

# Phonological Awareness and Decoding in Deaf/ Hard-of-Hearing Students Who Use Visual Phonics

Rachel F. Narr

California State University, Northridge

Visual phonics, a system of 45 hand and symbol cues that represent the phonemes of spoken English, has been used as a tool in literacy instruction with deaf/hard-of-hearing (DHH) students for over 20 years. Despite years of anecdotal support, there is relatively little published evidence of its impact on reading achievement. This study was designed to examine the relationship between performance on a phonological awareness task, performance on a decoding task, reading ability, and length of time in literacy instruction with visual phonics for 10 DHH kindergarten through Grade 3 students receiving academic instruction with sign-supported English and American Sign Language. Findings indicate that these students were able to use phonological information to make rhyme judgments and to decode; however, no relationship between performance on reading ability and length of time in literacy instruction with visual phonics was found.

The cognitive strategies that deaf/hard-of-hearing (DHH) students use to process print information are at least as varied and complex as those used by hearing readers. Recent publications and investigations are placing considerable value upon the cognitive processes believed to be used by hearing children, instruction in those processes, and the potential application with DHH students (Luckner, Sebald, Cooney, Young, & Muir, 2005/2006; Schirmer & McGough, 2005). Sev-

The author would like to thank the teacher and students of Hollyvale Elementary School for taking part in this study and helping to make this research possible. Thanks also to the graduate student who assisted in data collection and analysis and to Barbara Schirmer who provided valuable suggestions in the preparation of the manuscript. The author is a See-the-Sound/Visual Phonics trainer licensed by ICLI. No conflicts of interest were reported. Correspondence should be sent to Rachel Friedman Narr, California State University, Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8265 (e-mail: rachel.narr@csun.edu).

eral correlational and experimental studies specifically exploring the process of phonological awareness (Dyer, MacSweeney, Szczerbinski, Green, & Campbell, 2003; LaSasso, Crain, & Leybaert, 2003; Leutke-Stahlman & Nielsen, 2003; Sterne & Goswami, 2000) and phonics instruction (Trezek & Malmgren, 2005; Trezek & Wang, 2006; Trezek, Wang, Woods, Gampp, & Paul, 2007) with DHH students provide evidence that some DHH students do have access to phonological information in words and can use this information meaningfully for reading.

Phonological awareness skill is a strong predictor of reading ability in young hearing children (Adams, 1990; Wagner & Torgesen, 1987). Phonological awareness can be defined in broad terms as the ability to understand and engage in skills such as rhyming, alliteration, and syllabication. It includes specific phonemic awareness skills such as sound identification, sound blending, segmenting, and sound manipulation. Rhyming ability, in particular, is an often used technique to determine an individual's sensitivity to the phonological (or sound based) properties of English. Several researchers have used a variety of rhyming tasks to investigate this sensitivity with DHH individuals (Charlier & Leybaert, 2000; Hanson & Fowler, 1987; LaSasso et al., 2003; Sterne & Goswami, 2000) and have correlated phonological awareness with reading ability in DHH children (Colin, Magnan, Ecalle, & Leybaert, 2007; Dyer et al., 2003; Harris & Beech, 1998; Kyle & Harris, 2006). However, intervention studies teaching phonological awareness skills and measuring the impact on reading

with this population are limited in the research literature (Trezek & Wang, 2006; Trezek et al., 2007).

In addition to basic phonological awareness skills, specific and focused instruction in phonics also yields positive effects on reading ability in hearing children (National Reading Panel, 2000). Not surprisingly, there is also a significant lack of this kind of research investigating interventions with DHH students (Schirmer & McGough, 2005). Trezek et al. have published three studies that expressly examine phonics instruction with DHH students (Trezek & Malmgren, 2005; Trezek & Wang, 2006; Trezek et al., 2007). Those studies provide strong correlations between the phonics instructional programs they used and reading skills with DHH students.

There is a small but growing research base pertaining to phonological awareness and phonics instruction with DHH students, along with an extensive body of research that has demonstrated the critical importance of phonological awareness and phonics in learning to read any alphabetical script (such as English). In consideration of this research, several significant questions confront the field: how can DHH students acquire the phonemic aspects of spoken language if access to hearing is limited; should these skills be taught to DHH students for the purposes of impacting reading achievement; and if so, how can we provide accurate and complete representations of the phonemic aspects of spoken language, *regardless of hearing acuity or communication method*, so that DHH students can access and process that information?

