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## Teaching Reading to Children Who Are Deaf: Do the Conclusions of the National Reading Panel Apply?

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*The authors conducted a synthetic review of the research literature on the reading development and reading instruction of deaf students and compared their findings to the review of research literature conducted by the National Reading Panel (NRP) on four topic areas: (a) alphabetics (phonemic awareness instruction and phonics instruction); (b) fluency; (c) comprehension (vocabulary instruction and text comprehension instruction); and (d) computer technology and reading instruction. In their discussion of the areas of overlap in the two bodies of research and of the implications for future research, the authors note the lack of research with deaf readers on instructional interventions that have been found to be effective with hearing readers and on the implications for isolation from mainstream reading research.*

**KEYWORDS:** at-risk readers, deafness, National Reading Panel, reading instruction, struggling readers.

The National Reading Panel (NRP) was charged by the U.S. Congress in 1997 to assess the research evidence for the skills that are critical for becoming an independent reader and for the effectiveness of methods and approaches to the teaching of reading. Convened in the same year, the NRP consisted of 14 representatives of colleges of education, reading teachers, educational administrators, and parents. The panel identified a set of topics that it determined were of principal importance, and it developed a review process for examining and analyzing the research literature. The panel adopted standards that guided the screening of the extant research, which it termed *evidence-based methodological standards* because the standards of evidence were viewed as being as rigorous as those typically used in research on the efficacy of psychological and medical treatment interventions.

The conclusions drawn by the NRP (2000) have sparked intense debate among educators because of the restricted set of research studies that met the methodological standards and because of the implied judgment that other research methodologies were not scientific and rigorous. Nonetheless, though the set of studies reviewed by the NRP may be limited, the studies themselves cannot be assumed to be more flawed than other studies. The NRP's conclusions may have been drawn from a narrow range of studies, but those studies constitute an important body of research on the teaching of reading.

Given the impact of the NRP findings on federal financial support for research and instructional interventions in schools, it is worthwhile to compare the NRP results with the research on the reading development and reading instruction of children who are deaf—one population of students who traditionally have shown low reading achievement levels. The average deaf student gains only one third of a grade equivalent change each school year, and deaf students on average have a fourth-grade reading level at high school graduation; research indicates that this has been the case since the early twentieth century (Gallaudet Research Institute, 2002; Holt, 1993; Wolk & Allen, 1984). Given that low reading achievement has not been correlated with reading processes distinct from those of hearing readers (Schirmer & Williams, 2003), comparing the NRP results to findings from this population could provide evidence for the generalizability and the limitations of the NRP findings, as well as direction for future research with deaf readers.

Since 1990, when the Education of the Handicapped Act was renamed the Individuals with Disabilities Education Act, it has become preferred practice to use what is known as “people-first” language (preferring terms such as “people who are deaf” or “people with a hearing loss” rather than “deaf people” or “the deaf”). However, it is acceptable, and even preferred by many professionals and deaf individuals, to avoid the restrictions of people-first language when discussing deaf persons. Thus we have adopted a flexible approach to terminology in this article. Furthermore, we use the term “deaf person” to refer broadly to a range of individuals, from those who are hard of hearing to those who are profoundly deaf.

### **Mode of Inquiry**

Our mode of inquiry was a synthetic review of the research literature. We reviewed the body of research literature on the reading development and reading instruction of deaf students between preschool and Grade 16. We then compared our results with the results of the NRP, which examined the research literature on the reading development and reading instruction of normally developing and disabled readers between preschool and Grade 12. Our reason for including college deaf students was that the achievement gap between deaf and hearing readers would suggest that what is learned about hearing readers through Grade 12 would be applicable for deaf readers well beyond Grade 12. Given the number of studies on college deaf readers, we felt that the body of literature was substantive enough to be included.

It is characteristic of the body of literature on deaf readers to include participants with a range of hearing loss, from hard of hearing to deaf, and it is this body of literature that informs educational practice with deaf children. It might seem logical to differentiate children with moderate hearing loss from those with severe hearing loss, and those with severe hearing loss from those with profound hearing loss, for the purpose of research because children with milder hearing losses might approach reading differently from children with more profound hearing losses. In reality, however, this is rarely done. One reason is that children with moderate to profound hearing losses are typically found together in intact school programs for children with hearing loss. Another reason is that many children have hearing losses that vary across frequencies and from one ear to the other, making it diffi-

cult to characterize their hearing loss as a single factor. A third reason is that academic functioning is not neatly correlated with degree of hearing loss. Thus the studies that we reviewed included children with a range of hearing loss who were using a variety of communication methods. When the researchers themselves have identified subgroups of hearing loss and communication method, we provide that information.

The NRP studies met the following criteria: (a) They measured reading as an outcome; (b) they defined reading as reading real words in isolation or in context, reading pseudo-words that could be pronounced but have no meaning, reading text aloud or silently, and comprehending text read silently or orally; (c) they were published in English in a refereed journal; (d) they focused on reading development between preschool and Grade 12; and (e) they used experimental or quasi-experimental designs with a control group or a multiple baseline method. When the NRP found too few studies on a given subject, when the studies were too narrowly cast, or when they were of marginally acceptable quality, then correlational and descriptive studies were included. However, the NRP drew no conclusions solely from correlational or descriptive studies.

The studies on deaf readers that we reviewed met the following criteria: (a) they identified reading as a variable; (b) they were published in a refereed journal, conference yearbook, or monograph; (c) they focused on the reading development of deaf children between preschool and Grade 16; and (d) they used a quantitative or qualitative research design. Thus our review included experimental, quasi-experimental, analogue, single-subject, correlational, causal comparative, survey, program evaluation, empirical literature review, meta-analysis, case study, constant comparative, and ethnography studies. We included a wider range of research paradigms than the NRP review because we consider these methodologies to meet high standards of scientific rigor. Furthermore, had we included only studies that met the three methodological designs of the NRP review, we would have found too few studies to be considered representative of the literature.

