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Early Literacy in Children with Hearing Impairment: A Comparison Between Two Educational Systems

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The authors would like to express their appreciation to Dee Ankonina for her editorial contribution.

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Accepted: The Volta Review

Abstract

The current study examined the early literacy skills of kindergartners with hearing impairment who were enrolled in individual inclusion and in group inclusion as well as those of hearing children. The relationship between the early literacy skills and background variables such as the degree of hearing loss, the type of sensory aid used, the age of onset of rehabilitation and the family socio-economical status were examined as well. 42 children participated in the study: 16 hearing-impaired children in a group inclusive program, 15 hearing-impaired children in an individual inclusive program, and 11 normally hearing children. The following early literacy skills were evaluated: word identification, writing level, phonological awareness, letter identification, orthographic awareness, general knowledge and vocabulary. The main findings indicated that hearing-impaired children in the individual inclusive program yielded better achievements compared to those enrolled in the group inclusive program regarding phonological awareness, letter identification, general knowledge and vocabulary. The achievements of the hearing children in these parameters were higher than that of hearing-impaired children of either one of the inclusive programs. There were no statistically significant differences between individual and group inclusive programs regarding reading, writing and orthographic awareness. The achievements of the hearing children in these parameters were higher than that of hearing-impaired children enrolled in group inclusion but not statistically different than that of hearing-impaired children enrolled in individual inclusion. The findings showed a negative correlation between general knowledge and the degree of hearing loss. Also general knowledge, reading and writing were correlated to the age of onset of rehabilitation. No correlation was found between the socio-economical status and the early literacy skills of the children. The results suggest that gaps in the academic achievements

associated with literacy, between hearing and hearing-impaired children, as well as between hearing-impaired children enrolled in different inclusive programs, appear already at the kindergarten stage. Focusing on training and improvement of pre literacy capabilities in the kindergarten may decrease those gaps.

Early Literacy in Children with Hearing Impairment: A Comparison Between Two Educational Systems

The transition from kindergarten to first grade comprises an important stage in children's development, with long-term influences on children's functioning and success in the ensuing school years (Alexander, Entwisle, & Dauber, 1993). Children entering school face many new challenges and require novel academic skills that were not essential during kindergarten. While in kindergarten, children learn primarily through play, whereas first graders encounter more formal learning and more complex academic tasks.

Early literacy – the knowledge of reading and writing that children acquire before formal exposure to these domains in school – begins in children's natural surroundings at home and in kindergarten and has been shown to predict children's academic success in school (Korat & Levin, 2001; Shatil, Share, & Levin, 2000). Early literacy incorporates various skills, including linguistic knowledge, phonological awareness, and orthographic awareness. Michas and Henry (1994) found a correlation between kindergartners' language knowledge (vocabulary size and success in word recognition tasks) and their phonological awareness. Phonological awareness skills serve as mediators between the sound segments of the spoken language and the orthographic segments of written language. Many studies reported that phonological awareness skills in kindergartners predict future success in the acquisition of reading and writing (Adams, 1991; Bentin & Leshem, 1993; Shatil et al., 2000). Orthographic awareness involves the knowledge that letters differ from numbers or pictures, that spaces belong between words, and that words consist of a few letters. This knowledge in kindergartners was found to correlate with the later

acquisition of reading and writing in first grade (Shatil et al., 2000). Storch and Whitehurst (2002) reported that the best predictors of reading acquisition comprised language skills (especially vocabulary), grapho-phonemic skills, and letter recognition skills, which are all acquired during kindergarten.

Children with hearing loss exhibit lower academic achievements than do their same-age hearing peers. For example, researchers found that high school students with severe hearing loss evidenced a fourth grade level of reading (Paul, 1998; Spencer, Tomblin, & Gantz, 1998). School age children with hearing impairments also revealed lower performance on writing tasks than their normally hearing peers, including simpler and shorter sentences and the repeated usage of the same sentence pattern (Quigley & Paul, 1984). The large gaps between these children and children with normal hearing appear to result from the effects of the hearing loss on different aspects of language acquisition. In particular, these gaps implicate deficits in the area of spoken language due to the hearing loss (Paul, 1998).

The impact of educational setting on the literacy of children with hearing impairment has also received empirical attention. A substantial body of research on children with hearing impairments has underscored that those who attend regular classes perform better than those who attend special classes in different domains such as academic competencies and achievements, communication abilities, and social and emotional skills (Anderson, 1998; Bilir & Bal, 1998; Farlow, 1996; Gans, 1998; Geers & Moog, 1989; Paul & Quigley, 1990).

In Israel, young children diagnosed with hearing impairments enter early intervention and educational settings from the age of 3 years. These settings, under the administrative supervision of the national Ministry of Education, receive support and professional supervision from the MICHA Society for Deaf Children, a national

early intervention agency that provides educational and rehabilitational services to young children (ages 0-7 years) with hearing impairments and to their families. For kindergartners (from age 5 years), two different educational settings are available: individual inclusion and group inclusion. The individual inclusion track integrates children with hearing impairments into regular kindergartens in their neighborhoods. These children, numbering approximately 60% of Israeli kindergartners with hearing impairments, receive hearing, speech, and language therapy at two locations – in their natural environment at the kindergartens and also at the closest MICHA center. In addition, they receive social and emotional support through meetings at the MICHA center with peers who have hearing impairments. Children in the individual inclusion track usually communicate solely through spoken language.

