISL = Israel Sign Language.

Toddlers with hearing loss. These toddlers were recruited from educational centers operated by MICHA, the Israeli Society for Education of Deaf Children. The great majority of young children with hearing loss in Israel who are diagnosed during the preschool years are enrolled in MICHA centers for communication, language, and speech habilitation. Since the early 1990s, all MICHA centers implement the Kesher family-focused intervention program based in a developmental philosophy. The Kesher program enhances the inclusion of prelinguistic goals for intervention and highlights the importance of collaboration with parents (Dromi, 2003).

This sample, consisting of 28 children with hearing loss of hearing parents (16 girls, 12 boys), was recruited and enrolled in two steps. First, at the beginning of a new academic year, we asked all Kesher language clinicians to identify all MICHA clients aged 2 years and under who had hearing parents and who did not manifest cognitive, emotional, or behavioral problems, yielding a group of 35 children. Second, to verify prelinguistic status, we selected only those toddlers (n = 28) who did not produce more than 10 words or signs according to the parent-reported HPQ-CEL closed lists administered to all new participants in Kesher. Background characteristics of children in this group are presented individually for each participant in Table 1.

The mean age for the 28 toddlers with hearing loss was 16.35 months (SD = 2.71), ranging from 10 to 20 months. Three children (10.7% of the sample) were 10–12 months old, 9 children (32.1%) were 13–15 months old, 8 children (28.6%) were 16–18 months old, and an additional 8 children (28.6%) were 19–20 months old. The toddlers produced an average of 2.5 words (SD = 2.81). Nine children (32.1%) did not produce even a single word in Hebrew, 10 children (35.7%) produced 1–3 words, 6 children (21.4%) produced 4–6 words, and 3 children (10.8%) produced 7–9 words.

As described below, the cohort of toddlers with hearing loss was heterogeneous with respect to variables.
other than language level and chronological age. However, to the best of our knowledge, this sample was representative of most cohorts of children with hearing loss who are identified and begin intervention during the first 2 years of life. The sample comprised three subgroups according to the severity of hearing loss: 2 participants with moderate hearing loss (41-70 dB HL), 10 participants with severe hearing loss (71-90 dB HL), and 16 participants with profound deafness (91 dB HL or more in the better ear). The mean age at time of hearing loss identification in this cohort was 8.86 months (SD = 3.99). All the toddlers with hearing loss were enrolled in the intervention program shortly after the hearing loss was diagnosed. Average duration between hearing loss identification and intervention onset was 2.17 months (SD = 2.42). Nine children entered the program immediately after identification, 12 children entered the program 1-3 months following identification, 5 children entered the program 4-5 months following identification, and only 2 participants began intervention 7-9 months after hearing loss identification. The average age at intervention onset was 11.04 months (SD = 4.38). Four children began the program even before the age of 6 months (14.3% of the sample), 13 (46.4%) began therapy between the ages of 6 and 12 months, and 11 (39.3%) began therapy between the ages of 13 and 19 months. Children varied with respect to the number of private language therapy sessions that they received each week. Eleven children (39.3%) received individual language therapy once weekly, and the remaining 17 children (60.7%) received language therapy twice weekly. Children's average length of participation in Kesher prior to parents' completion of the HPQ-CEL was 3.89 months (SD = 2.33).

All participants used conventional hearing aids and received intensive auditory habilitation. Guidance and support regarding the maintenance and consistent use of the amplification devices was provided to all parents. At the time of data collection, Ministry of Health policy in Israel did not approve cochlear implantation for children younger than 3 years of age; therefore, none of the current participants used a cochlear implant.

The sample was divided unevenly with respect to the communication modality used at school: 57.1% of the children attended educational programs that were oral, and 42.9% of the participants attended educational programs that used simultaneous communication (i.e., generating signs from Israeli Sign Language and Hebrew words simultaneously in grammatical constructions of the Hebrew language) as a declared instructional method. Regarding the modality of communication at home, only 4 parents (14.3%) reported using simultaneous communication with their children, a full 75% of parents reported using only speech (i.e., oral communication), and only 1 parent (3.6%) reported the use of Israeli Sign Language and oral communication in Hebrew. In addition, 52.2% of fathers and 58.3% of mothers reported that they commonly used gestures to support speech when communicating with their children. With regard to parental education level, all mothers except 1 had at least some high school education (M = 12.67 years, SD = 1.9). The fathers' education was slightly more variant (M = 12.81, SD = 2.40).