Visual phonics represents one promising approach. Visual phonics was designed to visually represent phonemes in spoken language. Originally conceived by a parent of a deaf child to aid in reading acquisition, it is a system of 45 hand and symbol cues that provides visual and kinesthetic information associated with the way a sound is produced verbally. For example, the /p/ sound is represented with a hand cue that simulates the “plosiveness” of /p/—the air being released from the lips. There are unique symbol cues that correspond with each hand cue to provide students with a written correlate for a phoneme. Visual phonics is not a communication system, rather it is a tool for conveying the phonemic information contained within isolated words (International Communi-

cation Learning Institute, 1996). Teachers learn visual phonics from trainers who are licensed by the parent organization, International Communication Learning Institute (ICLI). Training typically consists of 10–14 hours of group instruction during which time the hand cues and symbols are learned and participants are provided with ideas and strategies for incorporating visual phonics into their reading instruction. Visual phonics is reportedly used by teachers, speech-language pathologists, paraprofessionals, and parents of a wide variety of children. Although visual phonics has been used in classrooms of DHH students for over 20 years, and was a component of several recent studies (Trezek & Malmgren, 2005; Trezek & Wang, 2006; Trezek et al., 2007), there is little research evidence to demonstrate its efficacy or describe its use.

The focus of the current study extends a prior study in which DHH students were assessed on two distinct tasks: phonological awareness and decoding (Dyer et al., 2003). Dyer et al. investigated the extent to which phonological awareness and decoding were correlated with reading performance as measured by word recognition and reading comprehension in 49 severely-to-profoundly deaf students. The students in the study had a mean age of 12.7 years, and their mean reading age was 7.3 years. Phonological awareness was assessed using a picture rhyming task. Decoding was assessed using pictures and pseudohomophones (letter strings that when “pronounced” sound like an English word [FOCS] [fox]) (Dyer et al., 2003; Sterne & Goswami, 2000). Dyer et al. found that phonological awareness strongly correlated with reading for their students. Although performance on the decoding task was positively associated with reading, it was not a statistically significant correlation.

This study was designed to examine the relationship between performance on a phonological awareness task, performance on a decoding task, reading ability, and length of time instructed with visual phonics for 10 DHH kindergarten through Grade 3 students receiving academic instruction with sign-supported English and American Sign Language (ASL). The hypothesis that predicated this examination was that literacy instruction using visual phonics with DHH students would be correlated with increased ability to

**Table 1** Participant demographics including age, grade level, and approximate time in literacy instruction with visual phonics, hearing level, and reading level

Age (years; months)	Grade level	Approximate length of time in literacy instruction with visual phonics (years)	Unaided pure tone average (better ear) (dB)	Aided pure tone average (binaural with frequency modulated system) (dB)	Reading level
5; 9	K	2	95	47	Early first
7; 7	First	2	93	37	Early to mid-first
7; 11	Second	2	78	47	Early second
8; 1	First	2	103	45	Mid-first
8; 10	Second	1	110+	57	Early to mid-first
9; 0	Second	3	107	62	Early to mid-second
9; 1	Second	1.5	82	40	Mid-second
9; 2	Second	1.5	120 <sup>a</sup>	32 <sup>a</sup>	Late kindergarten to early first
9; 7	Third	1.5	68	25	Early to mid-first
9; 10	Third	3	118	78	Early to mid-first

<sup>a</sup>This student had a cochlear implant but had not been using it.

carry out phonological awareness and decoding tasks. If confirmed, it would suggest that visual phonics can provide an accessible means of developing phonological awareness for these children, which in turn may enhance reading achievement.

## Methods

### Participants

*Students.* A convenience sample of one intact classroom was used. Students were selected from among the limited options within this geographical region in which whole classes of students were exposed to visual phonics as a supplemental tool to literacy instruction. Nine students were from a first to third mixed-grade classroom of DHH students; one younger student from a Pre-K/kindergarten class also participated. The younger child was selected to participate because she was reading at a level commensurate with many of the students in the first- to third-grade class. All the students received their daily instruction using a combination of ASL and sign-supported English, depending upon each students' needs and the subjects being taught. Eight students had severe-to-profound deafness and two had moderate-to-severe deafness prior to amplification. One of the students had a cochlear implant; however, he rarely used it. Hearing levels with and without amplification are presented in Table 1.

Two students were children of deaf parents. The students ranged in age from 5 years, 9 months to 9 years, 10 months old, with an average age of 8 years, 5 months. The length of time students had been enrolled in this school, and thus, participating in literacy instruction with visual phonics ranged from approximately 1.5–3 years. Length of time in literacy instruction with visual phonics was used as an independent variable. Demographic information pertaining to each student is presented in Table 1.

*Teachers.* The teacher of the first- to third-grade classroom is a veteran teacher with 16 years of experience working with DHH students, with the past 8 years at this school. She has incorporated visual phonics into her reading instruction for over 10 years. The Pre-K/kindergarten teacher has 17 years of experience working with DHH students and has been at the school for 5 years. She has used visual phonics for approximately 2 years. Both teachers are hearing and are proficient sign language users.