The group inclusion track (the remaining 40% of Israeli kindergartners with hearing impairments) integrates a group of 6 to 8 children who have hearing impairments into a regular kindergarten with 25 normally hearing children. Both groups share many common activities during the day, but some activities are conducted separately. The children in the group inclusion setting communicate through either spoken language and/or simultaneous communication (speech and sign).

The aforementioned strong relations between kindergartners' early literacy skills and children’s later reading and writing achievements in school, as well as the vulnerability of children with hearing impairment to deficits in literacy, call for research evaluating the efficacy of the preschool educational system for this population. The comparative investigation of kindergartners' school readiness in each of the two inclusion tracks and in a control group of normally hearing kindergartners

may inform attempts to design curricula that appropriately meet children's particular needs.

Method

Participants

Participants comprised 42 kindergartners aged 62 to 84 months (*M* = 72 months, *SD* = 7.6), divided into three groups. The first group of participants consisted of 15 children with hearing impairments who were in the individual inclusion track (herein: HI-II); each child with a hearing impairment was individually integrated into a regular kindergarten with normally hearing children in his or her neighborhood (i.e., in a total of 15 kindergartens). The second group of participants consisted of 16 children with hearing impairments who were in the small-group inclusion track (herein: HI-SG), integrated within small groups into a regular kindergarten (i.e., in a total of 4 kindergartens).The control group consisted of 11 normally hearing (NH) children who were enrolled in 2 regular kindergarten setting.

All 31 children with hearing impairments were recruited from the Tel Aviv branch of MICHA. They all had prelingual hearing loss. The mean degree of hearing loss was 61dBHL (SD = 28.5) for the HI-II group and 86dBHL (SD = 24.5) for the HI-SG group. The two groups were significantly different with regards to their mean degree of hearing loss *(t(29)= 2.67, p < .05).*

All 31 children with hearing impairments used sensory aids. In the HI-II group, 12 children wore hearing aids, and 3 children had cochlear implants. In the HI-SG group, 8 wore hearing aids, and 8 had cochlear implants. Regarding mode of communication, in the HI-II group all the children used spoken language except 1 who used total communication. In the HI-SG group, 9 children used spoken language and 7 children used total communication. The two groups differed significantly

regarding age at onset of rehabilitation. The age of onset for therapy was earlier for the HI-SG group than for the HI-II group ($t\ (28) = -2.82, p < .01$).

All 42 children had hearing parents and they came from Hebrew speaking homes. They were scheduled to start first grade in the following school year, and showed no cognitive, emotional or behavioral problems. The three groups did not differ significantly with regard to socioeconomic status (using Roe's 1956 scale that considers parents' professional status).

Instruments

Parents completed a demographic questionnaire including data on child's degree of hearing loss, type of sensory aid, mode of communication, age of onset of rehabilitation, other difficulties, parents' hearing status and profession. Children completed seven tests of early literacy: word writing, word recognition, phonological awareness, letter identification, orthographic awareness, receptive vocabulary, and general knowledge, as follows.

1. Word writing. We asked the child to write four pairs of words presented orally(and in signs when necessary). To avoid any misunderstanding caused by the child's hearing loss, the examiner presented the child with four cards (23 x 17 cm.), each of which displayed identifying drawings (9 x 9 cm.) of two nouns. The four pairs of words fell into two groups that encompassed different aspects of children's emergent literacy. In two pairs, the longer sounding word denoted a smaller referent (*pil* - *nɛmala* 'elephant – ant;' *soos* - *tolaat* 'horse – worm.' In the other two pairs, the two words differed in their phonological length but did not differ clearly in the size of their referents (*ɛt* – *iparon* 'pen – pencil;' *dag* - tsfard*ɛa* 'fish – frog.' With each card, the child received one A4 sized sheet of paper on which to write the pair of words. We scored each written word on a 14-point scale adapted from Levin, Share, and

Shatil (1996) and Levin and Bus (2003), consisting of (1) scribble; (2) a single good form like a square, a circle-like form, a triangle-like form, etc.; (3-5) writing-like schemes – linearity, segmentation, or diverseness – which each added a point; (6) pseudo letters; (7) random letters; (8) basic consonantal spelling without vowels; (9) partial consonantal spelling without vowels; (10) partial consonantal spelling with vowels; (11) advanced consonantal spelling with distortions and additions; (12) advanced consonantal spelling without vowels; (13) advanced consonantal spelling with vowels, accepting homophonic mistakes in consonants and vowels; or (14) conventional writing. The mean score across the eight words served as the *word writing* score. The reliability of the scale across the words was $\alpha = .96$.

