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Small-Group Phonological Awareness Training for Pre-Kindergarten Children with Hearing Loss Who Wear Cochlear Implants and/or Hearing Aids

Krystal L. Werfel¹, Michael Douglas² and Leigh Ackal³*

¹University of South Carolina, Columbia, SC, USA
²Vanderbilt University, Nashville, TN, USA
³Tulane University, New Orleans, LA, USA

Correspondence to:
Krystal L. Werfel,
University of South Carolina, 1224 Sumter Street, Suite 300,
Columbia, SC 29201, USA
werfel@sc.edu

Abstract
This case report details a year-long phonological awareness (PA) intervention for pre-kindergarten children with hearing loss (CHL) who use listening and spoken language. All children wore cochlear implants and/or hearing aids. Intervention occurred for 15 min/day, 4 days per week across the pre-kindergarten school year and was delivered by classroom teachers of the deaf. At the beginning of the year, children’s performance on measures of PA generally was low. After participating in the intervention, the majority of students performed within or above the developmental range. These findings indicate that PA training that is intense, modified for CHL, and transferable to mainstream setting is effective in increasing PA skills in CHL.

Keywords: hearing loss, phonological awareness, intervention

Introduction
Even though cochlear implants and digital hearing aids have provided increased access to sound for children with hearing loss (CHL) over the past several decades, their median reading levels by 18 years of age have not increased since the 1970s (Trybus & Karchmer, 1977; Qi & Mitchell, 2012). Literacy outcomes for CHL have been reported to continue to plateau at a median third- to fourth-grade reading level (Qi & Mitchell). Clearly, increased access to sound has not led to gains in literacy performance on its own. There is a great need, therefore, to develop effective and efficient literacy interventions for CHL.

Some research has shown that CHL struggle more with word decoding than with reading comprehension (e.g., Geers & Hayes, 2011). Phonological awareness (PA) skills, along with letter knowledge, underlie word decoding skills (e.g., Adams, 1990; Stahl & Murray, 1994). PA is the ability of an individual to analyse and manipulate the sounds of spoken language (Mattingly, 1972; Wagner & Torgesen, 1987). Analyzing the sounds of words at the level of the phoneme, as opposed to rhyming skill, is seen as the critical skill for later literacy success (Nation & Hulme, 1997; Hulme et al., 1998, 2002; Schuele & Boudreau, 2008). Similar to children with normal hearing, PA is related to reading gain in CHL (Harris & Beech, 1998). However, there is widespread evidence that CHL struggle to develop PA skills commensurate with peers who have normal hearing. The purported reasoning behind this delay has been that even though their hearing loss has been corrected, the amplification is imperfect, thus reducing the ability of CHL to analyze the sounds of words and learn to decode (Miller, 1997; Sterne & Goswami, 2000; Most et al., 2006; Moeller et al., 2007; Kyle & Harris, 2011). Interestingly, however, the PA development of CHL, although delayed, appears to follow the same developmental progression as in children with normal hearing (Sterne & Goswami).

Early explicit instruction in alphabet knowledge and PA has a positive effect on the early literacy abilities of children with normal hearing (National Early Literacy Panel, 2008). Very little research, however, on the effectiveness of PA intervention for preschool CHL has been conducted. In fact, to date, there are...
only three studies that have investigated changes in PA skills in preschool CHL.

Smith and Wang (2010) completed a case study on a 4-year-old preschooer with a cochlear implant and reported a significant improvement in her ability to identify beginning consonants and individual phonemes in words using visual phonics. Visual phonics is a multisensory method that consists of 46 hand cues and corresponding written symbols, each representing a phoneme (Trezek & Wang, 2006). Although the results of this case study are exciting, the authors noticed difficulty in the child’s ability to transfer learned skills into the general classroom where visual phonics was not utilized.

Additionally, two single subject studies provide some insight into intervention intensity, transferability, and modification, the key treatment variables in the current study. Miller et al. (2013) reported on a small-group PA intervention embedded in a comprehensive early literacy program. Five CHL who used cochlear implants and/or hearing aids participated in lessons on syllable segmentation, initial phoneme isolation, and rhyming discrimination under modified instruction that met the linguistic levels of each child. The intervention was generally associated with growth and generalization of children’s PA skills; however, growth was not observed to mastery criterion, defined by the authors as 80 per cent, for all children. The authors concluded that explicit instruction in early PA skills may provide CHL the ability to manipulate the sounds in spoken language (Miller et al.). Likewise, Werfel and Schuele (2014) reported that intensive individual PA intervention was effective for increasing PA skills in CHL; however, again the increase in skills was not always to mastery criteria, defined by the authors as 80 per cent accuracy for two consecutive sessions.

