Lexical and Grammatical Abilities in Deaf Italian Preschoolers: The Role of Duration of Formal Language Experience

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We evaluated language development in deaf Italian preschoolers with hearing parents, taking into account the duration of formal language experience (i.e., the time elapsed since wearing a hearing aid and beginning language education) and different methods of language education. Twenty deaf children were matched with 20 hearing children for age and with another 20 hearing children for duration of experience. Deaf children showed a significant delay in both vocabulary and grammar when compared to same-age hearing children yet a similar development compared to hearing children matched for duration of formal language experience. The delay in linguistic development could be attributable to shorter formal language experience and not to deafness itself. Deaf children exposed to spoken language accompanied by signs tended to understand and produce more words than children exposed only to spoken language. We suggest that deaf children be evaluated based on their linguistic experience and cognitive and communicative potential.

Deaf children exposed to sign language by deaf parents acquire it as a first language (Newport & Meier, 1985), yet around 95% of deaf children have hearing parents, most of whom are unfamiliar with sign language (Marschark, Lang, & Albertini, 2002). Deaf children with hearing parents have consistently revealed a general delay in the onset of language, as well as a slower rate of progression, resulting in poorer linguistic abilities with respect to same-age hearing children (Mayne, Yoshinaga-Itano, & Sedey, 2000; Mayne, Yoshinaga-Itano, Sedey, & Carey, 2000; Moeller, 2000; Pizzuto, Ardito, Caselli, & Volterra, 2001; Volterra, Capirci, & Caselli, 2001; see Caselli, Maragna, & Volterra, 2006, for a recent review). In particular, Mayne, Yoshinaga-Itano, and Sedey (2000) and Mayne, Yoshinaga-Itano, Sedey, and Carey (2000) studied the vocabulary of preschool-aged deaf/hard-of-hearing children (24–37 months old) with hearing parents using the MacArthur–Bates Communicative Development Inventories (CDI; Fenson et al., 1993), a questionnaire filled in by parents which is widely used for both clinical and research purposes (Dale, Bates, Reznick, & Morisset, 1989) and which was recently validated for children with hearing loss (Mayne, Yoshinaga-Itano, & Sedey, 2000; Mayne, Yoshinaga-Itano, Sedey, & Carey, 2000), including those with a cochlear implant (CI; Stallings, Gao, & Svirsky, 2002; Thal, DesJardin, & Eisenberg, 2007). The study of Mayne, Yoshinaga-Itano, Sedey, and Carey (2000) showed that deaf children produced significantly fewer words than similar-age hearing children and that their slower rate of acquisition resulted in increased differences with age, so that 6-year-old deaf children generally had a vocabulary comparable to that of 3-year-old hearing children, independently of the degree of deafness. Moreover, Lederberg and Spencer

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(2001) highlighted that deaf children lack a “spurt” in vocabulary development, which is characteristic in hearing children. With regard to the development of spoken grammar, in the early stages, some deaf and hard-of-hearing children have age-appropriate grammar skills, whereas others are significantly delayed, with a slower rate of successive development (Blamey, 2003).

So as to compensate for their difficulties in speaking, deaf children, and hearing children with linguistic disabilities in general, rely more on the use of gestures than do their peers (Capone, 2007; Goldin-Meadow & Mylander, 1984; Morford, 1998; Volterra & Erting, 1994). In this light, some language education and/or rehabilitation programs for deaf children rely on simultaneous communication, which consists of the spoken language and the simultaneous use of lexical signs from the sign language used in the given country, yet following the grammatical structure of the spoken language (in Italy, this form of communication is referred to as “bimodal”). In some cases (i.e., to improve the morphological aspects of speech), the spoken language may be accompanied by a form of manually coded language to highlight morphological word endings, using above all finger spelling, for example, Manually Coded English (MCE; Bornstein, 1990) or Italiano Segnato Esatto (Exact Signed Italian; Beronesi, Massoni, & Ossella, 1991). The supporters of simultaneous communication claim that the use of a visual–gestural modality, which is not impaired in deaf children, may improve the acquisition of spoken language. However, studies on the effect of the use of manually coded systems (mostly MCE) on language acquisition in deaf children with hearing parents show discordant results. Some show that deaf children learning MCE have significantly delayed vocabulary and grammatical development, compared with hearing children, whereas others show that vocabulary development is similar when compared to that of hearing children (Bornstein & Saulnier, 1981; Bornstein, Saulnier, & Hamilton, 1980; Schick & Moeller, 1992; see also Schick, 2003, for a review on this topic). The studies that found delayed vocabulary development also found that the rate of vocabulary growth was slower in deaf children with hearing parents compared to hearing children or deaf children exposed to sign language since birth. In Italy, no studies have evaluated the effects of the bimodal method on language acquisition in deaf children, although there are clinical case reports that show that this method has positive effects (Massoni & Maragna, 1997).