2. Word recognition. To measure word recognition from printed Hebrew for the same eight words as above, we asked the child to match each of the four word pairs, presented orally (and in signs when necessary) and accompanied by the respective pair of illustrations on a card, with a printed word pair from the pool of four printed cards. We also asked the child to explain his/her recognition ("Why do you think that this word is X and this word is Y?"). We only scored the explanations because recognition itself could have been subject to guessing. We scored the level of explanation of each pair along the following 4-point scale: (1) A pre-alphabetic explanation comprising egocentric, contextual, or "I don't know" responses, where the explanation did not refer to the system of writing (e.g., "Because I know," "I guessed"); (2) A rudimentary incorrect alphabetic explanation referring to characteristics relevant to writing, by noting letter names or phonological length, but applying them erroneously; (3) A partial alphabetic, mixed correct and incorrect explanation, which referred to characteristics relevant to writing, but applied them partly correctly and partly incorrectly (e.g., providing a correct name for a letter but

deriving the conclusion that it should be a word that is not actually spelled with that letter); (4) A correct alphabetic explanation that refers correctly to the written system as follows: mapping the longer sounding word onto the longer written word and explaining it by reference to phonology; naming a letter correctly and deriving the correct conclusion as to the written word; or a morphological explanation or decoding. The possible score for *explanations* ranged from 1 to 4, with higher scores indicating more correct alphabetic explanations. The mean of *word recognition's explanation* was highly reliable, Cronbach $\alpha = .92$, and served as the *word recognition* score.

3. Phonological awareness. We developed a test of phonological awareness for this study that presented all the words as illustrations to address the HI-II and HI-SG children's difficulty in managing auditory input. The test included 20 stimulus words, each accompanied by three alternatives: two distracter words and one target word that matched the stimulus on initial or final phoneme or syllable, as described below. Thus, for each of the 20 words, the examiner presented the child with four illustrations: an illustration of the stimulus word in the center and three other illustrations below it that included an illustration of the target word according to the following procedure. For 10 words, we asked the child to match the stimulus word with one of the three words below it that started with the same sound. For five of these words, we requested a matching initial syllable **(**e.g., stimulus word: *kapit* (spoon), target word: *kadur* (ball)) and for the other five we requested a matching initial phoneme (e.g.,stimulus word: *tinok* (baby) target word: *tapuach* (apple)). For the other ten words, we asked the child to match the stimulus word with one of the three words below it that ended with the same sound. For five of these words, we requested a matching final (rhyming) syllable (e.g., stimulus word: *beitsa* (egg) target

word: *hultsa* (shirt)), and for the other five we requested a matching final phoneme (e.g., stimulus word: *naal* (shoe), target word: *degel* (flag)). The sum of the child's correct responses served as the *phonological awareness* measure (Cronbach α= .73).

4. Letter identification. We asked the child to name 12 printed letters, each presented on a separate card in large print (200 Times New Roman). Within the Hebrew alphabet's 22 regular letters and 5 final letters, the 12 regular letters that were chosen for the present study were among the easiest to recognize for children in the 3 to 5 year age range (Levin, Patel, Margalit, & Barad, 2002). The sum of the correctly named letters, served as the *letter identification* score. The possible score ranged from 0-12. Reliability across words was α = .91.

5. Orthographic awareness. We adapted to Hebrew a test developed by Olson, Kliegl, Davidson, and Foltz (1985). The test included 18 pairs of graphic items comprising one printed word and one non-word that included a mixture of Latin and Hebrew letters, numerals, or illegal repetition of letters (for example: the pair 'שלום - תתתתת' which comprises the word *shalom* 'peace/hello' and a quintuple repetition of the letter 't'). We asked children to select the printed word and explain his/her reasons. The score on orthographic awareness consisted of the sum of items correctly selected and explained. The possible score range was 1-18. Reliability across words was α = .75.

6. Receptive vocabulary. We selected the Peabody Picture Vocabulary Test (PPVT) to examine children's receptive vocabulary, using Solberg and Nevo's (1979) translation to a Hebrew items set. For each spoken word/signed we asked the child to choose the appropriate illustration out of four options presented on one page. Each correct response added one point to the *receptive vocabulary* score. We started the word presentation at picture 15 which is the recommended starting point for hearing

children age 4. The last word is number 60. Thus the possible score ranged from 15-60.

7. General knowledge. We used the general knowledge subscale of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) adapted to Hebrew (Liblich, 1979), administered either orally or simultaneously. According to standardized procedures, each item could be scored 0 or 1, yielding a maximal score of 23. The sum of correct responses served as the *general knowledge* score.

Procedure

We assessed children individually during two sessions in a quiet room in the kindergarten. We divided the test into two fixed sequence sets: (1) word writing of two word pairs, phonological awareness (the final phoneme/syllable), receptive vocabulary (PPVT), half of the orthographic awareness test, and word recognition of two pairs; and (2) word writing of two word pairs, letter identification, phonological awareness (the initial phoneme/syllable), half of the orthographic awareness test, general knowledge (WPPSI), and word recognition of two pairs. Half of the sample started with set one and then completed set two, and the other half started with set two and then completed set one. In addition, parents completed the demographic questionnaire at home and returned it to the kindergarten teacher.