**Intervention intensity**

Werfel and Schuele (2014) further indicated that CHL may also require a higher level of intensity to achieve mastery in PA skills. Miller et al. (2013) reported that PA took weeks and sometimes even months to develop. In fact, in both studies, mastery did not occur in all participants with the dosage provided. In Miller et al., 8–9 per cent of the 1-h literacy sessions (5–6 min) provided 4 days a week throughout the year included explicit PA training. In Werfel and Schuele, 25 min of intervention was provided three times a week over 37–39 sessions.

The importance of intervention intensity has been cited in the literature with school-aged children (Gillam & Loeb, 2010). They found that daily intense schedules (up to 100 min/day) are one critical aspect of intervention that leads to successful results. However, generalizing this to preschool CHL can be problematic because of certain factors related to a preschooler’s developmental capacity to participate in lessons longer than 20 min and biological responses related to fatigue for CHL (Seefeldt & Waski, 2006; Hornsby et al., 2014). Conversely, activities that last 15 min on a daily basis might be more beneficial for preschoolers with hearing loss who need to develop PA skills (Seefeldt & Waski, 2006; Moog & Stein, 2008; Smith & Wang, 2010).

**Transferability and appropriate modifications**

Whereas transferability was not observed in Smith and Wang’s (2010) case report of the use of visual phonics, a technique not used in mainstream classrooms, to train PA, Miller et al. (2013) and Werfel and Schuele (2014) reported that most students achieved mastery on PA skills targeted in instruction using intervention techniques utilized with children with normal hearing. Werfel and Schuele (2014), however, suggested that instruction for CHL may require some different instructional components than those required for children with normal hearing, such as considering the properties of individual sounds (low vs. high frequency) and providing maximal acoustic and visual contrast (e.g., pairing a voiced bilabial stop /b/ with a voiced alveolar nasal /n/).

These three features of intervention (transferability, appropriate modifications, and intervention intensity) bring us to our research question. Do these three features facilitate acquisition of PA skills and result in functional performance comparable to developmental, mainstream expectations? In order to maximize the benefit CHL can receive from PA instruction and help them close the learning gap compared to children with normal hearing, practical, effective, and efficient interventions are needed. We hypothesized that such intervention for CHL can facilitate acquisition of PA skills that are commensurate with the developmental expectations of mainstream environments.

**Report of cases**

We present a case report of a small-group explicit PA intervention that lasted 15-min a day, 4 days a week for CHL that lasted for a full school year. All sessions were held in the students’ classrooms and led by a teacher of the deaf. Our study design and implementation was guided by the scope and sequence of transferable activities from Miller et al. (2013) and will add to the current knowledge base.
by incorporating two features from previous studies: 15-min lessons that lasted throughout the school year as designed in Smith and Wang (2010), as well as instructional modifications based on the tenets and suggestions made in Werfel and Schuele (2014).

Children Nine pre-kindergarten students with hearing loss participated in the small-group PA intervention. All of the students were amputations and were developing listening and spoken language. They received their cochlear implants and/or hearing aids before age 4 and had taken part in a spoken language education program for a minimum of one year. All students had a corrected pure-tone average of less than 35 dB hearing level.