The range of dates included in the NRP review varied by topic. Searches were limited by the relationship between recentness and amount of literature generated. No literature published before 1970 was included. The NRP conclusions were based on 441 studies published from the 1970s to 1999. In keeping with the NRP span of dates, we examined studies published from the 1970s and included 67 studies in our review. Both the PsycINFO and ERIC databases were used in the NRP review and in our review. For the NRP review, meta-analyses were conducted when possible. For the other studies, a subjective qualitative analysis was conducted. For our review, we did not conduct any meta-analysis because there were not enough studies with deaf readers employing experimental or quasi-experimental designs to allow for this kind of analysis; we conducted a subjective qualitative analysis in which trends and patterns in the research literature were identified. We created a rubric for analyzing each study that included categories for theoretical framework and review of related research; purpose, research questions, and hypotheses; design; participants; measures; procedure; analysis and results; and discussion. For each category, we used a set of descriptive questions (e.g., What measures are used?) and critical questions (e.g., Is information given on the trustworthiness of the measures?) that guided analysis of each study and comparison between studies.

The NRP focused on five topic areas: (a) alphabetics (phonemic awareness instruction and phonics instruction); (b) fluency; (c) comprehension (vocabulary instruction, text comprehension instruction, and instruction in teacher preparation and comprehension strategies); (d) teacher education and reading instruction; and (e) computer technology and reading instruction. Our review was organized around all of these topic areas; however, we ultimately excluded the subtopic "instruction in teacher preparation and comprehension strategies" and the topic "teacher education and reading instruction" because of the lack of research on those topics.

## Alphabetics

### *Phonemic Awareness Instruction*

Phonemic awareness is the awareness of the phonemes (smallest meaningful sound unit of speech) in spoken words. According to the NRP's working definition, phonemic awareness refers to the child's ability to focus on and manipulate phonemes in spoken words. The NRP contrasted phonemic awareness with phonological awareness, which it defined more broadly as including larger spoken units such as syllables and rhyming words. The NRP also recognized the potential overlap between phonemic awareness training and phonics instruction and noted that studies that were identified as addressing phonemic awareness instruction could involve grapheme-phoneme (i.e., letter-sound) manipulation but not reading of decodable text or writing of stories.

### *Phonological Capabilities of Deaf Readers and Use of Speech-Based Codes*

A number of researchers have been interested in the capability of deaf readers to use phonology in word recognition. The first underlying assumption in these studies is that if phonemic awareness is significantly related to the reading performance of hearing children, then the same should be true of deaf children. The second assumption is that if teaching hearing children to understand the correspondence between graphemes and phonemes has a significant effect on reading performance, then the same should be true of deaf children.

The research on phonemic awareness with deaf readers has been broadly concerned with determining how deaf readers cognitively code printed words. Thus there has been as much interest in fingerspelling and sign language codes as in phonological codes, often referred to in this body of literature as speech-based codes. The study that is considered seminal to the research on phonological coding in deaf readers was conducted by Conrad (1979). He was interested in determining if deaf readers use internal speech—his term for speech-based (phonological) codes—or a direct visual representation to code written words. Using words that sound alike but look different and words that look alike but sound different, he found that the deaf students in this study, between the ages of 15–16, who used internal speech were likely to be less deaf and to score higher on measures of intelligence than the students who did not use internal speech.

Conrad's results offered the possibility that regardless of hearing loss, deaf individuals could access and apply phonological information in word recognition. Hanson and her colleagues carried out a series of studies on phonological coding

by deaf readers beginning in the mid-1980s. In a study with 16 deaf children in Grades preparatory to 3 and using total communication (i.e., a system for communication used in some classrooms of deaf children that combines spoken and sign language), Hanson, Liberman, and Shankweiler (1984) used individual printed letters of the alphabet to determine if the deaf students were using speech and fingerspelling to code letters. They found that the better and older deaf readers more effectively used speech or fingerspelling coding, or both, and that ability to use speech coding was not related to the child's speech production skills. Hanson and Wilkenfeld (1985) then conducted a study with 14 college deaf students and 14 college hearing students by examining the participants' responses to sets of word triplets consisting of a target word, a morphologically similar word, and an orthographically similar but morphologically unrelated word (e.g., *think-thought-thin*). Both deaf and hearing participants showed shorter response times to words preceded by a morphologically similar but not orthographically similar word, which led Hanson and Wilkenfeld to conclude that deaf readers possess and use knowledge of phonology and that better deaf readers are more sensitive to morphological-phonological relationships than are poorer readers. In 1991, Hanson, Goodell, and Perfetti examined the ability of 14 college deaf students who used American Sign Language (ASL) and 16 college hearing students to read semantically acceptable and semantically unacceptable tongue-twister and control sentences. The results indicated that the deaf students used phonological coding; and, given the difficulty of acquiring a phonological code for readers with a hearing loss, the authors postulated that a phonological code could be visually derived from lipreading experience. We could find no subsequent research that either documented or disputed this conjecture.

Several researchers examined the demands that phonological processing places on readers with a hearing loss. Cavedon, Cornoldi, and DeBeni (1984) examined the presence of phonological processing during word reading in oral deaf children between the ages of 11 and 15. In the first experiment, 17 deaf participants and a matched group of 17 hearing participants were presented with a series of words, each on a separate card, and asked to indicate when any word had already appeared. In the second experiment, 32 deaf participants were asked to make a particular sign when the word was an animal and another sign when the word had already appeared. The researchers found that semantic processing was a greater problem than phonological processing for the deaf readers. Schaper and Reitsma (1993) examined the role of speech-based coding in 78 oral deaf children, ages 6–13, by analyzing their performance on tasks involving sets of pseudo-words that were alike visually but differed in pronunciation and sets of words with almost the same pronunciation but visual differences. They found that the younger children, ages 6–9, initially learned new words by coding the printed configurations. With more reading experience, there was a tendency toward speech-based coding. The authors concluded that speech-based coding might hinder word memorization in early reading development because speech-based coding demands so much effort by young deaf children.

One study was designed to determine whether deaf readers use phonological knowledge in actual reading situations. Kelly (1993) examined the recall of function words and inflections by 17 high school deaf students. The students read two sets of four expository passages each and answered true/false questions. For the

first set, they answered questions after reading each passage; for the second set, they answered questions after completing all four passages. In a third task, they inspected pairs of letter strings and judged whether they constituted real English words. The results indicated that the skilled readers showed a greater tendency to access phonological information than did the average readers, but this tendency did not correlate highly with accuracy of recall or increase of word processing time.