Hearing toddlers. The hearing toddlers were recruited during a routine visit to their neighborhood well-baby clinic. In these nationwide public health clinics, developmental nurses follow children from birth until they reach the age of 3 to exclude any developmental or medical problems. A behavioral observation hearing assessment with calibrated noisemakers is administered by trained public health nurses to screen for hearing loss when infants are 8 months of age. If an infant fails the screening, the family is immediately referred to a speech and hearing clinic for diagnostic hearing testing (Herzano, 1998). In addition, all children approaching their first birthday are tested for normal cognitive and social developmental milestones by the public health nurses. The hearing toddlers who were recruited to the current sample successfully passed both the hearing screening test at age 8 months and the developmental screening at age 12 months.

The 92 hearing toddlers (43 girls, 49 boys) ranged in age from 13 to 15 months (M = 13.39, SD = 0.98). According to the screening protocol at the well-baby clinics, all participants manifested normal hearing, and none was suspected of cognitive or social-emotional delays. The same criterion that served to determine assignment to the prelinguistic stage was applied to the sample of hearing participants: Children who produced more than 10 words in the HPQ-CEL word list were excluded from the sample. According to parental report, the hearing participants produced an average of 4.6 words (SD = 2.5). Six children (6.5%) did not produce even a single word (M = 13.78 months of age, SD = 0.68), 24 children (26.1%) produced 1-3 words (M = 13.10 months, SD = 0.97), 37 children (40.2%) produced 4-6 words (M = 13.52 months, SD = 1.12), and 25 children (27.1%) produced 7-9 words (M = 13.37 months, SD = 0.78). Mothers in the hearing subsample had at least some high school education (M = 13.45 years, SD = 2.08), and the fathers' education was similar (M = 13.16, SD = 2.35).

Instrument

The HPQ-CEL parent questionnaire has two parts. Part A presents guiding questions for parental observation of their own children in six everyday contexts at home: (a) child wants to eat or drink, (b) child wants to go out for a walk, (c) child looks for a desired object, (d) child calls parent, sibling, or a relative when they are out of sight, (e) child looks at a picture book together with parent,
Table 2. Six questions that guide parents to the contexts of observation.

1. What does the child do when he/she is hungry? (12-item response set)
2. What does the child do when he/she wants to go out? (9-item response set)
3. How does the child behave when he/she wants a desired object or a desired toy? (9-item response set)
4. When the parent, a sibling, or another familiar person is absent, what does the child do to call him/her? (7-item response set)
5. When you look at a picture book together, what does the child do? (14-item response set)
6. When you play peek-a-boo together, what does the child do? (7-item response set)

Table 3. Response set of 14 options for Question 5: When you and your child look at a picture book together, what does the child do?

- Touches book page(s) with hand or takes book into mouth
- Turns book page(s) and does not look
- Looks at pictures(s) in the book
- Focuses on adult’s mouth movements as adult describes picture(s) in the book
- Shifts gaze from book picture(s) to adult and from adult back to book picture(s)
- Points at specific picture(s) in book
- Looks at specific picture(s) in book to which adult is pointing
- Produces gesture that is related to a picture or to an action depicted in picture(s) in book
- Vocalizes—produces sounds associated with specific picture(s) in book
- Imitates sounds or words that the adult utilizes in context of looking at picture book
- Utters word that is related to picture(s) in book
- Vocalizes when asked by adult: “What is that?” (referring to specific picture in book)
- Produces word when asked by adult: “What is that?” (referring to specific picture in book)
- Asks adult: “What is that?” (or a similar question) referring to specific picture in the book

and (f) parent plays a peek-a-boo game with child. Table 2 lists the questions that guide the observation in these contexts. Each question is followed by a closed-inventory list of optional responses that are developmentally ordered from a noncommunicative response (e.g., independent motor activity or crying) to a linguistic response (e.g., uttering a word or sentence). As an illustration, Table 3 presents the set of 14 optional responses for the question examining how a child behaves when looking at a picture book jointly with his or her parent.