### Literacy Instruction Using Visual Phonics

Both teachers used an eclectic approach to literacy instruction following the standards specified per grade level by the state. They integrated resources from programs such as Reading A–Z (<http://www.readinga-z.com>) and use of leveled readers by Houghton-Mifflin,

Rigby, and Wright Group. Heavy emphasis was placed on vocabulary and general language instruction. They both used visual phonics to teach the phonemic awareness and phonic aspects of the reading process with their students. The visual phonics symbols were commonly used along with the standard reading materials that were used in the class. The majority of the visual and manipulative materials such as worksheets, flash cards, and games were teacher made. Students understood the symbols by demonstrating their ability to see a symbol and provide the corresponding hand cue (phoneme) for the symbol, and they did not confuse the symbols with letters. They were taught to understand that the symbols represent “sounds” and letters are the “written form of the sounds.” Students did not use the symbols for any of their own writing activities, they were written primarily by the teachers for depicting phonemic representations. In the first- to third-grade classroom, visual phonics cues were also used periodically throughout the day in other literacy types of activities. For example, during writing and spelling, visual phonics cues were used to support “sounding-out” strategies, where the teacher would provide the hand cue and the student would spell the word (i.e., teacher provides cues for /k-a-t/ and student writes *cat*). Visual phonics cues were also used to support learning new vocabulary words during content area instruction. The need for using the cues was faded as students no longer required this level of support in their reading or spelling.

The first- to third-grade teacher had a 60-min daily reading instructional block in the classroom that typically consisted of several stations through which the students rotated. One station consisted of leveled readers at each student’s independent reading level. Students each had reading shelves and “bookmarks” on which they kept track of the books they read independently at that station. The shelves encouraged independence in reading and provided the feel of a library. Another station consisted of independent sight word recognition activities. A third station consisted of small group work with the teacher. Activities in this station varied depending on the group but typically consisted of skill-building tasks and word and book reading. Activities for nonreaders focused consistently on phonemic awareness and phonics, beginning with

looking at picture books and predictable stories and matching visual phonics symbols representing particular concepts. Through much experience, the teacher found that “decoding” the visual phonics symbols before trying to make connections to letters assisted in the overall decoding process and facilitated a later transition to letters and word reading. In these activities, the teacher used the visual phonics hand cues and symbols to convey information about phonemes in words. Although the students were not required to use the hand cues or verbalize during these activities, most tended to use the hand cues consistently and often verbalized. For example, activities included phoneme-letter matching (matching the visual phonics symbol with the letter, with hand cues provided for support), initial phoneme matching (the word “mop” matched with the visual phonics symbol), onset-rime categorization with pictures, onset-rime categorization with using the symbols, and word-symbol matching (match words like “cat” with the visual phonics symbols). Figures 1 and 2 show materials for several of these activities. Beginning and more advanced readers participated in vocabulary building and syntactic skills, with visual phonics symbols used as one tool to figure out unknown words. At that point in the instructional process, most of the students had internalized the use of the visual phonics cueing system.

#### Reading Levels

Reading levels for each student were determined by an average of three curriculum-based measures:

1. Reading A–Z (<http://www.readinga-z.com>) Benchmark Books with Comprehension Questions.
2. A running record with leveled readers.
3. Classroom Reading Inventory (Silvaroli, 1996). Inventory Record for Teachers, Form A.

Teachers use curriculum-based measures to systematically monitor student progress and create appropriate instructional objectives. These measures were used schoolwide at this site, and the DHH classroom teacher was engaged in the assessments with her peers. Contrary to curriculum-based measures, standardized scores do not provide valuable instructional information, nor are they used as a means to monitor student progress. Furthermore, scores from standard statewide



**Figure 1** Sample teacher-made materials used in reading instruction with visual phonics symbols. Visual Phonics symbols: Copyright 1996 by ICLI. Reprinted with permission.

assessments were not available for all the students participating in this research because of exemptions via the Individual Education Planning process. Reading levels for these students ranged from late-kindergarten to mid-second grade. This information is presented in Table 1. The students' reading levels were used as the second independent variable.

### Measures

*Phonological awareness.* Phonological awareness was assessed using a picture rhyme task similar to the task described by Dyer et al. (2003) and Sterne and Goswami (2000). Modifications of their task were required to reflect standard American English rhyme patterns (Sterne & Goswami and Dyer et al., both used British English rhymes). Three pictures were presented on each page of a test book: a target picture above and two pictures below. One of the bottom pictures was a rhyme, and one was a distracter. The task required no reading or verbal expression and was simply to choose the picture that rhymed with the target. There were 4 trial items and 40 test items. Twenty of the items were orthographically similar rhyming pairs (pear, bear), and 20 were orthographically dissimilar pairs (light, kite). In addition, there were two types of distracters used in the task: 23 that shared some phonological features with the target rhyme (e.g., [top] and [ten]) and 17 that shared no phonological features

with the target rhyme (e.g., [drum] and [leaf]). Of the 23 distracters that shared phonological features, all but two (phone/feet and house/owl) also shared orthographic features (see Appendix). The dependent variable was the total correct for each participant.