The results of studies conducted by Leybaert and colleagues showed considerably less support for phonological knowledge or use of phonological codes by deaf readers than had been found in earlier studies. Leybaert and Alegria (1993) used a Stroop task to investigate phonological processing in deaf readers. They asked three groups of oral deaf students and hearing students to respond to the color of written non-words, pseudo-words, words unrelated to the color, words related to the color, and color words. Experiment 1 involved 30 deaf students, ages 10–15, and 24 hearing third graders; Experiment 2 involved 28 deaf students, ages 9–13, and 24 hearing third and fifth graders. The results indicated that the participants' lexical representations contained phonological as well as orthographic information. The researchers concluded that young deaf readers do access phonological information during reading, but Leybaert and Alegria could not determine the accuracy and strength of this phonological knowledge. Transler, Leybaert, and Gombert (1999) carried out a study with 21 deaf children using French Sign Language, ages 7–12, and 21 hearing children, ages 7–8, to investigate whether deaf children use phonological syllables as reading units. The students were asked to read and copy pronounceable pseudo-words and real words. No evidence of phonological processing was found in the deaf readers.

Researchers who examined the spelling strategies of deaf readers found striking differences between oral and signing deaf students. Johnson, Padak, and Barton (1994) presented 86 oral deaf students, ages 6–13, with a spelling test to determine if their spelling strategies matched those found in previous studies with hearing children. Findings showed that the deaf participants used the same strategies in the same developmental sequence as hearing children. Of particular interest was the finding that their spelling inventions were phonologically similar to those of hearing children. Sutcliffe, Dowker, and Campbell (1999) examined the spelling of 20 hearing children for whom English was a second language, ages 9–10, and 17 deaf children, ages 9–12, who used manual English (i.e., a sign language system that represents English in a visual-gestural modality and was developed for use in educational settings); the purpose of the study was to determine sensitivity to phonology. Shown 60 pictures corresponding to high- and low-frequency words, the participants were asked to watch the teacher say or sign the word, to look at the picture, and to spell the word. The results indicated that, although the deaf children showed sensitivity to phonology in spelling, they made limited use of spelling strategies requiring phonological awareness.

The results of these studies show that deaf readers, particularly more skilled readers, are able to access phonological information, but the results provide no evidence to indicate the strength of phonological knowledge. Some authors conjecture that deaf readers may acquire phonological sensitivity through experience in speaking and lipreading, as well as use of residual hearing through amplification

(i.e., hearing aids and assistive listening devices). It is noteworthy that the researchers do not consider the probability that many of the deaf participants in these studies were taught to attend to phonological features of words through phonemic awareness activities, auditory discrimination activities, or phonic analysis instruction, and that differences in capabilities may be accounted for by differences in instruction.

### *Effectiveness of Teaching Phonemic Awareness to Deaf Children*

We could find only one study in which the researchers examined the effects of teaching phonemic awareness to deaf readers. Schimmel, Edwards, and Prickett (1999) implemented a reading program with 48 elementary deaf students for 1 year. One of the five components of the program was phonemic awareness. No description of teaching strategies was provided. Though data indicated growth in phonemic awareness, it is not evident which aspects of intervention were responsible for the positive findings.

The research on intervention and instruction is so limited (it consists of one study with serious flaws) that we could not draw any conclusions regarding the relationship between phonemic awareness training and reading improvement in deaf readers.

### *Use of Fingerspelling and Sign Representations by Deaf Readers*

Several researchers have explored other codes that deaf readers use for representing English phonemes, morphemes, and words. Hirsh-Pasek (1987) engaged 22 deaf students, ages 5–16, and second-generation ASL users (i.e., their parents were deaf and used ASL), in a series of four tasks designed to determine if deaf readers can attend to fingerspelling in much the way that hearing readers attend to phonemes. Hirsh-Pasek found no evidence that the deaf students regularly decoded sight words into fingerspelling; however, the students showed increased word identification when they did decode into fingerspelling. In the Transler et al. (1999) study discussed earlier, although the researchers had not set out to examine the use of fingerspelling as a coding strategy, they observed that many of the hearing participants made subvocalizations and many of the deaf participants made fingerspelling movements. The researchers could not discern whether the fingerspelling movements corresponded to orthographic units, morphological units, or phonological units.

Siedlecki, Votaw, Bonvillian, and Jordan (1990) examined the role of a sign-based code in word recognition. They showed 192 words to 31 college deaf students and 31 college hearing students. The words made up four categories: high imagery/unsigned, low-imagery/signable, high-imagery/signable, low-imagery/unsigned. Findings showed that signable words were recalled more frequently by the deaf subjects and that imagery value affected the recall only of better deaf readers. The results provided limited evidence that better deaf readers may use a speech-based code in memory tasks but not in the same manner as hearing readers, and that the better deaf readers may also use visual codes, including a sign-based code.

The results of two case studies of deaf preschoolers point to the beneficial effects of sign print (i.e., graphic representation of the sign, or sign language picture,

above each English word) on word recognition. Maxwell (1984) carried out a longitudinal study of a deaf child interacting with her parents during interactive storybook readings. The child was 2 years old at the outset and 6 years old at the conclusion. Maxwell found that the child's attention to the sign print and matching of her own signs to the sign print resembled the way that hearing children match speech to orthography. Rottenberg (2001) examined the early reading development of a 4-year-old deaf child. She found that the child relied heavily on the sign print initially but, within a year, relied increasingly on the printed text.

The research on the use of fingerspelling and sign language codes is too limited to allow any conclusions about the effectiveness of those codes in enabling a child to make correspondences between the alphabetic writing system and his or her visual-gestural (as opposed to spoken) language in order to circumvent the necessity to use letter-sound relationships. This body of research appears to follow no path of building new studies on previous findings, with the consequence that there are indications that deaf readers may use fingerspelling and sign codes in word recognition but no tentative, let alone firm, conclusions.

We found relatively little research on phonemic awareness training. Since the 1970s, researchers have concentrated largely on the capabilities of deaf readers to access phonological information and code words phonologically. Almost all of the research is observational in nature. That is, the researchers manipulated variables with the intention of observing the deaf reader's phonological knowledge and ability. Very few researchers carried out intervention studies to enhance phonemic awareness abilities. Indeed, we could identify only one such study. With so little connection between factors that contribute to word recognition and manipulation of those factors through instructional interventions, the current body of research leaves little direction for classroom instruction on phonemic awareness, fingerspelling, or sign codes with deaf readers.