### Table 1: Descriptive Information about Students

<table>
<thead>
<tr>
<th>Child</th>
<th>Bilingual</th>
<th>Left ear amplification</th>
<th>Right ear amplification</th>
<th>Age (months)</th>
<th>Age at amplification</th>
<th>Articulation</th>
<th>Total language</th>
<th>Expressive vocabulary</th>
<th>Receptive vocabulary</th>
<th>Nonverbal intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No</td>
<td>HA</td>
<td>CI</td>
<td>59</td>
<td>32</td>
<td>94</td>
<td>94</td>
<td>133</td>
<td>120</td>
<td>113</td>
</tr>
<tr>
<td>2</td>
<td>ASL</td>
<td>CI</td>
<td>CI</td>
<td>59</td>
<td>17</td>
<td>95</td>
<td>73</td>
<td>95</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>CI</td>
<td>CI</td>
<td>60</td>
<td>45</td>
<td>81</td>
<td>81</td>
<td>92</td>
<td>104</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Spanish</td>
<td>HA</td>
<td>HA</td>
<td>60</td>
<td>24</td>
<td>78</td>
<td>88</td>
<td>104</td>
<td>107</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td>CI</td>
<td>CI</td>
<td>62</td>
<td>31</td>
<td>96</td>
<td>90</td>
<td>94</td>
<td>89</td>
<td>104</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>HA</td>
<td>None</td>
<td>64</td>
<td>27</td>
<td>90</td>
<td>93</td>
<td>101</td>
<td>91</td>
<td>84</td>
</tr>
<tr>
<td>7</td>
<td>No</td>
<td>CI</td>
<td>CI</td>
<td>64</td>
<td>16</td>
<td>99</td>
<td>72</td>
<td>80</td>
<td>87</td>
<td>84</td>
</tr>
<tr>
<td>8</td>
<td>No</td>
<td>CI</td>
<td>CI</td>
<td>65</td>
<td>32</td>
<td>77</td>
<td>96</td>
<td>92</td>
<td>89</td>
<td>99</td>
</tr>
<tr>
<td>9</td>
<td>Spanish</td>
<td>HA</td>
<td>CI</td>
<td>68</td>
<td>16</td>
<td>99</td>
<td>86</td>
<td>96</td>
<td>88</td>
<td>96</td>
</tr>
</tbody>
</table>

**Mean (SD)**

- 62.33 (3.12)
- 26.33 (8.93)
- 90.00 (8.90)
- 85.89 (8.82)
- 98.56 (14.54)
- 96.56 (11.35)
- 96.22 (9.37)

**Note:** All tests’ scores are standard scores. Articulation = Goldman Fristoe Test of Articulation (Goldman & Fristoe, 2000); total language = Preschool Language Scales — Fifth Edition (Zimmerman et al., 2011); expressive vocabulary = Expressive One Word Picture Vocabulary Test — 4th Edition (Brownell, 2011a); receptive vocabulary = Receptive One Word Picture Vocabulary Test — 4th Edition (Brownell, 2011b); nonverbal intelligence = Kaufman Brief Intelligence Test (Kaufman & Kaufman, 2004); ASL = American Sign Language; SD = standard deviation.
Intervention approach and activities

Transferability

Two evidenced-based PA programs that focus on skills relevant to a general, mainstream classroom were considered for this study; Phonemic Awareness in Young Children (PAYC; Adams et al., 1998) and the Intensive Phonological Awareness Program (IPA Program; Schuele & Dayton, 2014). PAYC provides concrete activities that stimulate the development of PA in the preschool or elementary classroom. Its effectiveness has been demonstrated in kindergartners’ ability to analyze words into sounds significantly more quickly than kindergartners who did not have this program (Adams, Foorman, Lundberg, & Beeler). The IPA Program is a 36-week small-group PA intervention designed as a Tier-2 intervention in the response-to-intervention model for children with normal hearing. The IPA Program was developed following the recommendations of the NRP for PA instruction. Its effectiveness has been demonstrated with children at-risk for literacy difficulties (Schuele et al., 2008).

We chose the IPA Program, because the authors considered the IPA Program to not only have activities that were transferable to the mainstream setting, but to be more explicit and systematic for the students and teachers. Although PAYC is similar to the IPA Program in that it consists of activities typically used in mainstream classrooms (e.g., segmenting words into syllables, rhyming, initial sound awareness, and final sound awareness), it did not organize these activities for each skill into a hierarchy like the IPA Program (e.g. first judging differences, then matching similarities, followed by identifying differences, and finally generating responses). PAYC also saved letters and letter-sound knowledge lessons for later in the curriculum apart from the PA tasks. The IPA Program, however, consistent with the National Reading Panel’s recommendation to include letter instruction alongside PA intervention (NICHD, 2000), built explicit alphabet and letter-sound knowledge into the beginning of each daily lesson. Finally, there were no guides for scaffolding in PAYC like those found in the IPA Program.

Modifications

We made several modifications to the IPA Program for the PA intervention. For instructional activities, targeted sounds were selected based on recommendations from Werfel and Schuele (2014) to carefully consider the properties of phonemes used in PA intervention for CHL. Phonemes that differed in acoustic and visual properties (e.g., /f/ and /b/) were targeted together to provide maximal support in analyzing sounds. Considering speechreading skills as a hypothesized predictor for growth in later reading achievement in CHL, teachers also administered all instruction while facing the students (Kyle & Harris, 2010).