Parents are instructed to read each question and then to observe their child in the relevant context several times before completing the questionnaire. They are asked to mark all the behaviors that they observed and to indicate how frequently the child produces each behavior in each context, along a three-point scale (1 = never, 2 = sometimes, 3 = often).

Part B of the HPQ-CEL contains two closed lists of 15 first words (e.g., dog or bow wow, car, daddy) and 15 gestures (e.g., waving bye-bye, clapping hands, shaking head for no) that young toddlers with and without hearing loss frequently produce at the onset of language. Parents mark in each list which words and gestures their child already produces, and they rate the frequency of use on a three-point scale (1 = never, 2 = sometimes, 3 = often). At the end of each list, parents are encouraged to add other unlisted words or gestures that their child uses.

Camaioni et al. (1991), who developed the Italian questionnaire, provided initial evidence for the reported results on the Italian instrument’s external and predictive validity as well as reliability. Their Italian sample of hearing toddlers was small, consisting of only 23 participants divided into three age levels: 2, 16, and 20 months old. Interrater reliability was tested on a subgroup of 12 children. Significant positive correlations for almost all variables (with correlation coefficients ranging from .59 to .77, p < .01) were found in the comparison between the parents and a trained observer who completed the same questionnaires in home visits.

In addition, in previous studies, the HPQ-CEL emerged as a reliable and valid instrument for examining communication and early language in Israeli children with and without hearing loss (Dromi, Weisel, & Treitel, 1996; Dromi & Zaidman-Zait, 2005; Shalom, 1994). The validity of the HPQ-CEL was tested on a sample of 48 children with deafness who ranged in chronological age from 6 to 49 months. Small space analysis (Guttman, 1982) of the questionnaire results revealed that pointing, independent behaviors, collaboration with adults, words, and signs comprised highly homogeneous and discrete categories of prelinguistic behaviors in that sample. Vocalizations also were recorded but were distributed less homogeneously. Crying and gestures were much less represented in the sample and were less distinct than the other behaviors (Dromi et al., 1996). Convergent validity also was demonstrated when a significant relation emerged between the HPQ-CEL score and a score on a different observation tool (r = .32) completed by an experienced language clinician, who observed a sample of typically developing toddlers individually (for details, see Shalom, 1994). In examining the scales’ construct validity in a sample of hearing children, Dromi and Zaidman-Zait (2005) identified seven subscales for the coding of HPQ-CEL results: Crying, Vocalization, Collaboration With Adults, Pointing, Words, Joint Engagement
in a Peek-a-Boo Game, and Triadic Interaction in Book Reading (i.e., the child, parent, and book). Reliability of the seven scales ranged from .58 to .83 (Cronbach's alphas). For the current subsamples, Cronbach's alphas ranged from .60 to .90 for the deaf sample (except for vocalization scale, \( \alpha = .34 \)) and from .54 to .88 for the hearing sample.

To determine interrater reliability in the current study, an experienced teacher of the deaf with a background in research on children with hearing loss visited the homes of 6 families, which made up 20% of the entire sample of participants with deafness. In each of the 6 homes, she conducted a direct 3-hr observation of the child and completed the HPQ-CEL for three of the six contexts of observation, depending on the spontaneous behaviors that occurred during the visit. Interjudge agreement, calculated between the teacher's and parent's reports on the same three contexts of observation, ranged from 82.1% to 100% per family, with an average of 89.35%. Interjudge reliability was above 82% for 3 families and above 50% for another 3 families. These levels of agreement even surpass the levels reported by Camaioni et al. (1991) for hearing parents of hearing infants. These results indicate that hearing parents of children with hearing loss can provide reliable information on the communicative behaviors of their children at home when they are guided by a structured questionnaire that presents a closed set of optional responses (Dale, Bates, Reznick, & Morisset, 1989).