### *Phonics Instruction*

Readers essentially have five strategies for recognizing words in print: (a) Phonic analysis involves using the cues that letter-sound relationships offer; (b) analogy involves using the cues that similar known words offer; (c) structural analysis involves using the cues that morphemes offer; (d) context involves using the semantic and syntactic cues of known words in the sentence; and (e) sight word recognition involves the ability of the reader to identify a word automatically.

The NRP review focused on phonics instruction because learning how to apply letter-sound correspondences and spelling patterns was viewed as an essential part of the process for beginning readers. The NRP was specifically interested in the effectiveness of two types of phonics instruction—systematic and incidental. According to the NRP's working definition, a systematic phonics approach involves the delineation and explicit teaching of a sequential set of phonics elements; and an incidental phonics approach involves highlighting phonics elements opportunistically as they appear in text.

We could find no research that specifically addressed the topic of phonics instruction with deaf readers. In the few studies on word recognition, researchers concentrated on sight word learning.



### *Capabilities of Deaf Readers*

The literature on sight word learning is distinct from that on many of the other topics in that most of the former involved instructional intervention strategies. The one study that focused on the capabilities of deaf readers was carried out by Fischler (1985), who assessed the importance of word recognition in sentence-level comprehension of deaf readers. He gave 39 college deaf students and 40 college hearing students incomplete sentence contexts that could be completed meaningfully with one word, showed them pairs of words, and asked if an item was a word or not a word. He concluded that by college age, word recognition was not a major factor in the reading ability of deaf readers.

### *Effectiveness of Instructional Approaches*

In two studies, sight words were taught in the context of reading material. Koskinen, Wilson, and Jensema (1986) investigated the use of closed-captioned television (i.e., the appearance of printed text scrolled across the bottom of the television screen that is designed to capture the dialogue and action of a program) to increase the sight vocabulary of high school deaf students, ages 13–15. The researchers found that retention of sight vocabulary was greater in lessons using closed-captioned television than in traditional reading materials. Johnson and Roberson (1988) engaged 4 deaf kindergartners and 3 deaf first graders in a language experience instructional program. In the language experience approach, children dictate sentences to the teacher, the teacher writes these in the form of a language experience story, and the children read their own stories. The researchers reported that the kindergartners added 31 words and the first graders added 58 words to their reading vocabularies by the end of the 3-month program. The study provided no comparative data from the research literature to indicate if these results were significantly better than those for other hearing or deaf children of comparable ages.

Teaching sight words by matching the printed form to the signed form was the intervention strategy in two studies. In the Schimmel et al. (1999) reading program that was discussed earlier, one of the components was adapted Dolch word lists (lists of words appearing with high frequency in typical reading material for children) linked to commonly used meanings with appropriate ASL signs. No information was provided regarding the techniques for teaching these as sight words. Descriptive data indicated gains on learning the Dolch words, though no statistical analysis was provided showing that the gains were significant. Wauters, Knoors, Vervloed, and Aarnoutse (2001) investigated the effects of an instructional intervention designed to improve the word recognition of deaf readers through pairing signs (in Sign Language of the Netherlands) with written words. They carried out the intervention with 14 deaf students, ages 6–10, in an educational program for deaf students in the Netherlands. One list of words was presented in speech only and one list in speech and sign. All words were taken from a list of spoken Dutch words that hearing children are supposed to know by age 6. The results showed that accuracy was significantly higher for words learned through speech accompanied by signs than for words learned through speech only.

Two studies involved the sight word learning of young deaf children. Suzuki and Notoya (1984) trained 6 mothers to teach their oral deaf children, who were

between the ages of 1 and 3 at the outset of the study, to identify words matched with objects, pictures, or actions. After 45 months, the researchers found that the children's written vocabulary was significantly greater than their spoken vocabulary. Soderbergh (1985) conducted an investigation of an explicit approach for teaching sight vocabulary to deaf children. One word was taught each day by matching the printed word with an object or action and the corresponding sign (in sign language). When the child had learned 50 common words, new words were embedded in simple sentences taken from a story and presented at a rate of one sentence per day. Three groups of children were involved: (a) 7 deaf children, ages 2–4, taught by their parents at home; (b) 13 deaf children, ages 3–4, taught by their parents at home; and (c) 27 deaf children, ages 5–6, taught in small groups in a nursery school setting. The results, which were similar to Suzuki and Notoya's, indicated that the children's written language positively influenced spoken and sign language development.

Of the five strategies available to readers for word recognition, the research with deaf readers has focused most intensely on sight word recognition. This body of research shows that deaf readers can learn to recognize words automatically and that young readers may benefit by matching written words with signs or sign print, or both.

### Fluency

Fluency is the ability to read accurately, quickly, and with appropriate expression. The correlate to fluency is freedom from word recognition difficulties. The NRP considered fluency one of the critical factors in reading comprehension and noted that only recently had teachers begun to recognize the importance of teaching fluency. The NRP was specifically interested in the effectiveness of the two most common types of fluency instruction—guided oral reading and independent silent reading.

#### *Guided Oral Reading*

In guided oral reading approaches, students read passages orally with systematic and explicit guidance and feedback. Examples of these approaches are repeated reading, neurological impress, radio reading, paired reading, shared reading, and assisted reading. We could find no studies that examined guided oral reading with deaf readers and thus could draw no conclusions about the effectiveness of this approach.

#### *Independent Silent Reading*

In independent silent reading, students are encouraged to read extensively on their own or with minimal guidance and feedback. Examples of these approaches are sustained silent reading (SSR) and "drop everything and read" (DEAR). Also, incentive programs that involve reading a target number of pages or books are examples of this approach to fluency instruction.

We found only one study that addressed independent oral reading as an approach for increasing fluency and one study that addressed the differential fluency abilities of skilled and average readers who are deaf. With only two studies, one on time spent reading and one on topic familiarity, we could conclude only that independent oral reading appears to hold promise as an instructional approach for increasing the deaf reader's fluency.

### *Effectiveness of Independent Oral Reading*

Limbrick, McNaughton, and Clay (1992) calculated the quantity of time allocated to reading for 45 deaf children, ages 5–10, in 10 separate classrooms for deaf children. Time allocated to reading was defined as the amount of time that the child was engaged in reading (reading to the teacher, reading to him/herself, or reading to another child) and reading-related activities (such as cloze exercises that require identifying words systematically deleted from a brief passage; reading to answer questions; and rewriting a story after having just read it). Case studies were then conducted with 6 of the children: 3 children observed as spending low levels of time engaged in reading and 3 children observed as spending high levels of time engaged in reading. The researchers found a correlation between levels of engaged time and reading achievement.