With regard to the potential factors involved in the delayed language development of deaf children, Marschark (1995) and Marschark and Clark (1998) have pointed out that linguistic abilities do not depend on the degree of hearing loss but are related to differences in the family, language, and educational environment (see also Pizzuto et al., 2001). In fact, most children with high performance levels in language tasks had parents who were well adjusted to their child’s deafness. The parents actively participated in the child’s education, promoting the child’s autonomy and awareness of the deaf and hearing cultures and their related languages (sign or speech). In the above-mentioned study, Mayne, Yoshinaga-Itano, Sedey, and Carey (2000) reported that the most important factors related to language development were age at diagnosis of hearing loss, age at beginning language rehabilitation, and the child’s general intellectual skills, demonstrating how the plasticity of the child’s brain and basic cognitive competence are crucial for successive learning. Children diagnosed before 6 months of age showed greater language skills than children diagnosed later, independently of the level of hearing loss, of the family’s socioeconomic status, and of the method of language rehabilitation, as also reported by Moeller (2000). However, although all the above studies reported individual variability, few deaf children showed above-average spoken language skills and most had fallen significantly behind their hearing peers (Blamey, 2003).

Although more recent studies have confirmed the importance of age at diagnosis and at beginning language rehabilitation (Yoshinaga-Itano, 2003, 2004), to the best of our knowledge, none of the studies that have compared deaf children with traditional hearing aids to hearing children have matched the two groups in terms of the duration of exposure to language, which for deaf children begins with the start of formal language rehabilitation and for hearing children begins at birth. Instead, this method has on a number of occasions been used to assess language development in deaf children with a CI. In fact, to demonstrate
the effectiveness of the CI, which in the past decade has been provided to many deaf children, language development has been evaluated not in relation to the child’s age but to the time elapsed since CI activation, that is, in terms of “time postimplant” or “time of implant use.” The results have shown that the language capabilities of these children are not significantly different from those of hearing children whose chronological age corresponded to the time postimplant of the children with the CI (Blamey et al., 2001; Ertmer, Strong, & Sadagopan, 2003; Nikolopoulos, Archbold, & Gregory, 2005; Svirsky, Robbins, Kirk, Pisoni, & Miyamoto, 2000; Tomblin, Spencer, Flock, Tyler, & Gantz, 1999).

The main objective of this study was to assess language development of deaf children without a CI, considering the chronological age as well as the time elapsed since beginning formal language training. The specific goals of this study were to evaluate language skills in deaf Italian preschoolers, compared to hearing children, taking into account both chronological age and duration of formal language training, to meet the following three main objectives:

1. to evaluate spoken vocabulary (comprehension and production) and early grammar skills and the relationship between the two;
2. to evaluate the effects of different rehabilitation methods (i.e., the oral method vs. the bimodal method) on language abilities; and
3. to evaluate the rate of progression of language development with age, comparing children with shorter and longer formal language training.

The importance of the results lies in the fact that in Italy, as in other countries, almost all children with severe or profound hearing loss undergo speech therapy programs and the linguistic capabilities acquired through this training often constitute one of the criteria for deciding whether or not the child should receive a CI.

Methods
Participants

We collected data on language development from 20 deaf children, whose parents were recruited at the Audiology and Speech Therapy Services of the Bambino Gesù Pediatric Hospital (Rome, Italy), where the children were undergoing regular controls of their hearing aid. None of the deaf children had a cognitive or neurological deficit associated with deafness. Five children had moderate hearing loss, 5 had severe hearing loss, and 10 had profound hearing loss. All the children had a hearing aid, whereas none of them had a CI (many children in Italy, and in particular in Rome, still use traditional hearing aids). All children attended speech therapy sessions, either two or three times a week; 10 children were taught with the oral method (speaking without systematically using gesture and/or signs) and 10 with the bimodal method. None of the parents knew sign language before discovering that their child was deaf. The parents of the 10 children taught with the bimodal method began attending a sign language course (once a week) within 2 months of their child’s beginning speech therapy. These parents were encouraged to use, in the most natural manner possible, the gestural modality together with spoken language when communicating with their child. All children were enrolled in regular nursery schools or kindergartens with hearing children. None of the teachers or the hearing children at school knew or used either sign language or any form of bimodal communication. The demographic characteristics of the deaf children are reported in Table 1.