**Procedure**

Parents of the participants with hearing loss received the HPQ-CEL during the first year of entry to the Kesher program. The experienced language clinician who was routinely assigned to the family explained the study goal to the parents and received written consent for participation. Parents were asked by the clinician to return the questionnaire within 2 weeks. Parents of the hearing participants were approached by a research assistant during their annual visit to the local well-baby clinic for their toddler's routine checkup. The research assistant explained the study goal to the parent and received written consent for participation. Parents were asked to complete the HPQ-CEL questionnaire at home and to return it to the research assistant within 2 weeks.

All parents received written cover materials for home perusal, which included (a) an explanation of the rationale for using the HPQ-CEL as a guide for observing their children at home; (b) a summary of the questionnaire's goals; and (c) definitions of the terms vocalizations, gestures, and words/signs that appear in the response lists following each observation context. Parents also received instructions to first gain familiarity with the questionnaire and to wait until after becoming confident that they understood all the response categories and procedures before observing their child in the six contexts and completing the checklist of words and gestures.

**Results**

To characterize the range of communicative behaviors and the relative frequency of each behavior's use by the participants in each group, we calculated mean scores for each of the seven HPQ-CEL subscales. Table 4 presents the group means and standard deviations for the groups of children with and without hearing loss.

Inspection of the table reveals that the toddlers with and without hearing loss in the present sample exhibited very similar prelinguistic behaviors. The parents in the two groups observed similar behaviors and a similar relative frequency of occurrence on each subscale. Interestingly, the mean frequency of occurrence of each subscale appeared to be highly similar in the two groups. On average, the parents in both groups recorded dyadic social interaction within the context of a peek-a-boo game as the most frequent behavior. Pointing was the second most frequent behavior recorded by parents, and triadic interaction in book reading was third. Crying and collaboration with adults, which do not involve a clear communicative signaling of intents, also appeared in both groups. Finally, words and vocalizations were recorded least frequently by parents in the present sample.

We used profile analysis to examine whether the pattern of prelinguistic communication was similar for the two groups. This multivariate analysis of variance (MANOVA) compares profiles of group measures on several different scales, all at one time. It includes tests of parallelism, flatness, a level test, and pair-wise comparisons. The test of parallelism (equivalent to the test of interaction in repeated-measures MANOVA) examined whether the overall shape of the curve that depicted

<table>
<thead>
<tr>
<th>HPQ-CEL subscale</th>
<th>Hearing loss [n = 28] M (SD)</th>
<th>Hearing [n = 92] M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crying</td>
<td>2.06 (0.52)</td>
<td>2.05 (0.42)</td>
</tr>
<tr>
<td>Vocalization</td>
<td>1.44 (0.42)</td>
<td>1.33 (0.44)</td>
</tr>
<tr>
<td>Collaboration With Adults</td>
<td>2.03 (0.68)</td>
<td>1.80 (0.56)</td>
</tr>
<tr>
<td>Pointing</td>
<td>2.28 (0.66)</td>
<td>2.25 (0.58)</td>
</tr>
<tr>
<td>Words</td>
<td>1.26 (0.35)</td>
<td>1.55 (0.46)</td>
</tr>
<tr>
<td>Joint Engagement in Peek-a-boo</td>
<td>2.71 (0.52)</td>
<td>2.54 (0.69)</td>
</tr>
<tr>
<td>Triadic Interaction in Book Reading</td>
<td>2.05 (0.50)</td>
<td>2.18 (0.47)</td>
</tr>
</tbody>
</table>

Note. Each subscale ranged from 1 to 3.
the means across the various subscales in the two groups was identical. The test of flatness compared the mean scores across the HPQ-CEL subscales for each group. The test of level compared the groups, averaging across the different HPQ-CEL subscales. (See Tabachnick & Fidell, 2001, for the rationale and detailed explanations of these statistical procedures.) Inasmuch as the age ranges of the two groups were not identical (with a more restrictive age range in the hearing group than in the group with hearing loss), the profile analysis included chronological age as a covariate. Figure 1 presents the results of the profile analysis.