### *Differences Between Skilled and Average Deaf Readers*

Kelly (1995) investigated the factors that distinguish skilled and average readers by asking 9 average readers, ages 16–19, and 9 skilled readers, ages 15–18, to read passages from a moving window text display. Half of the passages were about familiar topics and half were about unfamiliar topics. The results showed that the skilled readers read all topics significantly faster than the average readers, that both groups read familiar topics more quickly than unfamiliar topics, and that the skilled readers were significantly more fluent than the average readers. He observed that the average readers exhibited relatively halting processing rhythms and longer reading times.

## **Comprehension**

Comprehension is the construction of meaning. It represents the core of reading for two reasons: first, comprehension is the goal of reading instruction; and second, reading comprehension is essential to virtually all other subject area learning. The NRP examined the literature on the three predominant themes in the body of research on reading comprehension—vocabulary instruction, text comprehension instruction, and preparation of teachers to teach reading comprehension strategies. As we noted earlier, we did not include teacher preparation in our review.

### *Vocabulary Instruction*

The NRP noted that defining vocabulary is not a straightforward task, given that vocabulary can be defined as receptive (what the child understands when vocabulary is presented in text or in listening) and expressive (what the child uses in writing or speaking to others); and as oral (words the child recognizes when listening), reading (words the child recognizes when reading), and sight (words the child recognizes automatically when reading). Given the difficulty in finding an existent framework with which to organize the research on vocabulary instruction, the NRP created the following taxonomy of instructional methods reflecting the five major methods of teaching vocabulary, although the NRP noted that the research studies did not fit neatly into their taxonomic scheme:

1. *Explicit instruction* involves providing students with definitions or word attributes. A common approach is the pre-teaching of vocabulary before reading.

2. *Indirect or implicit instruction* involves extensive reading by students and the assumption that word definitions will be inferred. A common approach is the encouragement of wide and independent reading.
3. *Multimedia methods* involve using media such as graphic representations, hypertext, and ASL. A common approach is the use of semantic mapping.
4. *Capacity methods* involve activities that provide ample practice, with the goal of making reading automatic and thus increasing capacity for vocabulary learning.
5. *Association methods* involve drawing connections from what the students already know to the words they do not know. A common approach is the use of context.

### *Relationship Between Vocabulary Knowledge and Reading Comprehension*

Although the literature contains numerous theoretical and opinion articles on the importance of vocabulary to the reading comprehension of deaf readers, we were able to identify only three studies with deaf participants that empirically examined the relationship between vocabulary knowledge and reading comprehension. These studies provide limited evidence for the positive relationship between vocabulary knowledge and reading comprehension in deaf readers.

LaSasso and Davey (1987) asked 50 deaf students, ages 10–18 and reading at least at the fifth-grade level, to read expository passages at fifth-grade readability (i.e., passages that the children could read without assistance) and to respond to questions for which they were allowed to look back and questions for which they were not allowed to look back. The correlation between the students' vocabulary knowledge, as measured by the vocabulary comprehension subtest of the Gates-MacGinitie Reading Test, and comprehension were moderately high. The authors concluded that vocabulary knowledge is an effective predictor of reading comprehension in deaf students.

Kelly (1996) examined the test scores of three populations of deaf readers: 100 oral adolescents, 113 total communication adolescents, and 211 total communication postsecondary students. He examined scores on tests of syntactic and vocabulary knowledge and found that students with relatively high levels of syntactic competence were better able to apply vocabulary knowledge.

Garrison, Long, and Dowaliby (1997) examined the relationship between background knowledge, vocabulary knowledge, and comprehension. They asked 30 college deaf students, 26 hearing seventh graders, and 135 college hearing students to read five expository passages and answer 15 questions assessing word knowledge, 15 questions assessing world knowledge, and 20 questions assessing ability to make inferences. They found vocabulary knowledge to be a strong predictor of reading comprehension ability.

### *Indirect Instruction*

We could find research on only two of the methods in the NRP taxonomy, indirect instruction and multimedia methods. In an investigation of a vocabulary intervention, deVilliers and Pomerantz (1992) examined the extent to which deaf students could learn vocabulary through written context. The intervention involved 66 deaf students, ages 12–18; of those, 51 used primarily spoken language and 15 used signed English (i.e., a sign language system, also known as manual English,

that represents English in a visual-gestural modality and was developed for use in educational settings). Six nouns, six verbs, and six adjectives were embedded in two- to three-sentence passages with context that was *lean* (i.e., provided little information about meaning other than the word's grammatical category), *rich* (i.e., provided a great deal of semantic information about the word), or *explicit* (i.e., provided a clear contrast or equivalence statement). All of the students performed better with rich and explicit context. The findings also revealed that the better deaf readers were able to gain more from context than the poorer readers, independent of their language modes.

On the basis of the findings of this study, the method of indirect instruction appears to hold promise. However, given the deaf reader's difficulty with English syntax and the research showing that material rewritten in simplified syntax does not improve comprehension, which we discuss in the section on text comprehension instruction, there would appear to be an inherent challenge in identifying text that is explicit enough for the deaf reader to discern the meaning of new vocabulary while reading.

### *Multimedia Methods*

Two types of multimedia methods would appear to be well suited for vocabulary instruction with deaf students. One is computer technology and the other is ASL. We found the body of empirical research on these topics to be surprisingly small, and the results can only point to the possibility that vocabulary instruction can be enhanced through computer technology and ASL as the language of instruction for all or part of the school day.

Although the literature is replete with discussions and ideas about the instructional applications of computer technology, we identified just one series of studies in the 1980s and no more recent documented results of effectiveness for vocabulary instruction. Prinz and colleagues (Prinz, 1991; Prinz & Nelson, 1985; Prinz, Nelson, & Stedt, 1982; Prinz, Pemberton, & Nelson, 1985) developed a computer software system for improving the sentence writing, vocabulary, and word recognition of deaf children. The results showed significant improvement of deaf students between the ages of 2 and 14 years on measures of syntax and vocabulary.

Although the NRP casts ASL in the category of multimedia methods, the field of education of deaf children casts the use of ASL in educational settings as a bilingual method. In deaf education, bilingual methods are typically referred to as bilingual/bicultural or *bi/bi* programs because they emphasize the attainment of two languages and two cultures—both ASL and English, and both Deaf culture (capitalized because it represents the name of a cultural group) and the culture of hearing individuals (specifically, the culture of hearing parents). The body of literature on bilingual methods for deaf children is extensive; however, it consists mostly of theoretical papers, position papers, and program descriptions.