*Decoding.* The decoding task was also developed and used initially by Dyer et al. (2003) and Sterne and Goswami (2000). The decoding task was designed to assess students' ability to read and associate meaning with words without using a whole-word reading strategy. Modification for this task was substantive, though the fundamental processing strategy within the task was the same as that used in the previous studies. Visual phonics symbols were used instead of the phonetically spelled pseudohomophones used in the previous research. On each item, the task was to select the set of symbols that represented the picture target. For example, both Sterne and Goswami (2000) and Dyer et al. used nonwords to represent the name of the picture (e.g., [BOYS]—*boiz*), whereas the present task used visual phonics symbols to represent the name of the picture (e.g., [BOYS]—*bYz*) ("boiz" represented here using visual phonics symbols) Figure 3 shows a trial item from the task. Visual phonics symbols were written by the classroom teacher, and students were familiar with the symbols and her writing prior to the study. Like the previous research, there were three

Name: \_\_\_\_\_

Directions: Write the correct word for each picture below.

can      hat      fan      bag      cap

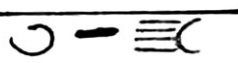
---




\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_







\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

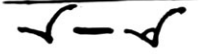


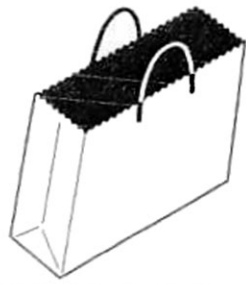


\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

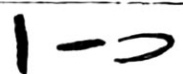


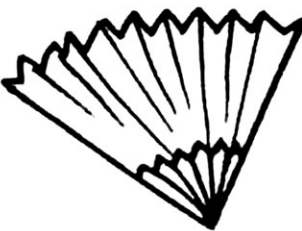


\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

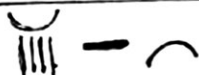




\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



**Figure 2** Sample teacher-made materials used in reading instruction with visual phonics symbols. Visual Phonics symbols: Copyright 1996 by ICLI. Reprinted with permission.

distracters for each item: initial phoneme different (/r/ for /b/), medial phoneme different ([æ] for [oy]), and final phoneme different (/n/ for /z/). The student was required to choose the correct set of symbols from a choice of four. All the distracter items were also written using visual phonics symbols. There were 4 trial items and 20 experimental items. The dependent variable was the total number of correct responses.

### Procedure

The teacher of the first- to third mixed-grade class delivered the instructions for both the phonological

awareness task and the decoding task. The instructions were written out explicitly by the researcher and rehearsed by the teacher. The instructions remained essentially the same for each student, though the mode of presentation varied depending on the primary communication style of the student (sign-supported speech or more ASL-like communication). The administration of the tasks was observed in-person by the researcher and a graduate assistant who also recorded the students' responses to each item. All administrations were videotaped in the event that the instructions or responses needed review at a later time. Prior to administration of the tasks, the

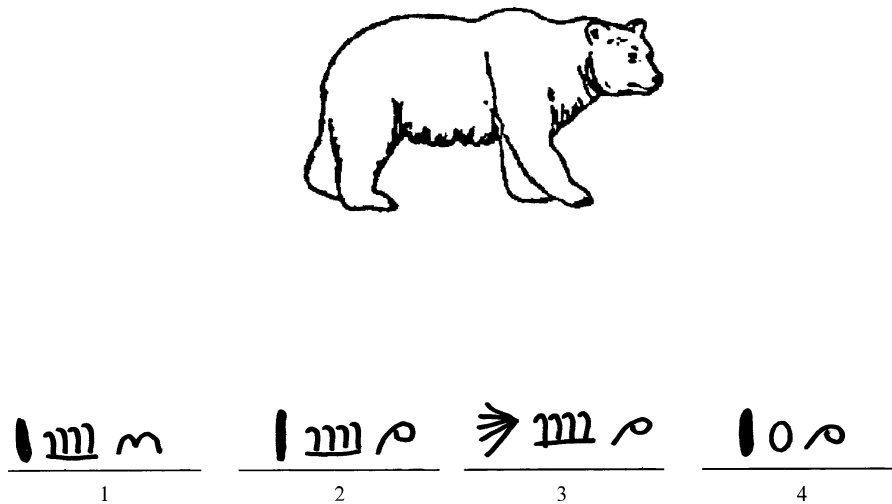


Figure 3 Trial item of decoding task. Visual Phonics symbols: Copyright 1996 by ICLI. Reprinted with permission.

participants performed a naming pretest to ensure that they were familiar with the pictured items used in the tasks. Students were allowed to name the picture in whatever mode they felt most comfortable (sign, speech, or a combination). Pictures that were not named accurately by more than six students were discarded from the selection, and alternate pictures were tested and substituted.