A remarkably similar overall shape emerged for the profiles obtained by the two groups. A repeated MANOVA on the segments (using Bonferroni adjustment for multiple comparisons) tested the parallelism hypothesis and did not reject it, $F(6, 112) = 1.882, p = .09$, confirmed this finding. Using Wilks's lambda criterion, the profiles of toddlers with and without hearing loss did not deviate significantly from parallelism. This result indicates that the difference between any two subscale scores in each profile (i.e., the difference between vocalization and pointing or between pointing and triadic book reading) was of similar size in the two groups.

The second analysis, conducted only in cases where parallelism was found to hold, tested the flatness hypothesis. This analysis tested whether all the dependent variables (i.e., the different subscales) within each group at a time elicited the same average responses. Using Hotelling's criterion, the profile deviated significantly from flatness, $F(6, 112) = 4.14, p = .001, \eta^2 = .18$, indicating that in each of the two groups, the different behavior subscales' mean scores differed from one another.

Next, a level test showed no reliable differences between groups when scores were averaged over all subscales, $F(1, 117) = 2.04, p = .12, \eta^2 = .02$. Finally, pair-wise comparisons between the groups for each subscale separately revealed significant differences between children with and without hearing loss in only 2 of the 7 subscales identified. Hearing children had a significantly higher adjusted mean score on the Words subscale ($M = 1.56, SD = 0.10$) than children with hearing loss ($M = 1.24, SD = 0.11$), $F(1, 117) = 6.84, p < .01, \eta^2 = .06$ as well as a significantly higher adjusted mean score on the Triadic Book Reading Interaction subscale ($M = 2.23, SD = 0.05$, and $M = 1.89, SD = 0.11$, respectively), $F(1, 117) = 6.80, p = .01, \eta^2 = .06$. These findings reflect a slow rate of new word accumulation and a relative difficulty of children with hearing loss to participate in tasks that require shared visual reference with adults.

To further explore the relationship between the use of gestures and the use of words in the two groups, we conducted Pearson correlations between the mean scores in the two closed lists of gestures and of words. A significant positive correlation emerged between the two lists for the hearing group ($r = .43, p = .00$) but not for the group of children with hearing loss ($r = .31, p = .11$). This finding indicates that the pattern of word accumulation in children with hearing loss deviates from their pattern of gesture accumulation. It should be noted that due to the similar strength of the correlations and the fact that the correlations were not tested across groups, this finding should be treated with caution. A one-way analysis of variance with chronological age as a covariate examined whether the two groups differed in their use of gestures. We calculated the score for gesture use from the number of different gestures marked on the checklist and the parent report of how often each gesture was used. The findings indicate that the reported use of gestures by the two groups of toddlers did not differ significantly ($p > .05$).

We also examined which gestures parents selected from the closed list of gestures. Figure 2 presents this analysis and also shows how many parents reported that their children produced gestures other than the ones included in that list. All 15 gestures were reported by at least some parents of the current sample. Fifty percent of the hearing participants produced seven or more different gestures, and 50% of the participants with hearing loss produced eight different gestures or more. More than 65% of the parents reported that their children produced Gestures A–F, which can be characterized as deictic or social gestures. A varying range of 25–65% of the parents reported that their children produced Gestures G–K, which are early referential gestures. Only 25% or fewer of the parents in the two groups reported that their children produced Gestures L–P, which are the more complex symbolic gestures in the list.
An examination of single-gesture use revealed noticeable gaps between the relative productions of different gestures. Hearing toddlers produced only two of the gestures at a greater frequency (at least 13% more) than did toddlers with hearing loss: gives and takes objects (C) and claps hands (E). On the other hand, toddlers with hearing loss produced six of the gestures at a greater frequency (between 10% and 27.5% more) than did hearing toddlers (gestures I, J, K, L, and Q). Regarding children's production of gestures other than those specified in the closed list, only 4.8% of parents of hearing toddlers reported such additional gestures, in contrast with 35.7% of the parents of toddlers with hearing loss. Taken together, the qualitative analysis of the list of gestures suggests a closely similar distribution of gestures in the two samples, with a tendency for children with hearing loss to produce more symbolic gestures than hearing children and to generate additional gestures other than those included in the closed list.