We found one study on reading aloud to deaf children in which the authors gathered data on vocabulary instruction during storybook reading. Bilson, Hayes, and Luetke-Stahlman (1996) asked teachers of deaf children who were in preschool to Grade 4 at 21 schools to answer questions about how much time they read aloud, the techniques they used, and how they chose books for storybook reading. Of the 57 completed surveys, 66% reported using ASL or manual English when reading

aloud; 58% reported discussing vocabulary before the reading began; 75% reported defining new or unfamiliar vocabulary during reading; and no teacher reported discussing vocabulary after reading.

We also found one study on the effects of a bilingual program with 7 deaf children over a period of 3 years from the beginning of pre-kindergarten to the end of first grade. Andrews, Ferguson, Roberts, and Hodges (1997) noted that the teacher followed the same state curriculum as used in the public schools. The deaf teacher used ASL for all instruction, written material was explained in ASL, books were read to the children in ASL, and the children's parents were taught how to read aloud using ASL. At the end of first grade, all but one child tested at grade level on standardized achievement tests and a vocabulary test.

### *Text Comprehension Instruction*

The research literature on reading comprehension divides along two major categories: (a) prior knowledge that the reader brings to the reading situation, and (b) the cognitive strategies used by the reader before, during, and after reading. Prior knowledge falls into four areas: knowledge of syntax, background knowledge of text topic, knowledge of text structure, and vocabulary knowledge. The NRP included vocabulary instruction as a separate topic from text comprehension instruction and did not include knowledge of syntax at all, undoubtedly because this area is an issue only for some children, such as children with language learning disabilities, children for whom English is a second language, and children who are deaf. Cognitive strategies involve the ways that readers consciously monitor their comprehension and adapt their strategies to improve understanding.

The NRP identified the following 14 categories of text comprehension instruction separate from vocabulary instruction and teacher preparation:

1. *Comprehension monitoring* involves being aware of understanding and employing procedures for dealing with comprehension breakdowns.
2. *Cooperative learning* involves working together with others to learn reading strategies.
3. *Graphic and semantic organizers* involve representing meanings and relationships of ideas graphically.
4. *Story structure* involves learning the form of typical stories, such as setting, episodes, characters, and plot lines.
5. *Question answering* involves responding to questions posed by the teacher and receiving effective feedback.
6. *Question generating* involves posing questions to oneself.
7. *Summarization* involves identifying the important ideas and integrating them into a meaningful whole.
8. *Multiple-strategy teaching* involves using strategies in combination, flexibly and appropriately.
9. *Mental imagery* involves generating an image to represent the text content.
10. *Mnemonic procedures* involve using devices, such as a picture or keyword, for improving memory.
11. *Curriculum plus strategy* involves providing opportunities to learn, adapt, and practice strategies in different subject areas.
12. *Listening actively* involves listening for meaning as the teacher reads.

13. *Prior knowledge elicitation* involves comparing text topic with the child's personal experience and knowledge, teaching relevant knowledge, predicting, previewing, making associations, and inferring.
14. *Psycholinguistic strategy* involves learning to identify noun substitutes, verb substitutes, clause substitutes, and antecedents of pronouns.

### *Prior Knowledge of Syntax*

The deaf reader's obvious difficulty with English syntax has produced numerous studies on the effects of syntactic difficulties in reading performance and investigations on ameliorating those difficulties through syntactic manipulations of text material. Indeed, the problem was considered so pervasive that a basal reading series, *Reading Milestones* (Quigley, McAnally, King, & Rose, 1991), was developed specifically for deaf readers; it consisted of stories written with increasingly more complex sentence structures that represented what appeared to be a developmental sequence based on research studies of the syntactic ability of deaf students (e.g., Quigley, Power, & Steinkamp, 1977; Quigley, Wilbur, & Montanelli, 1974; Wilbur & Goodhart, 1985; Wilbur, Goodhart, & Montandon, 1983). We could find no assessment of the effectiveness of the series with deaf readers.

We found three studies in which researchers examined the effects on comprehension of text material rewritten in less complex syntactic structures. In a study that won the *Volta Review* editor's award for best research paper, Israelite and Helfrich (1988) asked 15 oral deaf students, ages 10–13, and 15 hearing students, ages 8–9, who were reading at the third-grade reading level, to read two stories from the *Reading Milestones* series at second-grade readability. One story was the original version; the other was revised on the basis of parameters for text coherence. Although hearing students were unaffected by story type, the deaf students showed significantly better comprehension with the stories revised to improve coherence. The authors concluded that efforts to control readability through manipulation of syntax and vocabulary may result in texts that are actually more difficult for deaf students to comprehend because of lack of text coherence. Stoeften-Fisher (1987–1988) sought to identify the difficulty of specific English structures that should be considered when creating linguistically controlled reading materials and television captions. She administered a test with target linguistic structures embedded in short paragraphs to 90 deaf students, ages 10–18, classified as high and low scorers on a test of syntactic abilities. On the basis of their answers to "wh-" questions (i.e., who, what, where, when, why, and how) after reading the paragraphs, she concluded that semantic issues were at least as important as syntactic issues in modifying reading material for deaf students. Diebold and Waldron (1988) investigated the effects of simplified syntactic structures and insertion of pictorial symbols into the text. The participants, 60 deaf students between 12 and 22 years of age, read text passages of approximately 500 words each and responded to comprehension tasks. The results indicated that syntactic complexity did not influence comprehension but that pictorial symbols improved comprehension.

In two studies of rewritten material, sentence structures were left intact but formatted so that meaningful units were visually separated from one another. Negin (1987) asked 20 deaf students, who used total communication and were reading at the second-grade level, to read two 500-word passages, one narrative and one

expository, and answer eight literal and two inferential multiple-choice questions. One pair of passages was formatted normally and one set was formatted by segmenting subjects from predicates and objects from predicates, as well as separating clauses and phrases. The results showed that segmentation significantly increased reading comprehension on both the narrative and expository passages. Gregory (1987) asked 40 oral deaf students, ages 10–17, to read four 50- to 70-word passages formatted in four typographical modes—whole sentences, meaningful phrases, nonmeaningful word groupings, and single words—and to answer seven factual and inferential questions. The results showed that the students were sensitive to typographical mode and performed better with meaningful phrases than with the other modes.