## Results

Means ( $M$ ), standard deviations ( $SD$ s), and response ranges for all dependent variables are presented in Table 2.

### Phonological Awareness

Group data were analyzed at several levels for the picture rhyming task: overall accuracy, accuracy for orthographically similar and orthographically dissimilar rhyme pairs, error analysis per item, and overall percent accuracy per item. Individual performance was then considered across the group according to age, reading level, and length of time being instructed

in reading with visual phonics. Results from a one-sample  $t$  test revealed that the group mean for overall accuracy on the rhyme judgments ( $M = 31.1$ ,  $SD = 6.02$ ) was significantly greater than chance,  $t(9) = 5.82$ ,  $p < .01$ . The effect size  $d$  of 1.84 indicates a large effect. Individual performance on the task ranged from 52.5 to 92.5% accuracy. One-sample  $t$  test results also revealed that group performance on the 20 items that were orthographically similar was significantly greater than chance ( $M = 16.0$ ,  $SD = 3.16$ ),  $t(9) = 6.00$ ,  $p < .01$ . Similarly, group performance on the 20 orthographically dissimilar items was also significantly greater than chance ( $M = 15.0$ ,  $SD = 3.27$ ),  $t(9) = 4.84$ ,  $p < .01$ . The ranges on individual performance for these tasks were 50 to 95% accuracy on orthographically similar items and 45 to 95% accuracy on orthographically dissimilar items.

An error analysis of the items on the picture rhyme task showed that seven students missed one item in which the rhyming pair was orthographically dissimilar, yet the distracter shared a phonological feature with the target rhyme (*whale*, *nail*, and *stairs*). Five students missed three other items, two of which

Table 2 Participant descriptive statistics:  $M$ ,  $SD$ s, and response ranges

		$M$	$SD$	Response range
Phonological awareness	Orthographically similar rhymes (out of 20)	16	3.16	10–19
	Orthographically dissimilar rhymes (out of 20)	15	3.26	9–19
	Overall (out of 40)	31	6.02	21–37
Decoding	Overall (out of 20)	11	3.74	4–15

were orthographically similar rhyme pairs with orthographically and phonologically similar distracter items (*house*, mouse, and owl; *tree*, bee, and train). The third item was an orthographically dissimilar rhyming pair with a distracter item that was orthographically and phonologically similar (*wheel*, seal, and whistle). Errors on all three of these items could be orthographical or phonological in nature. All other items were missed by less than 50% of the students.

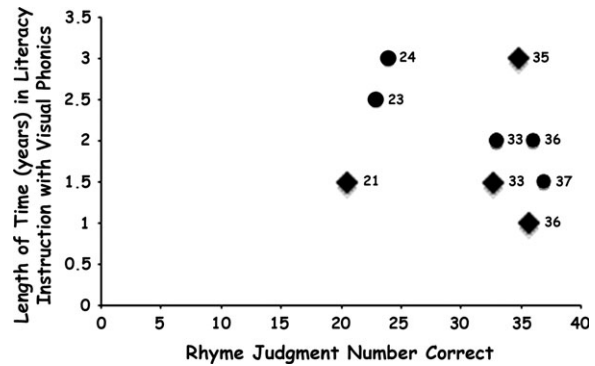
A second analysis was conducted on correct responses. Of particular interest were items that had orthographically dissimilar rhyming pairs and orthographically and phonologically similar distracters (*chair*, pear, chicken). Correct responses on these items would suggest rhyme decisions were being made based upon the phonological features of the word. There were a total of 11 of these items, 90% (10/11) of which were answered correctly by six or more students, showing some of these students do make rhyme judgments based on phonological information alone.

The younger students were equally as able to make rhyme judgments as the older students in the group. For example, the student 7 years and 7 months old was as good at making rhyme judgments as students 2 years older than him; all achieving 82.5% correct.

Six of the ten students in this group were reading at or slightly above grade level. Examination of rhyme judgment and reading level showed that four of those six had greater than 80% accuracy on the rhyme judgment task, whereas two students reading on grade level scored just greater than 50% accuracy. Furthermore, three of the four students reading below grade level also achieved greater than 80% accuracy on the task. Similarly, length of time being instructed in reading with visual phonics did not seem to influence how well students performed on the rhyme task or their reading level. Figure 4 shows student performance on the rhyme judgment task in relationship to reading level and length of time in reading instruction using visual phonics.