Discussion

This study aimed to examine the similarities and differences in prelinguistic behaviors of Israeli children with and without hearing loss in their second year of life and prior to the establishment of a productive vocabulary that exceeds 10 different words. An attempt was made to stratify the sample with respect to the two important variables of language level and of chronological age. The wider age range of the children in the hearing loss subsample compared with that of the children in the hearing subsample could not be avoided because hearing children's transition from communication to formal language occurs much more quickly than it does in children with hearing loss. Children with hearing loss are reported to demonstrate a prolonged period of intentional communication before they begin to spontaneously utter single words (Lederberg, 2003). The results of the present investigation indicated that parents of toddlers with and without hearing loss documented a remarkably similar set of prelinguistic behaviors at home. Moreover, an inspection of the interrelationships between these prelinguistic behaviors clearly indicated that the overall profile for producing each behavior relative to any other was noticeably analogous in the two groups.

Our findings revealed that prelinguistic toddlers with hearing loss significantly differed from hearing toddlers in only two characteristic behaviors. First, parents of participants with hearing loss reported less frequent use of words in the different observational contexts than did parents of hearing participants. Second, toddlers with hearing loss exhibited a reduced amount of involvement in joint picture-book reading with adults in comparison with hearing toddlers.

Studies on prelinguistic prerequisites to vocabulary learning have repeatedly stated that triadic interactions involving the adult, the child, and an external object are of utmost importance for the establishment of shared reference and for learning new words (Adamson & Bakeman, 1991; Dromi, 1987; Ninio & Bruner, 1978). The relatively
more limited appearance of triadic interactions with books in the deaf group requires serious consideration and has immediate implications for the planning of early intervention programs.

Ben-Itzhak (1997) and Ben-Itzhak and Levin (2001) have claimed that 1-year-old infants with and without a hearing loss demonstrate an overall similar pattern of prelinguistic communication. In her longitudinal study of the development of symbolic play in children with hearing loss during the first year of life, Ben-Itzhak (1997) administered the HPQ-CEL to evaluate communicative abilities as a background variable for a carefully matched sample of 17 infants with hearing loss and 14 hearing infants. She concluded that both infant groups used the same range of communicative behaviors. This finding, obtained via the same experimental tool, extends the generalizability of our results beyond the current sample that we studied here.

The results of the present study also substantiate Dromi's (2003) argument, based on a larger and more heterogeneous sample of Israeli children with hearing loss who participated in the Kesher program. In that earlier sample, children's chronological ages ranged from 8 to 49 months, and no comparison group of hearing participants was included. On the basis of a comparison with existing literature, Dromi claimed that the main categories proposed in the literature for describing prelinguistic communication in hearing children characterize prelinguistic communication in children with hearing loss. Dromi's earlier results indicated that gestures and pointing emerge much earlier than vocalizations and words in children with hearing loss, and she concluded that the interrelationships that exist among the different prelinguistic behaviors are unique to this population (Dromi, 2003, p. 376). The present study's direct comparison between participants with and without hearing loss, of similar ages and the same linguistic levels, highlights this unique characteristic that distinguishes the two groups from each other.

The current findings coincide with the argument raised in Nicholas's (2000) aforementioned cross-sectional study of 5 children with hearing loss and 5 hearing children (at each age level from 12 to 54 months). Nicholas reported that only around the age of 18-24 months did differences emerge between children with and without hearing loss regarding their rate of learning formal language. Nicholas attributed the difference to the relatively earlier emergence of speech in the hearing children and the much slower rate of progress in speech exhibited by the children with hearing loss throughout childhood. Nicholas and Geers (1997) claimed that children with hearing loss use gestures and vocalizations excessively as a substitution for conventional words and more elaborated syntactic constructions.