As controls, we considered 40 hearing children, recruited at daycare centers, nursery schools, and kindergartens in Rome. The 40 hearing children were divided into two groups of 20 children each. To form the first control group, each hearing child was individually matched with a same-age deaf child (this control group is referred to as “same-age hearing children”). To form the second control group, each deaf child was individually matched with a hearing child whose chronological age corresponded to, for the deaf child, the amount of time that had elapsed between starting a speech therapy training (which also corresponded to the time of receiving the hearing aid) and the time that the questionnaire was administered. This time was considered as the duration of formal spoken language experience (for hearing children language experience begins with birth); this second control group is referred to as the “same duration of language
experience hearing children.” Table 2 shows the mean age and duration of language experience for the deaf and hearing children. To test the correct pairing of groups, we conducted a Student’s t test for age and for duration of language experience. The results showed that the groups were correctly paired, age: $t(19) = 0.370; p = .72$, and duration of language experience: $t(19) = 0.252; p = .80$. Moreover, the mean age and duration of language experience of the deaf children exposed to the oral method were equal to those of the deaf children exposed to the bimodal method, age: $t(18) = 0.083; p = .934$, and duration of language experience: $t(18) = 0.000; p = 1.000$.

To evaluate the differences in vocabulary and grammar in relation to the duration of language experience, we subdivided both deaf and hearing children into two subgroups each. The deaf children with a duration of spoken language experience of 8–17 months were defined as “shorter language experience deaf children” and those with a duration of spoken language experience of 18–44 months as “longer language experience deaf children.” These specific durations were chosen based on the results of previous studies on language development in hearing children, which were conducted using the MacArthur–Bates CDI and which highlighted that at about 18 months important developmental changes usually occur, in particular, the lexical repertoire dramatically increases and the ability to produce simple sentences emerges (Caselli, Casadio, & Bates, 1999; Dale, Dionne, Eley, & Plomin, 2000; Fenson et al., 1994). Six of the shorter language experience deaf children were exposed to the oral method and four to the bimodal method; among the longer language experience deaf children, four were exposed to the oral method and six to the bimodal method. Using the same criteria, the 20 same duration of language experience hearing children were also divided into two subgroups: “shorter language experience hearing children” (i.e., younger children; 7–18 months of age) and “longer language experience hearing children” (i.e., older children; 19–44 months of age).

To evaluate the differences in the transversal profiles of the deaf children, from the shorter language experience group to the longer language experience group, compared to the hearing control groups, we

### Table 1  Demographic characteristics of the deaf participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>M</th>
<th>SD</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronological age</td>
<td>41.60</td>
<td>10.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at identification of deafness</td>
<td>13.80</td>
<td>11.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at amplification (hearing aids)</td>
<td>17.95</td>
<td>11.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Months after hearing aids</td>
<td>23.65</td>
<td>9.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at beginning speech therapy</td>
<td>20.50</td>
<td>11.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Months after beginning speech therapy</td>
<td>21.30</td>
<td>11.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Here referred as duration of language experience</td>
<td>Severe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of hearing loss (in better ear)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aided pure-tone average</td>
<td>46.07 dB</td>
<td>15.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cause of hearing loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>10</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic</td>
<td>4</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*These data are available only for 14 participants.