Results

To account for the significant difference that emerged in degree of hearing loss between the two groups of children with hearing impairment, we conducted one-way analyses of variance (ANOVAs) for all the study measures, for the two groups with hearing loss, utilizing degree of hearing loss as a covariate. No significant effect of hearing loss emerged between the two groups for any measure; therefore, the following section presents results of ANOVAs conducted to examine the differences

among the three groups of participants (two groups with hearing impairment and one group with normal hearing), utilizing age as a covariate, due to the generally lower age of the group with normal hearing.

ANOVA Tests for the Seven Early Literacy Variables

Word writing. The one-way ANOVA for word writing performance (with age as covariate) revealed a significant difference between children in the three groups, F (2, 39) = 5.60, $p < .01$. Table 1 presents the means, standard deviations, ranges, and F value. A Bonferoni test conducted to reveal the source of the difference showed that the NH group performed significantly better than the HI-SG group. No significant difference emerged either between the NH and HI-II groups or between the two HI groups.

Word recognition. The one-way ANOVA for reading revealed a significant difference between children in the three groups, F (2, 39) = 9.18, $p < .01$. Table 1 presents the means, standard deviations, ranges, and F value. A Bonferoni test conducted to reveal the source of the difference showed that the NH group performed significantly better than the HI-SG group. No significant difference emerged either between the NH and HI-II groups or between the two HI groups.

Phonological awareness. Table 2 presents the means, standard deviations, ranges, and F values for the three groups of children on the phonological awareness test's grand total, initial position total, final position total, and each of the four subtests: initial phoneme, initial syllable, final phoneme, and final rhyming syllable. Regarding the grand total for the phonological awareness test, the one-way ANOVA (with age as covariate) showed a significant difference between children in the three groups, F (2, 39) = 14.58, $p < .01$. A Bonferoni test conducted to reveal the source of

the difference showed that the NH group significantly outperformed each of the HI groups. The HI-II group also scored significantly higher than the HI-SG group.

A significant difference between groups also emerged for the final position category, F (2, 39) = 5.01, $p < .05$. A Bonferoni test revealed that the NH group performed significantly higher than the HI-SG group but not than the HI-II group. Neither did a significant difference emerge between the two HI groups. In the final syllable (rhyming) subtest, the NH group significantly outperformed the HI-SG group but not the HI-II group, and no significant difference emerged between the two HI groups. In the final phoneme subtest, no significant differences emerged between the groups.

Finally, a significant difference between groups also emerged for the initial position category, F (2, 39) = 13.91, $p < .01$. A Bonferoni test revealed that the NH group performed significantly better than each of the two HI groups, and that the HI-II group significantly outperformed the HI-SG group. In the initial syllable subtest, the NH group significantly outperformed the HI-SG group but not the HI-II group, and the HI-II group performed significantly better than the HI-SG group. In the initial phoneme subtest, the NH group outperformed each of the two HI groups, but no significant difference emerged between the two HI groups.

Alphabetic and orthographic measures. Table 3 presents the means, standard deviations, ranges, and F values for the three groups of children on letter identification and orthographic awareness. The one-way ANOVA for letter identification revealed a significant difference between the groups, F (2, 39) = 9.82, $p < .01$. A Bonferoni test showed that the NH group performed significantly better than the two HI groups, and that the HI-II group significantly outperformed the HI-SG group. The one-way ANOVA for orthographic awareness also revealed a significant

difference between the groups, F (2, 39) = 4.10, $p < .05$. A Bonferoni test showed that the NH group performed significantly higher than the HI-SG group, but not higher than the HI-II group. Neither did a significant difference emerge between the two HI groups.

Knowledge and vocabulary. Table 4 presents the means, standard deviations, ranges, and F values for the three groups of children on general knowledge and receptive vocabulary. The one-way ANOVA for general knowledge revealed a significant difference between the groups, F (2, 39) = 39.92, $p < .01$. A Bonferoni test showed that the NH group performed significantly better than each of the HI groups, and the HI-II group significantly outperformed the HI-SG group. The one-way ANOVA for receptive vocabulary also revealed a significant difference between the groups, F (2, 39) = 26.11, $p < .01$. A Bonferoni test showed that the NH group performed significantly better than the children in each of the HI groups, and the HI-II group significantly outperformed the HI-SG group.

Pearson Correlation Tests

Table 5 presents the results of the Pearson product moment correlations conducted to investigate the relations among the various tests employed to evaluate early literacy. As seen in the table, significant correlations emerged among all of the tests except between orthographic awareness and phonological awareness.

Analysis of Demographic Variables

In addition, we conducted further analyses to examine the effect of several demographic variables on children’s early literacy performance: the child's degree of hearing loss, type of sensory aid, age at onset of treatment, and age, as well as the family's socioeconomic status.

Degree of hearing loss. Pearson product moment correlations between the child's degree of hearing loss and the various early literacy tests revealed a significant negative correlation only for general knowledge, $r = -.46$, $p < .01$, and for vocabulary, $r = -.41$, $p < .05$. Children with greater hearing loss (poorer hearing ability) demonstrated lower levels of general knowledge and vocabulary.