Several research studies found the syntactic abilities of deaf readers to contribute less to reading problems than had been previously thought. Nolen and Wilbur (1985) investigated the ability of 50 deaf students in Grades 4–12 to interpret difficult syntactic structures by using contextual information. They administered a test consisting of 30 multiple-choice items in two modes, single sentences and paragraphs containing an underlined sentence. The students were asked to choose one of four line drawings that best illustrated the target sentence. They found that the students performed significantly better on context items and that even the lower-level readers made inter-sentence connections. Yurkowski and Ewoldt (1986) examined the story retellings of a 17-year-old deaf student. On the basis of an analysis of the semantic, syntactic, and graphic cues that she used, the authors concluded that the semantic cueing system has primacy over the syntactic cueing system for deaf readers. McKnight (1989) conducted a study with 50 deaf and 50 hearing students in Grades 4, 6, 8, 10, and 12. On the basis of their comprehension of passages at the mid-third- to fourth-grade reading level, he concluded that deaf readers comprehend better when given the opportunity to predict within context beyond the sentence level.

Two studies in the 1990s confirmed findings of the relative importance of the deaf reader's syntactic abilities in comprehension. Lillo-Martin, Hanson, and Smith (1992) conducted a study with 26 college deaf students identified as good or poor readers on the basis of their performance on the comprehension subtest of the Gates-MacGinitie Reading Test. In addition to the Gates-MacGinitie, the students were administered the Raven's Progressive Matrices and a test of relative clauses. They found that regardless of reading ability, the participants were proficient in comprehending the relative clause structure. Miller (2000) sought to determine whether syntactic or semantic processing dominates the comprehension of deaf readers. He asked 32 oral and signing deaf students and 36 hearing students in Grades 4–9 to read 12 semantically leading, 12 semantically neutral, and 13 semantically misleading sentences, each followed by a short multiple-choice question. Approximately half of the sentences were simple and half were complex, syntactically. The finding that semantic plausibility showed up consistently as related to comprehension regardless of syntactic structure led Miller to conclude that semantic processing is predominant in deaf readers.

#### *Prior Knowledge of Topic*

The NRP could not find enough evidence for prior knowledge elicitation strategies to conclude that this type of instruction improves comprehension. Studies



with deaf readers provide support for the conclusion that background knowledge directly influences reading comprehension (e.g., Garrison et al., 1997), but intervention studies have shown mixed effects for approaches designed to build and activate the prior knowledge of topics before reading.

Schirmer and Winter (1993) investigated whether a thematic organizer would have a beneficial effect on comprehension because it served to activate background knowledge. They asked 24 signing deaf students, ages 10–16 and reading at least at the third-grade level, to read two stories at second-grade readability and to make predictions at three stop points during silent reading. For one story, the students were given a thematic organizer summarizing major ideas in the upcoming story. The researchers found no support for the hypothesis that the deaf students would provide better predictions using a thematic organizer. They concluded that either the organizer was not sufficient for activating background knowledge or activation did not ensure application of background knowledge to the reading situation.

Andrews, Winograd, and DeVille (1994) used ASL summaries before reading for activating background knowledge. The participants were 7 deaf students, ages 11–12 and reading at least at the high second-grade level, 7 hearing college students, 7 hearing children reading at the same levels as the deaf students, and 7 hearing children reading above the level of the deaf students. The participants read six fables and retold all that they remembered after reading each one. For two of the fables, the investigator summarized the fable in ASL before reading began. The hearing readers received no ASL summary treatment. Findings indicated significant improvement for retelling in the ASL summary condition for the deaf readers, surpassing their performance on stories for which they did not receive the ASL summary treatment and surpassing the performance of the hearing readers who received no summary treatment.

Jackson, Paul, and Smith (1997) investigated the contribution of prior knowledge to the reading comprehension of 51 deaf students, ages 12–20, in oral and total communication settings. The participants were pretested on prior knowledge, asked to read a 500-word passage at third-grade readability, and then tested on comprehension. The researchers found that reading comprehension was more positively promoted by asking the students lengthy, multiple-part questions about an upcoming passage than by asking brief questions in the pretest.

The results of these studies imply that building and activating prior knowledge enhances the comprehension of deaf readers. However, not all techniques are equally effective. Given the small number of empirical studies, we could draw no definitive conclusions about the most effective instructional strategies, but there is evidence to suggest that providing extensive information before reading is considerably more valuable than providing brief information.

### *Knowledge of Text Structure*

The research on hearing children has shown that they expect text to have a predictable structure and demonstrate better comprehension and recall of text that adheres to predictable structures. Although it has been conjectured that deaf readers develop knowledge of text structure more slowly than hearing readers do, the research evidence is inconclusive regarding the text structure knowledge of deaf readers.

Griffith and Ripich (1988) examined the ability of 11 deaf students in a total communication program, ages 6–15, to use story structure in organizing their retellings. The students were presented with three stories, differing on the basis of number of events, in sign and speech simultaneously. The students then retold each story to another student who had not been present for the story presentation. The results showed that the retellings were consistent with story structure elements.

Donin, Doebling, and Browns (1991) included an oral comprehension task in their study with 48 oral deaf children between 7 and 18 years of age. The students were orally presented a 654-word folktale at fifth-grade readability, with a well-defined structure and narrative organization, and were asked to retell it. A subgroup was then identified for further testing. Students who tested below sixth-grade level were divided into groupings so that older poor readers could be compared with younger students at the same reading level. They were asked to read and recall three passages (narrative fiction, narrative nonfiction, procedural nonfiction) at their reading level. The results showed that although comprehension increased with age, no structure promoted significantly better comprehension than any other type.

Schirmer (1993) sought to determine if a well-formed story would have a beneficial effect on comprehension because it confirmed the student's expectation for story structure. She asked 48 signing deaf students, ages 9–16 and reading at least at the third-grade level, to read one well-formed and one non-well-formed story at second-grade readability. Analysis of their predictions at three stop points during silent reading indicated that they made more elaborated predictions with the non-well-formed stories. The author concluded that active cognitive processing is more likely to occur when deaf readers encounter material that does not completely confirm their expectations.