### Table 2  Chronological age and duration of language experience of deaf children and hearing children

<table>
<thead>
<tr>
<th>Children</th>
<th>Number</th>
<th>Range (months)</th>
<th>Mean (months)</th>
<th>SD</th>
<th>Range (months)</th>
<th>Mean (months)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Chronological age</td>
<td></td>
<td></td>
<td>Duration of language experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaf</td>
<td>20</td>
<td>18–61</td>
<td>41.6</td>
<td>10.4</td>
<td>8–44</td>
<td>21.3</td>
<td>11.1</td>
</tr>
<tr>
<td>Oral method</td>
<td>10</td>
<td>28–61</td>
<td>41.8</td>
<td>11.0</td>
<td>8–44</td>
<td>21.3</td>
<td>13.1</td>
</tr>
<tr>
<td>Bimodal method</td>
<td>10</td>
<td>18–55</td>
<td>41.4</td>
<td>10.4</td>
<td>8–35</td>
<td>21.3</td>
<td>9.3</td>
</tr>
<tr>
<td>Hearing</td>
<td></td>
<td>Same chronological age</td>
<td>19–60</td>
<td>41.6</td>
<td>10.3</td>
<td>7–44</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Same duration of language experience</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
performed an analysis of variance (ANOVA), with two factors at two levels each. The first factor was “hearing status,” with two levels: “deaf” and “hearing.” The second factor was duration of spoken language experience, with two levels: “shorter” and “longer.” In each analysis, we tested the statistical significance of the interaction between the two factors and, if lacking, we tested the significance of the factor “duration of language experience.”

Table 3 shows the mean duration of language experience, range, and standard deviation and the results of the statistical tests, which show that the groups of deaf and hearing children were correctly matched.

**Instrument and Procedures**

To evaluate language development in deaf children, we used the MacArthur–Bates CDI (Fenson et al., 1993), a questionnaire that has been adapted to more than 40 languages. Various studies have found that this parent report measure is effective in characterizing children’s early language skills (Dale et al., 1989; Fenson et al., 1994; Thal, O’Hanlon, Clemons, & Fralin, 1999). It has been used in both populations with typical development (e.g., Dale et al., 2000; Farrar & Maag, 2002; Feldman et al., 2003) and those with atypical development, including deaf children (Mayne, Yoshinaga-Itano, & Sedey, 2000; Mayne, Yoshinaga-Itano, Sedey, & Carey, 2000; Stallings et al., 2002; Thal et al., 2007; Yoshinaga-Itano, Snyder, & Day, 1998). For the Italian version, norms are available for hearing children between 8 and 36 months of age (Caselli et al., 2007). Short forms of the CDI have also been developed (Eriksson, Westerlund, & Berglund, 2002; Fenson et al., 2000). The short form of the Italian version has been validated among 800 Italian hearing children (Caselli et al., 2007). In this study, we used this short form, which we adapted for use with hearing parents with deaf children. In particular, we included an evaluation of lexical comprehension and lexical production in terms of both the spoken word and/or gestures or signs (adapted version referred to as “Il Primo Vocabolario del Bambino Sordo,” PVB-s (“The First Vocabulary of the Deaf Child”); Caselli & Rinaldi, 2005).

The questionnaire was filled in on one day by the parents of both deaf and hearing children. Of the five sections of the questionnaire, in this analysis we considered “Vocabulary” and “Sentences,” given that these are the sections used for children greater than 18 months of age (Caselli et al., 2007; Fenson et al., 1994). The Vocabulary section consists of a list of 100 meanings (the same used in the short version for hearing children) expressing both content words (i.e., nominal, such as Cane/Dog, Cappello/Hat) and predicates, such as Dormire/To sleep, Caldo/Hot), and function words (such as Perche’/Why, Ancora/More). Parents were asked to indicate their child’s comprehension of meanings and their production, whether spoken and/or using a gesture or a sign of Italian Sign Language, and even if using a different pronunciation or if making an imprecise sign (e.g., slightly modified hand shape). When both a spoken word and a gesture/sign were reported for a single item, we counted this as one meaning. Parents were instructed not to record meanings expressed by a pointing gesture, unless explicitly requested, such as for body parts (e.g., eyes) or pronouns (e.g., me). The Sentences section is for investigating the emergence of grammatical skills in