Type of sensory aid. We conducted a series of one-way ANOVAs with type of sensory aid (hearing aid or cochlear implant) as the independent variable and each of the seven early literacy tests as a dependent variable, for a subset of the children. To provide a reasonable comparison group regarding degree of hearing loss for the 11 children with cochlear implants, we only included the 6 children who wore a hearing aid and had severe to profound hearing loss. No significant differences emerged in the performance of these two groups on any of the tests.

Age at onset of rehabilitation. Pearson product moment correlations between the child's age at onset of rehabilitation and performance on the seven tests revealed three significant correlations ($p < .05$), with general knowledge, $r = .46$, word writing, $r = .40$, and word recognition, $r = .45$.

Child's age. Significant Pearson product moment correlations ($p < .05$) emerged between the child's age and word recognition, $r = .31$, orthographic awareness, $r = .32$, and vocabulary, $r = -.32$.

Family's socioeconomic status. Pearson product moment correlations conducted between the socioeconomic status of the family and the children's performance on the various early literacy tests yielded no significant correlations.

Discussion

The present study aimed to evaluate and compare the early literacy skills of children with hearing impairments in two different educational settings and in

comparison with the skills of hearing children. We hypothesized that children with hearing impairments who were individually integrated into a regular kindergarten (HI-II) would exhibit stronger early literacy skills than would their counterparts who were mainstreamed into a regular kindergarten along with a small special group of other children with hearing impairments (HI-SG). In addition, we predicted that the normally hearing (NH) children would outperform the HI children in both educational settings.

These hypotheses derived from results of previous research on older children, which reported superior academic skills among school children with hearing impairments who attended regular classrooms in comparison to those of school children with hearing impairments who attended special classes (Paul & Quigley, 1990; Foster, cited in Bunch, 1994), and which reported a generally better academic level of hearing school children in comparison to peers with a hearing loss (Paul, 1998; Spencer et al., 1998). Indeed, the current study on younger children in kindergarten corroborated these hypotheses regarding four of the early literacy skills studied: phonological awareness, letter identification, general knowledge, and vocabulary.

However, these hypotheses found only partial support regarding the other three skills studied: word recognition, word writing, and orthographic awareness. On these three early literacy tests, the two groups of children with hearing impairments did not differ significantly. Nevertheless, for these three variables, the NH group exhibited significantly higher performance than the HI-SG group but not than the HI-II group. In the following discussion, we shall address these findings.

Supported Hypotheses

Phonological awareness. As hypothesized, a significant difference emerged between the HI-II and HI-SG groups in their general level of phonological awareness, thus supporting previous outcomes for older children with hearing impairments, such as Geers and Moog's (1989) and Paul and Quigley's (1990) studies where children in regular classes showed higher phonological awareness than that of children in special classes. Furthermore, the current study also revealed significant differences between the NH group and the other two groups, thus substantiating Harris and Beech (1998) and Miller (1997), who found that the level of phonological awareness among school-aged children with hearing loss was lower than that of their hearing peers.

However, a more detailed examination of our kindergartners' performance on phonological awareness allows a better understanding of this capability among children with and without hearing impairments. The results showed that the children performed differently on the four different recognition tasks targeting words' initial syllable, initial phoneme, final syllable, and final phoneme. In recognizing a word's initial syllable, the NH and the HI-II groups performed similarly, and both significantly surpassed the HI-SG group. Thus, only the HI-SG group was lower in its awareness of initial syllables. In recognizing a word's final (rhyming) syllable, however, the NH group significantly outperformed the HI-II group, who, in turn, showed significantly higher phonological awareness than the HI-SG group. These findings for initial and final syllable appear to support Sterne and Goswami's (2000) examination of children with hearing loss aged 11-12 years. Generally, at the syllable level, these children, who were mostly exposed to an oral educational approach as well, did not differ from their hearing peers, but they did show poorer rhyming abilities.

In comparing recognition of syllables, the present findings suggested that, in general, kindergartners' performance on tasks requiring recognition of a phoneme was lower than on tasks requiring recognition of a syllable. These results seem to corroborate the known developmental progression from syllable recognition to phoneme recognition (initial and final), as shown, for example, by Carroll, Snowling, Hulme, and Stevenson's (2003) longitudinal study of 3- to 4-year-old hearing children. The present study also found that the NH group recognized initial phonemes more accurately than did either the HI-II or the HI-SG groups, exhibiting the advantage of the hearing children over on their peers with hearing loss. In contrast, the entire sample, across the board, demonstrated low scores in recognition of final phonemes, suggesting that this task was overly difficult for all of these kindergarten-age children, thus precluding inter-group differences.

The differential performance on the phonological tasks emphasized the need to expose and train the children in the small-group inclusion track on both syllable and phoneme awareness and to promote phoneme tasks among the children in the individual inclusion track, in order to improve those phonological awareness skills that play a crucial role in the acquisition of reading (Adams, 1991; Bentin & Leshem, 1993). Inasmuch as hearing loss limits the audibility of different sounds and exposure to them, strategies that involve visual representation of sounds should be adopted (Nielsen & Luetke-Stahlman, 2002; Paul, 1998).