### Decoding

Like the phonological awareness task, the decoding task was analyzed along several dimensions: overall accuracy for the group, error analysis per phoneme



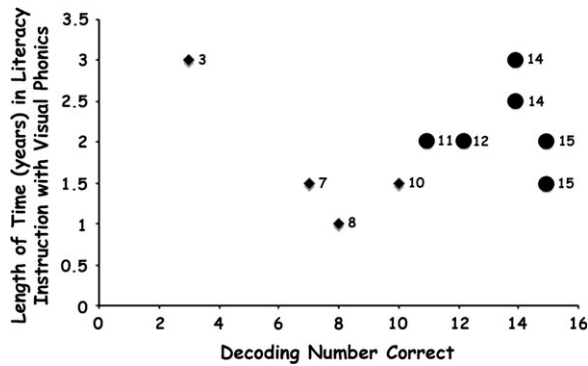
**Figure 4** Relationship between length of time in literacy instruction, performance on the rhyme judgment task, and reading levels. Circles represent students reading on or above grade level. Diamonds represent students reading below grade level. Two data points are represented at (33, 2).

position in the distracter items, and individual performance across age, reading level, and length of time being instructed in reading with visual phonics. Results from a one-sample *t* test revealed that the group mean for overall accuracy on the decoding task ( $M = 11.0$ ,  $SD = 3.74$ ) was significantly greater than chance,  $t(9) = 5.07$ ,  $p < .01$ . The effect size  $d$  of 1.60 indicates a large effect. Although their performance of 55% was lower than the group performance of 64% accuracy reported by Dyer et al. (2003), the current group's performance was still impressive. Only one student performed exceedingly low on this task, achieving 3/20 correct. The students' range of percent correct was 15–75%.

Students' performance on each item on the decoding task was disaggregated to determine if there were patterns among the distracter types. This analysis showed that errors were made relatively equally among distracters with different initial consonants, different medial vowels, and different final consonants. Age did not seem to be important for decoding skill. Younger students were just as good at decoding the visual phonics symbols as their older classmates.

All six of the students reading on grade level were better decoders than the students performing below grade level in reading. Length of time of literacy instruction with visual phonics did not seem to influence how well students performed on the decoding task nor their reading level. Figure 5 shows student performance on the decoding task in relationship to reading





**Figure 5** Relationship between length of time in literacy instruction, performance on the decoding task, and reading levels. Circles represent students reading on or above grade level. Diamonds represent students reading below grade level.

level and length of time in literacy instruction with visual phonics.

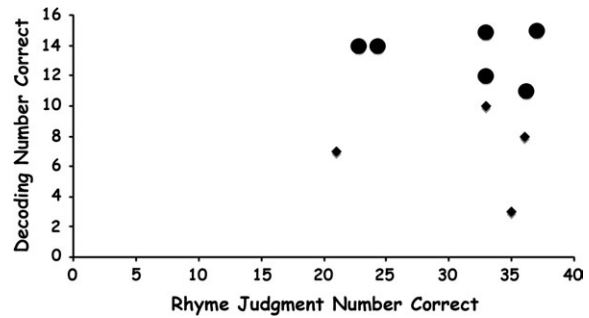
#### Phonological Awareness and Decoding

There was no discernable pattern between students' performance on the rhyme-judgment task and their performance on the decoding task. Students better at the rhyme task were not necessarily better at the decoding task or vice versa. Only two students performed equally on both tasks. Figure 6 demonstrates this relationship.

#### Discussion

At the outset of this study, it was hypothesized that reading instruction using visual phonics with DHH students would be correlated with increased ability to carry out phonological awareness and decoding tasks. These 10 students were able to complete both tasks with greater than chance performance, supporting this hypothesis.

For the phonological awareness task, the 10 students as a whole made rhyme judgments at a rate that was statistically greater than chance performance. This significance held for both orthographically similar and orthographically dissimilar items. Furthermore, item analysis of correct responses showed an important and interesting pattern. Students judged orthographically dissimilar rhyming pairs with orthographically and phonologically similar distracters at



**Figure 6** Relationship between performance on the rhyme judgment, the decoding task, and reading levels. Circles represent students reading on or above grade level. Diamonds represent students reading below grade level.

a high rate of accuracy. In other words, despite having both visual- and sound-based similarity, the distracter did not confound the students' rhyme judgment. Correct responses were achieved for 90% (10/11) of those items, making this pattern quite consistent. Both Dyer et al. (2003) and Sterne and Goswami (2000) reported that their participants made use of orthographic similarity over phonologic similarity on the rhyme judgment task. The certainty in responses in this study indicates that the students used phonological information alone to make rhyme judgments.