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number</th>
<th>Range of language experience (months)</th>
<th>Mean duration of language experience (months)</th>
<th>SD</th>
<th>t</th>
<th>Significance (two-tailed), df = 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shorter duration of language experience, deaf children</td>
<td>10</td>
<td>8–17</td>
<td>12</td>
<td>3.882</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Shorter duration of language experience, hearing children</td>
<td>10</td>
<td>7–18</td>
<td>12</td>
<td>4.518</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longer duration of language experience, deaf children</td>
<td>10</td>
<td>19–44</td>
<td>30</td>
<td>7.777</td>
<td>−0.429</td>
<td>0.678</td>
</tr>
<tr>
<td>Longer duration of language experience, hearing children</td>
<td>10</td>
<td>21–44</td>
<td>30</td>
<td>7.457</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
spoken Italian. If the child has already begun to produce sentences, the level of completeness of sentences is explored. The first level consists of incomplete sentences, such as those with no function words or predicate (e.g., “mella bimba”/“candy baby” or “bimbo piange, caduto”/“baby cry, fall”). The second level consists of complete sentences and the use of function words (e.g., “do la caramella alla bimba”/“I give the candy to the baby” or “il bimbo piange perché è caduto”/“the baby is crying because he fell”). The same questionnaire was used for all children, except that the parents of hearing children were asked about gestures but not about Italian Sign Language.

Results

Comprehension and Production of Meanings

The deaf children understood a mean of 64 of the 100 meanings ($SD = 29.7$), which was lower than the mean of 88 meanings ($SD = 19.0$) understood by the same-age hearing children, $t(38) = -3.054, p < .01$, yet not statistically different from the mean of 53 meanings ($SD = 33.5$) understood by hearing children with the same duration of language experience, $t(38) = 1.030, p = .31$ (Figure 1).

Among the deaf children, controlling for age and duration of language experience, the mean number of meanings understood was similar when comparing those exposed to the oral method (61 meanings; $SD = 34.6$) and those exposed to the bimodal method (66 meanings; $SD = 25.4$), $t(18) = -0.391, p = .70$ (Figure 1).

With regard to production, the deaf children produced a mean of 47 spoken words ($SD = 32.4$; with or without an accompanying gesture/sign) and an additional five gestures/signs ($SD = 5.7$; Figure 2). The same-age hearing children produced a mean of 75 spoken words ($SD = 30.2$) and one other gesture ($SD = 1.8$), and the hearing children with the same duration of language experience produced a mean of 34 spoken words ($SD = 36.9$) and an additional three gestures ($SD = 3.4$; Figure 2).

When comparing the groups in terms of spoken words (with or without gesture/sign), the deaf children produced fewer words than the same-age hearing children, $t(38) = -2.823, p < .01$, whereas when considering only gestures/signs, they produced more.

Figure 1  Mean number of meaning understood by hearing children (same duration of language experience and same chronological age as deaf children) and by deaf children (bimodal and oral method).

Figure 2  Mean number of meaning produced by hearing children (same duration of language experience and same chronological age as deaf children) and by deaf children (bimodal and oral method).
meanings, $t(38) = 2.960, p < .01$. When comparing the deaf children to the hearing children with the same duration of language experience, no significant differences were found in the number of either spoken words, $t(38) = 1.188, p = .24$, or meanings produced only with a gesture/sign, $t(38) = 1.452, p = .16$. When considering the total number of meanings (spoken and gesture/sign), deaf children produced fewer meanings than same-age hearing children, $t(38) = -2.548, p < .05$; when compared to the hearing children with the same duration of language experience the difference was not significant, $t(38) = 1.469, p = .15$.

Among deaf children, the mean number of spoken words (with or without gesture/sign) did not differ significantly by educational method, $t(18) = -0.182, p = .86$, mean of 46 ($SD = 36.0$) for those exposed to the oral method and 49 ($SD = 30.2$) for those exposed to the bimodal method (Figure 2). The mean number of meanings expressed with only a gesture/sign was higher for deaf children exposed to the bimodal method (mean of 7; $SD = 6.3$), compared to deaf children exposed to the oral method (mean of 3; $SD = 4.4$), though the difference was not significant, $t(18) = -1.686, p = .11$ (Figure 2).

With regard to the relationship between the spoken word and gestures/signs, for deaf children, the mean percentage of meanings expressed only with the spoken word was lower than that for the same-age hearing children, $t(38) = -3.477, p < .01$, yet it was not different from that for hearing children with the same duration of language experience, $t(34) = -0.919, p = .36$ (Figure 3). The percentage of meanings expressed by deaf children with only a gesture/sign was higher than that among same-age hearing children, $t(38) = 2.011, p = .05$, yet similar to that among the hearing children with the same-duration of language experience, $t(34) = -0.325, p = .75$. Regarding the percentage of meanings expressed using the spoken word combined with a gesture/sign, this percentage was higher among deaf children, compared to both

![Figure 3](https://academic.oup.com/doi/10.1093/jdsde/14.1.633/32293)
same-age hearing children, \( t(38) = 3.051, p < .01 \), and hearing children with the same-duration of language experience, \( t(34) = 1.969, p = .06 \).