Intervention intensity

Intervention began in late August at the beginning of the school year and continued through early May at the end of the school year. The intervention sessions lasted 15 min each and occurred four times per week based on recommendations from Smith and Wang (2010). As specified in the IPA Program, all intervention was completed in small groups. More specifically, the student-teacher ratio varied from 2:1 to 3:1 in order to facilitate a higher rate of participation, practice and scaffolding than a small group of 4–6.

Activities

The first 5 min of the session focused on promoting a shallow level of letter-sound and letter-name
knowledge for the preschool-aged participants in this study (Schuele & Boudreau, 2008). The students alternated using an uppercase and lowercase alphabet chart daily, pointing to each letter with their fingers along the chart while the teacher led the students in a chant to promote letter-sound knowledge: ‘A says /æ/ - /æ/, /æ/, /æ/, B says /b/ - /b/, /b/, /b/,’ and so on. Immediately following the letter-sound chant, the teacher guided the students in singing the alphabet song together, pointing to the letters on the chart while singing.

The first 5 min of the intervention remained unchanged for the entire school year. In contrast, the last 10 min of the session focused on developing the students’ skills through two daily activities that targeted the hierarchical development of PA. The IPA Program manual included recommended activities and materials lists for each activity.

For each PA domain targeted, students were guided through increasingly difficult skill levels in order to master that domain. The skill levels for each domain (e.g. rhyming) were targeted in the following order: judgment (example: ‘Do cat and snake rhyme?’), matching (example: ‘Here are pictures of the words three, cat, and snake. Which word does not rhyme?’), odd one out (example: ‘Hat, mat, book. Which one does not rhyme?’), and generation (example: ‘What word rhymes with cake?’).

After each session, the teacher evaluated the students’ performance and chose to either repeat the same activity in the following session or move on to the next activity as suggested by the IPA Program. Student mastery was determined by informal teacher assessment and professional judgment as indicated by ease of student response and little to no scaffolding required. The 5th day was utilized for summative assessment of the children’s skills.

Student outcomes at the end of the school year
Substantial increases in early literacy skills were observed in spring compared to fall. Table 3 displays individual students’ performance at posttest and Figure 1 displays the average gains on each measure across the school year. For PA, most students made gains from fall to spring. On rhyme awareness, one student’s performance remained the same and one student performed worse at spring than fall. On beginning sound awareness, one student was at ceiling in fall and therefore could not make gains in the spring (this student also performed at ceiling in the spring). The average increase in performance was 2 for rhyme awareness (rhyme matching) and 5 for beginning sound awareness (initial sound segmentation). For letter names and letter sounds, all students made gains from fall to spring. The average increase in performance was 15 for letter names and 13 for letter sounds. According to Heroman and Jones (2010), expectations for letter and letter-sound knowledge by age 5 is the ability to recognize as many as 10 letters and identify the sounds of a few letters. According to early childhood Tennessee state standards (2012), kindergarten-entry expectations for PA is the ability to recognize rhyming words in spoken language (RF.PK.2a) and with guidance and support identify whether or not two words begin with the same sound (RF.PK.2e).

The average total PALS raw score at the end of the year was 84.11 (SD = 20.19) with a range of 47–117 at the end of the year. The acceptable developmental range for performance according to the PALS is 53–87 raw score points; 89 per cent of the students achieved performance within or above the developmental range on the PALS at the end of the school year. For PA, 89 per cent of the students performed within or above the developmental range on beginning sound awareness, and 45 per cent on rhyme

Table 3  Student Performance on Early Literacy Skills at the End of the School Year (Gain Score)