In her discussion of why the prelinguistic profile of children with hearing loss demonstrated unique interrelationships between the use of pointing and gesture, Dromi (2003) also raised the hypothesis that children with hearing loss who lack conventional means for communication use nonverbal resources such as pointing, collaboration with adults, and gestures in contexts where hearing children would produce vocalizations and words. As we reported above, the present study confirmed an association between gesture and word use in the hearing group but not in the participants with hearing loss (see also Dromi, 2003; Dromi et al., 1996).

It is important to highlight the significant difference that was found between the groups with respect to triadic child–adult–book interactions. Note that participants in the two groups engaged similarly in behaviors that involved dyadic social interaction with adults (the social game of peek-a-boo). We assume that the coordination of object and social schemes is impeded in toddlers with hearing loss (and especially in participants who are deaf) because it is difficult for them to alternate gaze between the adult and the book than to only listen to the adult's speech while watching the pictures in the book. To achieve shared visual attention, children with profound hearing loss need to simultaneously manage two competing visual stimuli. They must coordinate their looking behavior between the picture in the book and the mother's face, lips, and/or signs that convey the linguistic information (Swisher, 1992).

Indeed, in studies comparing the visual behaviors of mother–child dyads with different hearing status, researchers found that hearing mothers and hearing children considerably surpassed mother–child dyads with dissimilar hearing status. This was particularly true with respect to the visual behavior of children with deafness who were studied in contexts of learning new linguistic labels (Jamieson, 1994a, 1994b, 1998; Jamieson & Pederson, 1993; Koester et al., 1998; Lederberg, 2003; Prendergast & McCollum, 1996; Spencer & Gutfreund, 1990; Swisher, 1992). Our results call for future detailed investigations of book reading activities between mothers and toddlers with various amounts of residual hearing and in different ages and linguistic levels in order to better characterize the association between hearing status and triadic interaction with books.

The results of the present study shed light on goals for early intervention with toddlers with hearing loss and their families. International awareness is growing about the importance of early identification of infants with hearing losses and the strong impact of early intervention on later language learning (Calderon & Naidu, 2000; Moeller, 2000; Yoshinaga-Itano, 2003). In many centers for deaf education and early intervention around the world, family-focused programs are now implemented with
babies in the first and second years of life. In such pro-
grams, collaboration with parents constitutes a central
goal (Sass-Lehrer & Bodner-Johnson, 2003).

The similarities found between the groups of chil-
dren with and without hearing loss in the overall pattern
of prelinguistic behaviors support the feasibility of adopt-
ing goals and principles known to hold true in typical
development for fostering communication in infants with
hearing loss. In addition, the results emphasize the im-
portance of highlighting family strengths as well as ad-
vocating training for families, to offer parents means to
overcome the difficulties faced by children who are deaf or
hard of hearing in learning labels for pictures and objects
(Dunst, 2000; McWilliam & Scott, 2001).

The results of the present study, for example, ad-
vocate that hearing parents of infants and toddlers with
hearing loss be trained to enhance triadic interactions.
Such mothers need to be taught how to enhance their
children's engagement with an object or a picture book.
They also need to become sensitive to their children's
focus of attention when they provide linguistic input
(Harris, Clibbens, Chasin, & Tibbits, 1989). Intervention
programs for young children with hearing loss and
their families should address clinical goals related to
the establishment of joint attention by showing mothers
how to relocate objects as well as how to share interest in
picture books. Likewise, mothers should learn strategies
for timing of input. They should learn to wait until their
child with hearing loss focuses on their face or hands
before providing the linguistic input for the child (Dromi
& Ringwald-Frimerman, 1996; Harris et al., 1989; Mohay
et al., 1998).