Letter identification. The current results showed that hearing kindergartners were significantly more capable of identifying printed letters of the Hebrew alphabet than were individually integrated kindergartners with hearing impairments. Likewise, our kindergartners in the individual inclusion track identified printed letters significantly better than their peers in the small-group track. Previous research on

hearing kindergartners highlighted the great importance of letter identification on tasks of early reading (Levin et al., 2002). Very little research has investigated this domain with children who have hearing loss. In one rare study, Andrews and Mason (1986) found that some 5-8 year olds with hearing loss showed very little knowledge about letter identification. The researchers compared their results with those of hearing children and claimed that kindergartners with hearing loss acquire letter identification as do hearing children. These findings, together with research indicating a strong correlation between letter identification and phonological awareness among 4- to 5-year-old hearing children (for example, Burgess & Lonigan, 1998) and a strong correlation between these tasks and reading (Adams, 1991; Shatil et al., 2000), suggest that future research should follow these relations and the effect of letter identification on reading acquisition among children with hearing impairments.

Vocabulary and general knowledge. As we hypothesized, the hearing children demonstrated significantly more vocabulary and general knowledge than did the individually integrated kindergartners with hearing impairments, who, in turn, surpassed their peers in the small-group track on these two measures. Unfortunately, hearing loss limits exposure not only to language but also to general knowledge (Akamatsu, Musselman, & Zweibel, 2000; Just & Carpenter, 1987). These phenomena may already be observed in children with a minor degree of hearing loss (Blair, Peterson, & Viehweg, 1985; Bess, Dodd-Murphy, & Parker, 1998) and certainly appear when the degree of hearing loss is more pronounced such as in the present study. Possibly, the HI-II group's higher success than the HI-SG group here may have resulted from the former group's exposure to richer language and more diverse topics in the kindergarten program that involved many hearing children. Teachers in the special program may have restricted their use of speech to more

simple language and may also have limited exposure to or elaboration of general subject matter (Wood, Wood, Griffiths, & Howarth, 1986).

Although the two groups of HI children differed in their mean degree of hearing loss, recall that this variable was controlled in the statistical analyses. Also, the two groups revealed a similar mean family SES. Nevertheless, other aspects that differentiate the children in the two inclusion programs may have contributed to the aforementioned differences in the four early literacy skills: phonological awareness, letter identification, general knowledge, and vocabulary. It is possible that their level of hearing impairment may have been associated with other factors that we did not study, which may have rendered an impact on the current outcomes. Whether the current findings relate to the inclusion program or not, the results provide an important opportunity to describe these children's profile of early literacy skills and to plan an intervention program accordingly.

Partially Supported Hypotheses

Next, we shall discuss the remaining three early literacy tasks that only partially supported our hypotheses.

Word writing and reading (word recognition). Although the two groups of children with hearing impairments resembled one another on both word writing and word recognition tasks, the performance of the NH group was statistically higher than that of the HI-SG group only. Thus, although no statistical difference emerged between the HI-II and HI-SG groups, apparently the individual inclusion group performed somewhere in between the small-group inclusion group and the hearing group. The gap found here between children with and without hearing loss corroborates previous findings that older children with hearing impairments exhibited lower writing skills in comparison to same-age hearing children, both for elementary

school students between the first and fourth grades (Quigley & Paul, 1984) and for high school students (Spencer et al., 1998). The current findings suggest that the gap in word writing and reading skills between children with and without hearing impairments already begins during kindergarten, at least for the children mainstreamed in small groups. Geers and Moog (1998) and Paul and Quigley (1990) showed that the reading and writing performance of high school students with hearing impairments who attended special classes was lower than among their peers who were fully integrated into regular classrooms.

It should be noted that nowadays, as a result of the Israel Special Education Law (Al-Yagon & Margalit, 2001) and technological developments, most children with hearing impairment join regular classes in school, i.e. they are individually integrated in the school system. Thus, future research should examine these children's progress longitudinally at various intervals during the school years, to compare the reading and writing performance of children who had attended the two kindergarten educational tracks.

Orthographic awareness. Both groups with hearing loss in our study performed similarly when asked to discriminate genuine printed words from unacceptable word stimuli. The NH group gave statistically more correct explanations for their choices in comparison to the HI-SG group but revealed only a tendency toward statistical difference in comparison to the HI-II group. Children are exposed from a very young age to the different written symbolic systems, and they know how to differentiate among them. They are also aware of the differences between numbers, letters, drawings, and so forth and understand the fact that these systems remain separate from one another (Tolchinsky-Landsmann & Karmiloff-Smith, 1991). Possibly, the gap in the level of orthographic awareness between children with and

without hearing loss may be associated to the degree of exposure to significant literacy interactions. Moores (2001) suggested that parents of children with hearing impairments concentrate on language teaching such as vocabulary and grammar and are less aware of the importance of reading to or writing with the children. Gioia (2001) reported that children with hearing impairments showed better knowledge of printed words and an enhanced vocabulary following an intervention using interactive reading. Together with research underscoring the strong relationship between orthographic awareness and reading and writing acquisition (Shatil et al., 2000), the present findings suggest that parents and their children with hearing loss should be encouraged to share literacy activities. Such activities, particularly for children who exhibit low orthographic awareness, will facilitate acquisition of orthographic knowledge.