When comparing deaf children by educational method (Figure 3), the two groups did not differ in terms of the percentage of meanings expressed only with a gesture/sign, \( t(18) = -0.589, p = .56 \), whereas deaf children exposed to the oral method had a higher percentage of meanings expressed only with a spoken word, compared to the other group, \( t(18) = 2.162, p < .05 \), and consequently a lower percentage of meanings expressed using both modalities, \( t(18) = -2.673, p < .05 \).

Early Spoken Grammar

The percentage of deaf children who combined two or more words to form a sentence (whether complete or incomplete; 80.0%) was similar to that for same-age hearing children (90.0%), \( t(38) = -0.872, p = .39 \), yet it was higher than that for the hearing children with the same duration of language experience (45.0%), \( t(38) = 2.390, p < .05 \).

Regarding the number and completeness of sentences (Table 4), deaf children, compared to same-age hearing children, produced slightly fewer sentences (difference not significant), \( t(38) = -1.882, p = .07 \), and significantly fewer complete sentences, \( t(38) = -5.013, p < .01 \). The deaf children were similar to the hearing children with the same-duration of language experience in terms of both the total number of sentences, \( t(38) = -1.291, p = .21 \), and the number of complete sentences, \( t(38) = -0.000, p = 1 \).

Among deaf children, the percentage who formed sentences was 80% for both the oral method and the bimodal method group. The total number of sentences produced was also similar for the two groups, \( t(18) = 0.261, p = .80 \), whereas the number of complete sentences was slightly higher for deaf children exposed to the oral method, though not significantly, \( t(18) = 1.578, p = .13 \) (Table 3).

Regarding the relationship between vocabulary level and early spoken grammar, for both deaf and hearing children, there was a significant correlation (Table 5).

Language Abilities by Age Group

The mean number of meanings understood and produced for the deaf and hearing children, by duration

<table>
<thead>
<tr>
<th>Number of sentences produced</th>
<th>Deaf (oral method)</th>
<th>Deaf (bimodal method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>7.5</td>
<td>7.8</td>
</tr>
<tr>
<td>10.2</td>
<td>9.3</td>
<td>4.3</td>
</tr>
<tr>
<td>7.2</td>
<td>3.0</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**Table 4 Number of sentences and of complete sentences produced by hearing children and deaf children**

<table>
<thead>
<tr>
<th>Number of complete sentences (out of total produced)</th>
<th>Deaf (oral method)</th>
<th>Deaf (bimodal method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>3.0</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**Table 5 Correlation between vocabulary and early grammar skills for deaf children and hearing children (same duration of language experience and same chronological age as deaf children)**

<table>
<thead>
<tr>
<th>Word production</th>
<th>Deaf children</th>
<th>Same duration of language experience hearing children</th>
<th>Same chronological age hearing children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of sentences</td>
<td>( r = .64 )</td>
<td>( r = .80 )</td>
<td>( r = .77 )</td>
</tr>
<tr>
<td></td>
<td>( p &lt; .01 )</td>
<td>( p &lt; .01 )</td>
<td>( p &lt; .01 )</td>
</tr>
<tr>
<td>Total sentences</td>
<td>( r = .86 )</td>
<td>( r = .81 )</td>
<td>( r = .81 )</td>
</tr>
<tr>
<td></td>
<td>( p &lt; .01 )</td>
<td>( p &lt; .01 )</td>
<td>( p &lt; .01 )</td>
</tr>
<tr>
<td>Complete sentences</td>
<td>( r = .76 )</td>
<td>( r = .78 )</td>
<td>( r = .85 )</td>
</tr>
<tr>
<td></td>
<td>( p &lt; .01 )</td>
<td>( p &lt; .01 )</td>
<td>( p &lt; .01 )</td>
</tr>
</tbody>
</table>
of language experience, is shown in Figure 4. For comprehension, the ANOVA showed that the interaction between the two factors was significant, $F(1.36) = 7.931, p < .01$. For hearing children, the number of words understood increased with increasing duration of language experience, whereas for deaf children, it basically remained stable.