Results did not support a relationship between reading ability and rhyme judgment for these students. For example, four of the six students who were reported to be reading at or slightly above grade level performed with greater than 80% accuracy on the rhyme judgment task. At the same time, however, three students reading below grade level performed with a similar level of accuracy on the same task. Dyer et al. (2003) showed that for their 49 DHH students, rhyme judgment was positively correlated with reading ability, making this finding somewhat unexpected. Similarly, no correlation was found between length of time in literacy instruction with visual phonics and rhyme judgment skills. The students in this study had been receiving literacy instruction supplemented by visual phonics for 1–3 years. Students participating in that instruction for greater amounts of time were not necessarily better at rhyme judgment than those participating for less time.

For the decoding task, the group performance was statistically greater than chance. When shown a picture

of an object, students tended to choose the correct set of visual phonics symbols that when “decoded” (verbally or not) represented the picture. This finding indicates that the students used some process of label (or concept) storage and retrieval that was based upon the phonological information of the English word labels. Students reading at, or slightly above, grade level were better decoders than their classmates. This is inconsistent with the findings from the phonological awareness task where students better at rhyme judgment were not necessarily the better readers. According to Wagner and Torgesen (1987), rhyming skills with hearing children frequently yielded lower correlational values than other phonemic awareness tasks; this may be the case here as well. Similar to the findings for the phonological awareness task, the length of time in literacy instruction with visual phonics did not seem to affect students’ performance on the decoding task.

### Implications

DHH students may have underdeveloped internal phonological representations with which they try to make sense of the alphabetic code (Leybaert, 2005). These underdeveloped representations are thought to be a result of the lack of specificity in input. Students typically gain information about the phonologic code (and spoken English) through varying amounts of residual hearing, speechreading cues, and participation in speech therapy. However, none of these avenues provide complete access to the phonologic code.

Visual phonics addresses this dilemma via the visual, tactile, and kinesthetic input related to the phonemic structure of words. Using visual phonics, complete information about the phonologic code is provided at the isolated phoneme and word level, not in communicative contexts. As used with students who are communicating in sign language, visual phonics can be used as a supplemental tool in literacy instruction, as described in this study. The language of instruction can remain manual (via ASL), and the previously inaccessible or partially accessible features of spoken English are rendered accessible.

In this study, the students’ successful use of phonological judgments on the rhyme judgment task and

their accuracy on the decoding task may be an indication that literacy instruction in visual phonics yields better differentiated internal phonological representations. The students’ performance on the decoding task showed that they seem to be storing labels for concepts “phonologically.” In other studies, Trezek et al. have demonstrated the efficacy of using visual phonics to enhance reading instruction with DHH students (Trezek & Malmgren, 2005; Trezek & Wang, 2006; Trezek et al., 2007).

### Limitations

Several limitations associated with this research are acknowledged. The lack of relationships between reading ability and rhyme judgment and length of time in literacy instruction with visual phonics and rhyme judgment for these students may be due to independent variables uncontrolled for in this study. For example, the mixed-grade primary teacher who instructs these students in reading reported that despite years of literacy instruction with visual phonics, at least two of the older students (who were also below-grade-level readers) have inconsistent attendance at school. There may have been other concomitant factors associated with students’ learning processes that were also present; however, these factors were not assessed.

Additionally, although small sample sizes are not uncommon in research in deaf education, this study included only 10 students from an intact classroom. Larger sample sizes will provide stronger statistical correlations among variables.

### Conclusion

The results of this study show that reading instruction using visual phonics may be a viable tool in teaching phonological awareness and decoding skills with some DHH students. Visual phonics provides visual, tactile, and kinesthetic support for phoneme perception, without the need for hearing or articulation. This additional information for understanding how spoken language maps to print may provide the cognitive support needed by many DHH students as they learn to read.

These findings also point to areas for further investigation including designing more experimental

and quasi-experimental studies investigating the unique contribution to reading achievement that visual phonics may provide. Additional intervention research such as that conducted by Trezek et al. will

enhance the professional conversation and potentially lead to expanding the kinds of literacy instructional tools we implement with our DHH students in the classroom.