<table>
<thead>
<tr>
<th>Child</th>
<th>PALS-PreK total score (max 125)</th>
<th>Rhyme awareness (max 10)</th>
<th>Beginning sound awareness (max 10)</th>
<th>Letter names (max 26)</th>
<th>Letter sounds (max 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>117</td>
<td>10 (+1)</td>
<td>10 (+)</td>
<td>26 (+5)</td>
<td>24 (+17)</td>
</tr>
<tr>
<td>2</td>
<td>77</td>
<td>4 (+4)</td>
<td>5 (+5)</td>
<td>18 (+18)</td>
<td>14 (+14)</td>
</tr>
<tr>
<td>3</td>
<td>66</td>
<td>4 (+2)</td>
<td>4 (+4)</td>
<td>20 (+20)</td>
<td>10 (+10)</td>
</tr>
<tr>
<td>4</td>
<td>93</td>
<td>6 (+2)</td>
<td>9 (+4)</td>
<td>22 (+4)</td>
<td>12 (+12)</td>
</tr>
<tr>
<td>5</td>
<td>95</td>
<td>9 (+9)</td>
<td>9 (+9)</td>
<td>23 (+23)</td>
<td>15 (+15)</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
<td>2 (+1)</td>
<td>6 (+6)</td>
<td>13 (+11)</td>
<td>1 (+1)</td>
</tr>
<tr>
<td>7</td>
<td>76</td>
<td>4 (-)</td>
<td>6 (+6)</td>
<td>19 (+16)</td>
<td>13 (+13)</td>
</tr>
<tr>
<td>8</td>
<td>92</td>
<td>5 (+4)</td>
<td>10 (+10)</td>
<td>22 (+15)</td>
<td>18 (+17)</td>
</tr>
<tr>
<td>9</td>
<td>94</td>
<td>4 (-4)</td>
<td>10 (+4)</td>
<td>24 (+21)</td>
<td>16 (+15)</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>84.11 (20.19)</td>
<td>5.33 (2.60)</td>
<td>7.67 (2.40)</td>
<td>20.78 (3.83)</td>
<td>13.67 (6.23)</td>
</tr>
</tbody>
</table>

Note. All test scores are raw scores. SD = standard deviation.
awareness. For letter knowledge, 100 per cent of the students performed within or above the developmental range on letter names and 89 per cent scored above the developmental range on letter sounds.

Discussion

In this case report, we aimed to find features of PA intervention for preschoolers with hearing loss that could facilitate mastery of PA skills comparable to children without hearing loss. In particular, we highlighted issues related to skills that are transferable to mainstream settings, intervention modifications suspected to be important for CHL and treatment intensity.

This intervention was transferable to the mainstream setting in that it utilized an existing, evidenced-based method effective for school-aged children with reading delays who did not have hearing loss. Results revealed age-appropriate PA skills, as well as letter knowledge, for almost all of the participants across the pre-kindergarten school year as evidenced by results on the PALS. In fact, the children in this study were able to enter kindergarten with skills that generally exceeded minimal entry-level expectations for peers with normal hearing. The one child who did not meet the PALS developmental benchmark had a diagnosed behaviour disorder. This diagnosis may explain the lack of observed growth in PA skills.

Our results provide additional evidence that modifying PA intervention in a way that provides clarity through maximal contrasting stimuli cannot only be effective in improving PA outcomes for CHL but also facilitate performance that meets expectations for a mainstream classroom. Only two students did not make gains in rhyming skills, however, these two students did make improvements in both beginning sound awareness and letter knowledge. Generally, children made more gains in beginning sound awareness than in rhyming. Perhaps CHL are better able to attend to and analyze sounds at the beginning of words than at the end. Future studies could address this hypothesis. Measures of phonemic awareness, such as beginning sound awareness, have shown to be important predictors of later literacy success over rhyming skills for children with typical hearing (Hulme et al., 2002). All students made gains in beginning sound awareness (the one exception scored at ceiling in the fall).

Finally, the intensity of the program appears to be sufficient in improving the PA skills of CHL to age-appropriate expectations. The PA intervention consisted of two 5-min PA activities preceded by a 5-min letter knowledge activity. In just 15 min/day, 4 days per week, our teachers saw substantial gains in PA skills across the pre-kindergarten school year.

Although the results of this report are encouraging, it is not without limitations. The sample size, though the largest in such a study to date, was small. Additionally, all students received the same intervention. Future work comparing intervention approaches is needed. Finally, we did not follow students after leaving the preschool program to measure long-term literacy outcomes.

Moving forward, there is a need for more work to be done by researchers and practitioners who work with CHL evaluating PA interventions. In particular studies are needed that include larger groups, CHL who are delayed, late-identified and whose PA delays persist, despite evidence-based intervention.

Given the difficulty that many CHL experience in later reading and writing development, it is vital that effective early literacy interventions be developed and utilized. We reported here a case study of modifying a PA intervention originally developed for use with children with normal hearing while adjusting the time the children spent in intervention to an age-appropriate level. It is the hope of the authors that this study serves as an initial set of considerations when designing effective PA instruction for preschool CHL.
References