There was also a significant interaction between the two factors for production (spoken word with or without gesture/sign), $F(1.36) = 6.208, p < .05$, revealing that for hearing children, the number of words produced increased with increasing duration of language experience, whereas for deaf children, it basically remained stable.

For the production of gestures/signs only, there was no significant interaction, $F(1.36) = 2.782, p = .10$. Moreover, the significance of the duration of language experience effect, $F(1.36) = 11.390, p < .01$, shows that, independently of whether or not the children were deaf or hearing, the use of only gestures/signs decreases with increasing duration of language experience.

The scores obtained for the number of sentences produced by deaf and hearing children for the two levels of duration of language experience were subjected to the same statistical analysis. According to the results (Figure 5), for hearing children, the number of sentences produced increased with increasing duration of language experience, whereas for deaf children, it basically remained stable.

Figure 5 shows the scores obtained for the number of morphologically complete sentences. Again, for hearing children, the number of morphologically complete sentences produced increased with increasing duration of language experience, whereas for deaf children, it basically remained stable, $F(1.36) = 4.976, p < .05$.

**Discussion**

In this study, we used a questionnaire filled in by parents to study the language development of preschool-aged deaf children and to highlight the similarities and differences with respect to children who acquire the spoken language in “typical” contexts. To this end, the data for deaf children were compared to data on two groups of hearing children who were matched with deaf children in terms of age and duration of language experience. We are aware that when

Figure 4  Number of meanings understood and produced by spoken word (accompanied or not by gesture/sign) and by gesture/sign only, for hearing children and deaf children, with shorter and longer duration of language experience.

Figure 5  Number of sentences and number of complete sentences produced by hearing children and deaf children, with shorter and longer duration of language experience.
deaf children begin formal language training, they probably have already been exposed to language and have some communicative and linguistic experience. However, given that exposure is mainly auditory for deaf children with hearing parents, uptake is probably quite low until formal language training begins.

The results showed that deaf children, compared to same-age hearing children, have a significant delay in both vocabulary and grammar, confirming the findings of other studies conducted using a similar tool on children exposed to English (Mayne, Yoshinaga-Itano, & Sedey, 2000; Mayne, Yoshinaga-Itano, Sedey, & Carey, 2000; Yoshinaga-Itano, 2003, 2004). The results are also consistent with those of other studies using direct observation through formal testing and with the results of longitudinal studies (Blamey, 2003; Pizzuto et al., 2001). With regard to grammar, deaf children produced fewer sentences, which were shorter and had fewer function words. Thus, weaknesses in free morphology, which were previously demonstrated for older children acquiring Italian (Volterra et al., 2001), are already evident in the early stages of language acquisition. Moreover, the differences that we observed in grammar development are probably intensified by the fact that the younger hearing children (mean age of 12 months) clearly did not yet produce sentences, whereas all the older hearing children (mean age of 30 months) produced sentences that in most cases were morphologically complete.

With regard to the finding that the differences between deaf and hearing children were greater for grammar than for vocabulary, this could indicate that these are domains of language that develop autonomously as proposed by other studies (Pinker, 1994). However, we found a close correlation between the number of words produced and the development of grammar, as previously reported for hearing/typically developing children (Bates & Goodman, 1997; Caselli et al., 1999) as well as for children with language and/or cognitive impairment (Caselli, Monaco, Trasciani, & Vicari, 2008; Vicari, Caselli, Gagliardi, Tonucci, & Volterra, 2002). One possible explanation for the deficit in grammar could be that the deafness causes serious problems in the processing of acoustic events (e.g., verbal strings, phonemic sequences, rhythms in sequence) and thus atypical construction of morpho-phonological representations, resulting in atypical processes in acquiring and mastering morphological aspects (Volterra et al., 2001).

Despite these considerations, when comparing language development in deaf and hearing children with comparable duration of language experience, we found no differences in the number of words produced or in the number or completeness of sentences, indicating that the duration of formal language experience is an important element which should be taken into consideration when evaluating deaf children’s spoken language abilities. These findings confirm those of previous studies, which have reported that only spoken language ability is impaired in deaf children, leaving intact the more general linguistic and cognitive capacities (Marschark, 1995, 2006).