## Appendix

List of word sets used in the rhyme judgment task

Type	Cue	Rhyme	Distracter	Type	Cue	Rhyme	Distracter
Word set—dissimilar distracter item to the target							
O+	Bat	Hat	Key	O−	Eye	Pie	House
O+	Spoon	Moon	Feet	O−	Tie	Eye	Brown
O+	King	Ring	Cheese	O−	Whale	Nail	Stairs
O+	Nail	Snail	Snake	O−	Rain	Plane	Key
O+	Fan	Man	Cake	O−	Light	Kite	Bag
O+	Sun	Gun	Rabbit	O−	Drum	Thumb	Leaf
O+	Sock	Clock	Bed	O−	Cheese	Knees	Cloud
O+	Star	Car	Blue	O−	Rope	Soap	Comb
O+	Corn	Horn	Ring	O−	Wheel	Seal	Light
Word set 2—similar distracter item to the target							
O+	Pear	Bear	Pig	O−	Wheel	Seal	Whistle
O+	Rake	Cake	Rabbit	O−	Three	Key	Thumb
O+	Bag	Flag	Book	O−	Plane	Rain	Pants
O+	Boat	Coat	Moon	O−	Shoe	Blue	Sheep
O+	Phone	Bone	Feet	O−	Kite	Light	Key
O+	Top	Mop	Ten	O−	Seal	Wheel	Saw
O+	Mouse	House	Owl	O−	Bear	Hair	Pie
O+	Train	Rain	Tree	O−	Key	Bee	Kite
O+	Clown	Brown	Clock	O−	Bed	Head	Boat
O+	Tree	Bee	Train	O−	Box	Socks	Pig
O+	Run	Gun	Ring	O−	Chair	Pear	Chicken

*Note.* O+, orthographically similar rhyme pairs; O−, orthographically dissimilar rhyme pairs.

## References

- Adams, M. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: Massachusetts Institute of Technology Press.
- Charlier, B. L., & Leybaert, J. L. (2000). The rhyming skills of deaf children educated with phonetically augmented speechreading. *Quarterly Journal of Experimental Psychology*, *53A*, 349–375.
- Colin, S., Magnan, A., Ecalte, J., & Leybaert, J. (2007). Relation between deaf children's phonological skills in kindergarten and word recognition performance in first grade. *Journal of Child Psychology and Psychiatry*, *48*, 139–146.
- Dyer, A., MacSweeney, M., Szcerbinski, M., Green, L., & Campbell, R. (2003). Predictors of reading delay in deaf adolescents: The relative contributions of rapid automatized naming speed and phonological awareness and decoding. *Journal of Deaf Studies and Deaf Education*, *8*, 215–229.
- Hanson, V., & Fowler, C. A. (1987). Phonological coding in word reading: Evidence from hearing and deaf readers. *Memory & Cognition*, *15*, 199–207.
- Harris, M., & Beech, J. R. (1998). Implicit phonological awareness and early reading development in prelingually deaf children. *Journal of Deaf Studies and Deaf Education*, *3*, 205–216.
- International Communication Learning Institute. (1996). *See the sound/Visual Phonics*. Webster, WI: ICLI.
- Kyle, F. E., & Harris, M. (2006). Concurrent correlates and predictors of reading and spelling achievement in deaf and hearing school children. *Journal of Deaf Studies and Deaf Education*, *11*, 273–288.
- LaSasso, C., Crain, K., & Leybaert, J. (2003). Rhyme generation in deaf students: The effect of exposure to cued speech. *Journal of Deaf Studies and Deaf Education*, *8*, 250–270.
- Leutke-Stahlman, B., & Nielsen, D. (2003). The contribution of phonological awareness and receptive and expressive English to the reading ability of deaf students with varying degrees of exposure to accurate English. *Journal of Deaf Studies and Deaf Education*, *8*, 464–484.
- Leybaert, J. (2005). Learning to read with a hearing impairment. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 379–396). Malden, MA: Blackwell Publishing.
- Luckner, J. L., Sebald, A. M., Cooney, J., Young, J., & Muir, S. G. (2005/2006). An examination of the evidence-based literacy research in deaf education. *American Annals of the Deaf*, *150*, 443–456.
- National Reading Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Washington, DC: National Institute of Child Health and Human Development.
- Schirmer, B. R., & McGough, S. M. (2005). Teaching reading to children who are deaf: Do the conclusions of the National Reading Panel apply? *Review of Educational Research*, *75*, 83–117.
- Silvaroli, N. (1996). *Classroom reading inventory* (8th ed.). Blacklick, OH: McGraw-Hill.
- Sterne, A., & Goswami, U. (2000). Phonological awareness of syllables, rhymes, and phonemes in deaf children. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *41*, 609–625.
- Trezek, B., & Malmgren, K. (2005). The efficacy of utilizing a phonics treatment package with middle school deaf and hard of hearing students. *Journal of Deaf Studies and Deaf Education*, *10*, 256–271.
- Trezek, B., & Wang, Y. (2006). Implications of utilizing a phonics-based reading curriculum with children who are deaf or hard of hearing. *Journal of Deaf Studies and Deaf Education*, *11*, 203–213.
- Trezek, B., Wang, Y., Woods, D., Gampp, T. L., & Paul, P. V. (2007). Using visual phonics to supplement beginning reading instruction for students who are deaf or hard of hearing. *Journal of Deaf Studies and Deaf Education*, *12*, 373–384.
- Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin*, *101*, 192–212.

Received June 2, 2007; revisions received November 16, 2007; accepted November 19, 2007.