Although the two groups in the current study did not
differ in the general distribution and quantity of the re-
ported gestures or words that they used, the qualitative
analysis of the HPQ-CEL closed lists of words and of ges-
tures demonstrated that the association between the
toddlers' usage of gestures and of words was higher in
hearing children than it was in the children with hearing
loss. We also reported that the size of the gesture lexicon
beyond those included in the closed checklist provided in
the HPQ-CEL was larger in the group of children with
hearing loss than in the group of hearing participants.
These preliminary findings require consideration. Re-
search reports on the use of gestures by children with
hearing loss demonstrated that they develop gestures
naturally when they have limited access to linguistic in-
put (Goldin-Meadow & Morford, 1990; Goldin-Meadow
& Mylander, 1984, 1998). Many of these toddlers learn
words very slowly through structured training in inter-
vention programs. It might well be that the words mas-
tered in therapy by young children who are deaf may not
lend themselves to use in a range of spontaneous contexts
at home (Acerdolo & Goodwyn, 1990; Dromi, 1987, 2003;
Iverson & Thal, 1998).

The different age range in our two participating
groups also may explain why, in their natural home con-
texts, children with hearing loss produced gestures more
than hearing participants. The participants with hearing
loss in our sample produced more referential symbolic
gestures than did the hearing participants and also pro-
duced some innovative gestures that were not included in
the checklist given to parents. The latter result provides
indirect testimony to the richness of the gestural system
in cohorts of toddlers with hearing loss. We propose that
our results corroborate claims that children with hearing
loss need to communicate more and at higher levels as
they age, at least in those children who are otherwise cog-
nitively normal, and the lack of a complex verbal com-
unication system dictates that they will use a richer
gestural system than children with more typically de-
veloping communication skills (Goldin-Meadow & Morford,
1990; Goldin-Meadow & Mylander, 1998). Another expla-
nation might be that the use of gestures is reinforced by
parents of toddlers with a hearing loss out of necessity, and
this parental behavior, rather than innate predisposition,
enhances the use of gestures by the toddlers. The links
noted between the growth function of gestures and words
among hearing children was described for a later period in
the one-word stage as well as during the transition to syn-
tax (Iverson et al., 1994). Future studies should investigate
this link in toddlers with hearing losses who are older than
2 years of age.

Another point for further consideration is the fact
that the present analysis was conducted on data reported
by parents. It is very unlikely that parents with no formal
training in linguistics could collect the detailed data nec-
essary for a close examination of the relationship between
the use of words and of gestures. Research programs on
gestures use require a highly differentiated approach to
defining the various kinds of gestures, and should be con-
ducted by scientist–experts using direct observational
measures (Iverson et al., 1994). The questionnaire data
presented here calls for future empirical scrutiny of the
relationship between gesture use and word learning in
toddlers with hearing loss.

Taken together, the results of the present study in-
dicate that toddlers with hearing loss who were born to
hearing parents and entered a family-focused early lan-
guage intervention program demonstrated communica-
tive behaviors similar to those observed in hearing
toddlers at the same age and language level. The study
results showed that when assisted by a highly structured
questionnaire such as the HPQ-CEL, parents can observe
prelinguistic communication and report about it reliably.
The unique properties of communication that were do-
cumented in the toddlers with hearing loss made up two
main areas—spontaneous use of words and involvement
in triadic book reading interactions—that were relatively
lower compared with hearing peers. To expand on the

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present study's results, future comparative research should control language levels in older children while carefully attending to the importance of using identical means for data collection and data analytic procedures. Future research also should look at larger populations that have been identified prior to 6 months of age. It is feasible that children who begin intervention very early in infancy may present a profile that would even more closely resemble the one described for hearing infants. Another goal for future investigations is to assess prelinguistic communication with children who received cochlear implants prior to the development of conventional speech. Such studies will shed light on the relationships between hearing and communicative experiences in the first year of life and the development of communicative prerequisites for language learning.

Acknowledgments

We express gratitude to Bruno Zumbo for his input on the data analysis, Dee B. Ankonina for her editorial help, and Julia Reznick for her technical assistance in the preparation of this article.

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Received April 24, 2005
Revision received October 2, 2005
Accepted January 26, 2007
DOI: 10.1044/1092-4388(2007/081)
Contact author: Anat Zaidman-Zait, University of British Columbia, Department of Educational and Counseling Psychology and Special Education, 2125 Main Mall, Vancouver, British Columbia V6T 1Z4, Canada. E-mail: zaidman@interchange.ubc.ca.