Deaf and hearing children with comparable duration of language experience were also similar in terms of the use of nonverbal modalities: signs and/or gestures were used to “name” events or objects for which the child did not know the corresponding word. In both deaf and hearing children, this behavior was closely related to the development of spoken vocabulary: the number of signs/gestures produced decreased with increasing lexical repertoire. This finding is consistent with the results of numerous studies on hearing children, which show that in the early stages of language development, when the number of words is limited, gestures are more numerous and more commonly used than in successive stages (Capirci, Contaldo, Caselli, & Volterra, 2005; Capirci, Iverson, Pizzuto, & Volterra, 1996; Iverson, Capirci, & Caselli, 1994). A recent study conducted on hearing children in Italy confirmed that co-speech gestures decreased but did not disappear with increasing age and spoken naming competence (Stefanini, Bello, Caselli, Iverson, & Volterra, 2008). Older hearing children in diverse observational settings have been shown to produce gestures, which may help them to express ideas that they do not succeed in expressing with spoken language and to convey a substantial proportion of their knowledge (Alibali, Kita, & Young, 2000; Guidetti, 2002; Pine, Lufkin, Kirk, & Messer, 2007).

As reported in other studies (Lederberg, 2003; Mayne, Yoshinaga-Itano, & Sedey, 2000; Mayne, Yoshinaga-Itano, Sedey, & Carey, 2000; Moeller,
2000; Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998), yet in contrast to our hypotheses, we found no statistically significant differences between deaf children exposed to the bimodal method and those exposed to the oral method, in either vocabulary or grammar. However, the lack of significant differences could be due to the small number of participants in each subgroup. Nonetheless, our data show that the deaf children exposed to the bimodal method tended to understand and produce more words, which could indicate that the use of visual–gestural modality does not hinder the learning of the spoken language and that it can instead constitute a useful means of support for learning to speak. In fact, children exposed to the bimodal method tend to use more frequently the gestural modality to express new meanings for which they do not know the corresponding word, as well as meanings for which they do know the spoken word.

The similarities between deaf children and hearing children with a similar duration of formal language experience could suggest that these groups undergo similar “phases” in language development. In light of this finding, we divided the children into groups based on whether the duration of spoken language experience was shorter or longer, in an attempt to simulate a longitudinal perspective. According to the results, the increases in language development with increasing duration of language experience were quite evident for the hearing children and much less evident for the deaf children. This could be due to the fact that hearing children are exposed to the spoken language not only when it is specifically directed at them but also when others around them are speaking (e.g., their parents or other adults and other children), in what could be referred to as a “natural” context. Instead, deaf children are only exposed to language through face-to-face interactions and undergo a long, slow, arduous process of formal exposure, consisting of a highly structured didactic processes.

In interpreting the results of this study, some potential limitations should be considered. First of all, the results derive from indirect observations (i.e., a questionnaire filled in by parents). However, as previously reported, numerous studies have shown that this is a valid method, although direct observation is necessary to better understand the use of language in different modalities and in different contexts. Second, the study population was not large, and there were few children in each of the subgroups considered. Moreover, the comparison of children with a shorter duration of language experience and those with a longer duration was cross-sectional in design, and the results can only be used to make general inferences regarding language development over time.

With regard to the clinical implications of our findings, in terms of language education for deaf children, these data could help speech therapists and teachers in planning interventions that combine gestural modality with speech, so as to improve the language capabilities of deaf children. Moreover, measurements similar to that of time postimplant used to evaluate the effectiveness of the CI (Blamey et al., 2001; Ertmer et al., 2003; Nikolopoulos et al., 2005; Svirsky et al., 2000; Tomblin et al., 1999) could be very useful in understanding the effectiveness of speech therapy also for children with the traditional hearing aid, to determine whether the progress made is consistent with expectations based on the duration of formal language experience. In fact, this information could help clinicians to decide whether or not to change the type of hearing aid and/or the type of language education and to decide whether or not the child is a candidate for a CI.

To conclude, the delay in linguistic development in deaf children, compared to same-age hearing children, may in part be attributable to less language experience (and not to deafness itself). In this light, we suggest that the language abilities of deaf children be evaluated in a different perspective: instead of estimating deficiencies compared to hearing children, deaf children should be evaluated based on their linguistic experience and cognitive and communicative potential.

References


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