Demographic Issues

Degree of hearing loss. Negative relations emerged between children's degree of hearing loss and performance on the general knowledge task. Greater hearing loss correlated with lower levels of general knowledge. However, no other significant relations emerged for any of the kindergartners' other early literacy tasks. These findings do not coincide with previous reports on older children. Paul and Quigley (1990), for example, reported that writing and reading achievements were significantly negatively correlated with degree of hearing loss among school age children. Perhaps at the kindergarten age other factors such as motivation and concentration play a more dominant role.

Type of sensory aid. Based on previous research reporting that the cochlear implant's better auditory input led to enhanced academic achievements compared to children with a similar hearing loss who used hearing aids (Spencer et al., 1998), we

had hypothesized that children with cochlear implants would outperform children with hearing aids. Yet, we found that the children with hearing aids performed as well as children with cochlear implants.

A comparison of the children's degree of hearing loss in the two groups, however, revealed that most of the children who wore hearing aids had significantly better hearing than those who had implants. Only 2 children with hearing aids had hearing loss poorer than 90 dBHL. Thus, implanted children who had profound hearing loss functioned at the level of children with only a severe hearing loss who had hearing aids. These results corroborated previous findings demonstrating the advantage of implants over hearing aids among children with profound hearing loss. Blamey et al. (2001) showed that children with cochlear implants (and a mean hearing loss of 106 dBHL) performed on different language areas similarly to children with a mean hearing loss of 78 dBHL who used hearing aids.

Age at onset of rehabilitation. As we hypothesized, children's age at onset of intervention correlated with their performance on some of the early literacy tasks. A younger age at entrance to intervention correlated with more successful performance on general knowledge, reading, and writing tasks. These results support the notion that early detection of hearing loss, which is followed by earlier intervention, enables children to develop and utilize residual hearing to acquire spoken language. Thus, better use of the child's hearing facilitates acquisition of spoken language and consequently improves performance on academic skills.

Family's socioeconomic status. Contrary to our expectations, children's early literacy performance did not correlate with the family's socioeconomic status. This may have stemmed from the fact that all of the children with hearing impairments were enrolled in the MICHA special preschool program that provides services to

young children with hearing impairments and to their families. The MICHA program considers parents as part of the rehabilitation team and guides them in how to interact with their child to promote the child's communication as well as academic and social development. Professional intervention with parents may possibly have blurred any differences relating to socioeconomic variables.

In sum, few significant findings emerged with respect to the impact of demographic factors on children's early literacy. That is, only age at onset of intervention correlated with reading, writing, and general knowledge, and degree of hearing loss correlated with general knowledge. Nevertheless, this population is very heterogeneous, suggesting that factors other than those investigated in the present study may have come into play, such as the child’s motivation level or concentration ability. Future research should consider such additional factors. Moreover, the limitations of this study must be acknowledged. The inherent nature of intervention with children having hearing loss requires inclusion based on individual needs, therefore precluding our ability to randomly assign these children to controlled groups. We studied existing groups of children with hearing loss who met our criteria: attendance of the MICHA intervention program in Tel-Aviv, parents with normal hearing, Hebrew as the first language, use of either oral or total communication mode, and no additional handicapping conditions. Therefore, the present outcomes do not enable conclusions based on cause and effect relations, but rather reveal correlations between inclusion track and early literacy skills. Future studies may endeavor to expand on these findings by examining a larger sample that could afford matching of children in different inclusion tracks on demographic and personality variables of interest.

In summary, this study demonstrated that children with hearing impairments who were individually integrated into regular kindergartens performed significantly better than their peers who were integrated into such kindergartens in small groups of children with hearing loss. Likewise, children with normal hearing performed significantly better than did children with hearing impairments on many early literacy tasks. These results emphasize the need to teach and train young children with hearing loss on early literacy skills during the preschool years within existing educational systems. Many studies have reported on the relations between early literacy skills and later reading and writing performance (e.g., Korat & Levin, 2001; Shatil et al., 2000). Also, research has shown that children with hearing impairments exhibit lower performance on academic measures than do their hearing classmates (Spencer, Tomblin & Gantz, 1998; Paul, 1998). The present study suggests that these gaps between children with and without hearing loss already begin during kindergarten. Intervention programs to encourage early literacy skills at this stage may decrease these gaps. Future longitudinal research would allow for an investigation of children's performance along the years, to examine the relations between early performance and later functioning at school. Further research should also address social and emotional aspects with a possible effect on children's early literacy skill acquisition, to provide a more complete evaluation of children's readiness for school.

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Table 1

Means, Standard Deviations, Ranges, and F Values for the Three Groups of Children's Writing and Reading Scores

	Group	*M*	*SD*	Min.	Max.	*F*
Word writing	HI-SG	7.22	2.56	2.00	13.30	5.60**
	HI-II	8.43	1.68	6.25	11.90	
	NH	10.20	2.75	6.75	13.60	
Reading (word recognition)	HI-SG	1.87	1.02	1.00	4.00	9.18**
	HI-II	2.73	1.16	1.00	4.00	
	NH	3.36	0.8	2.00	4.00	

Note. HI-II = children with hearing impairments in the individual inclusion track; HI-SG = children with hearing impairments in the small-group inclusion track; NH = normally hearing children. Ranges were 1-14 for word writing and 1-4 for word recognition.

* $p < .05$. ** $p < .01$.

Table 2

Means, Standard Deviations, Ranges, and F Values for the Three Groups of Children's Phonological Awareness Scores

	Group	*M*	*SD*	Min.	Max.	*F*
Initial syllable	HI-SG	2.06	0.99	0.00	4.00	7.62**
	HI-II	3.26	1.03	1.00	5.00	
	NH	3.72	1.42	1.00	5.00	
Initial phoneme	HI-SG	1.69	1.30	0.00	4.00	12.57**
	HI-II	2.41	1.24	0.00	4.00	
	NH	4.15	0.87	3.00	5.00	
Total for initial position	HI-SG	3.75	1.77	0.00	6.00	13.91**
	HI-II	5.68	1.91	2.00	8.00	
	NH	7.79	1.94	4.00	10.00	
Final syllable (rhyming)	HI-SG	2.64	1.53	0.00	5.00	3.67*
	HI-II	3.12	1.38	1.00	5.00	
	NH	4.15	1.13	2.00	5.00	
Final phoneme	HI-SG	1.63	0.80	0.00	3.00	2.19
	HI-II	2.22	1.20	0.00	4.00	
	NH	2.58	1.50	0.00	5.00	
Total for final position	HI-SG	4.62	1.58	2.00	7.00	5.01*
	HI-II	5.35	1.88	3.00	9.00	
	NH	6.74	2.33	3.00	10.00	
Grand total	HI-SG	8.03	2.46	4.00	11.00	14.58**
	HI-II	11.03	2.99	7.00	17.00	
	NH	14.45	3.58	9.00	20.00	

Note. HI-II = children with hearing impairments in the individual inclusion track; HI-SG = children with hearing impairments in the small-group inclusion track; NH = normally hearing children. Ranges were 1-5 for each subtest, 1-10 for total final/initial position, and 1-20 for the grand total.

* $p < .05$. ** $p < .01$.

Table 3

Means, Standard Deviations, Ranges, and F Values for the Three Groups of Children's Letter identification and Orthographic Awareness Scores

	Group	***M***	***SD***	**Min.**	**Max.**	***F***
Letter identification	HI-SG	5.32	3.50	0.00	12.00	16.64**
	HI-II	8.71	3.77	2.00	12.00	
	NH	11.93	1.88	6.00	12.00	
Orthographic awareness	HI-SG	7.27	5.39	0.00	16.00	4.10*
	HI-II	7.96	4.70	0.00	15.00	
	NH	12.83	5.03	2.00	18.00	

Note. HI-II = children with hearing impairments in the individual inclusion track; HI-SG = children with hearing impairments in the small-group inclusion track; NH = normally hearing children. Ranges were 1-12 for letter identification and 1-18 for orthographic awareness.

* $p < .05$. ** $p < .01$.

Table 4

Means, Standard Deviations, Ranges, and F Values for the Three Groups of Children's General Knowledge and Receptive Vocabulary Scores

	Group	***M***	***SD***	**Min.**	**Max.**	***F***
General knowledge	HI-SG	8.11	3.16	2.00	13.00	39.92**
	HI-II	12.79	3.34	8.00	20.00	
	NH	19.11	2.42	14.00	21.00	
Receptive vocabulary	HI-SG	29.18	7.06	18.00	44.00	26.11**
	HI-II	37.82	6.28	26.00	48.00	
	NH	48.32	4.57	39.00	56.00	

Note. HI-II = children with hearing impairments in the individual inclusion track; HI-SG = children with hearing impairments in the small-group inclusion track; NH = normally hearing children. Ranges were 1-23 for the Wechsler Preschool and Primary Scale of Intelligence general knowledge subscale and 15-60 for the Peabody Picture Vocabulary Test of receptive vocabulary.

* $p < .05$. ** $p < .01$.

Table 5

Pearson Product Moment Correlations Among the Study Variables

	WPPSI general knowledge subscale	**PPVT (receptive vocabulary)**	**Phonological awareness**	**Letter identification**	**Orthographic awareness**	**Writing**	**Reading (word recognition) explanations**
WPPSI	—						
PPVT	0.73**	—					
Phonological awareness	0.63**	0.59**	—				
Letter identification	0.66**	0.38*	0.15**	—			
Orthographic awareness	0.36*	0.35*	0.29	0.40*	—		
Writing	0.50**	0.34*	0.57**	0.68**	0.45**	—	
Reading explanations	0.58**	0.42**	0.55**	0.69**	0.47**	0.66**	—

Note. WPPSI = Wechsler Preschool and Primary Scale of Intelligence;

PPVT = Peabody Picture Vocabulary Test.

* $p < .05$. ** $p < .01$.