In several intervention studies, approaches to teaching story structure to deaf readers were investigated. In these studies, explicit instruction, indirect instruction, and teacher mediation all proved effective.

Akamatsu (1988) investigated the effects of an instructional intervention designed to increase knowledge of story structure in two deaf students, ages 11 and 12, using manual English. The intervention, which lasted 3 weeks, involved techniques and materials for teaching story structure components and strategies for summarizing stories. The findings indicated greater use of story structure elements in the students' written summaries as a result of the intervention, and the results were maintained 3 weeks after the intervention ended. The purpose of a study by Cambra (1994) was to improve the writing of deaf children through instruction in story structure. The participants were 10 oral deaf children, ages 11–14. The intervention lasted 12 weeks and involved 15 activities for teaching story structure. The results showed a 20–40% increase in use of story structure components in the students' writing at the end of 12 weeks.

Whereas Akamatsu and Cambra used an explicit approach for teaching story structure, Schirmer and Bond (1990) used an indirect approach. They engaged 4 deaf children, ages 10–11 and using conceptual sign language (i.e., ASL signs in English word order), in daily 45-minute reading lessons that followed the format of a Directed Reading Thinking Activity. One story was read every week for 11 weeks, and, after each was read, the students responded to written

questions reflecting story structure components. They were also asked to write a story each week beginning the 4th week of the intervention. Pre- and post-retellings indicated that the students included a greater number of story structure components in their retellings and wrote more well-formed stories at the end of intervention.

Luetke-Stahlman, Griffiths, and Montgomery (1998) used teacher mediation during student retelling as an approach to teach story structure. They targeted text structure components based on the child's retellings during baseline. The participant was a 7-year-old deaf child with a cochlear implant, who used signed English and was reading at the mid-first-grade level. The teacher read a story to the child, and the child retold it every week for 28 weeks. During the intervention phases (lasting 6 weeks and 12 weeks, respectively), the teacher mediated the child's retellings by encouraging the targeted text structures. Findings showed an increase in the targeted story structure components as well as lengthier retellings as a result of the intervention.

### *Comprehension Monitoring*

When applied to the reading process, metacognition refers to readers' awareness of and control over their own comprehension processes. Metacognition can be viewed as having four parts: knowing when you comprehend, knowing what you comprehend, knowing what knowledge you need to acquire in order to comprehend, and knowing how to invoke strategies to improve comprehension. Comprehension monitoring strategies identified by the NRP included thinking aloud, looking back in the text, restating or paraphrasing, and looking forward in the text. The research with deaf readers underlies the importance of being aware when comprehension breaks down and being able to activate strategies to improve understanding.

Davey (1987) assessed the comprehension and metacomprehension processes of 50 deaf readers with a mean age of 15 years, 61 proficient hearing readers in Grades 5–6, and 62 hearing-disabled readers in Grades 9–10. The participants were asked to read 12 brief expository passages at sixth-grade readability and to answer eight wh- questions under look-back and no-look-back conditions. The results indicated that both hearing groups reported greater comprehension when allowed to look back at the passage. Although the deaf readers also showed better comprehension when allowed to look back, they did not report being aware that their comprehension improved.

Ewoldt, Israelite, and Dodds (1992) compared the strategy use of 16 deaf students, ages 13–17, with the strategy use recommended by their teachers. The students were described as using a continuum of communication modalities, from manual English to ASL. The students read a folk narrative, a descriptive text, and an expository text at fourth-grade readability and provided a retelling. High-scoring retellers were asked to reread the three texts and their own retellings and to report whether the rereading improved their comprehension; they were also given the opportunity to change their retellings. The students' teachers were interviewed after reading the three texts and were asked to recommend strategies that they believed would help their students to comprehend the texts better. The results revealed evidence of student self-monitoring of comprehension, a match between the teachers' and students' perceptions of text difficulty, and a mismatch between

the teachers' and students' recommended strategies for improving comprehension. The students recommended a greater number of independent strategies, such as rereading and using picture cues; their teachers recommended a greater number of dependent strategies, such as asking for help.

Andrews and Mason (1991) examined the strategy use of deaf and hearing readers by asking the students to read the first 10–14 sentences of seven expository passages with a word or phrase blanked out in one or two sentences. The participants included 5 deaf students, ages 17–20, who were using ASL; 5 hearing students, ages 14–18, with learning disabilities; and 5 hearing students, ages 8–11; all were reading at levels somewhere between second and sixth grades. The students' "think-alouds" while filling out the deleted words showed that the deaf students used strategies similar to those of the hearing students but that the frequency and type differed. The deaf readers relied more often on rereading and background knowledge; the hearing readers made greater use of context cues.

Strassman (1992) investigated the metacognitive knowledge of deaf students about school-related reading. She videotaped 29 deaf students, ages 14–19, responding to a questionnaire about the purpose of reading, what makes a good reader, and what the student does when she or he has difficulty reading. The results indicated that the students focused on school-related skills that they had been taught and did not use comprehension-monitoring strategies extensively. For example, 48% of the students identified rereading as a strategy for remembering information, but only 32% identified it as a strategy for answering the teacher's questions and just 20% identified it as a strategy for understanding a text segment that the student does not understand.

Given the relatively weak comprehension monitoring skills found in these studies of deaf readers, we expected to find intervention studies designed to improve their skills. We found no studies designed specifically to improve comprehension monitoring.

### *Question Answering*

Questions that teachers ask are designed to assess comprehension, extend comprehension, and provide models of self-questioning. For deaf readers, the ability to answer questions is complicated by the relatively complex syntactic structure of question forms in English. Thus question-answering difficulty can arise from confusion caused by the form of the question as well as from comprehension breakdowns. Garrison, Dowaliby, and Long (1992) examined the difficulty of reading comprehension items in a standardized achievement test that had been administered to 158 college deaf students and found that background knowledge (or world knowledge) was as important as vocabulary and syntactic features of the test items. They concluded that "the necessary skills or processes involved in answering test questions remain elusive" (p. 29).

Two intervention studies were designed to improve comprehension through question answering. Dowaliby (1992) conducted two experiments on the effects of adjunct questions on the reading comprehension of 74 college deaf students and 100 middle school hearing students. An expository text of just over 1,100 words at seventh-grade readability was separated into 10 topical sections. The conditions were no questions, adjunct questions inserted immediately preceding the relevant page of text, and adjunct questions inserted immediately following

the relevant page of text. Look-backs and look-aheads were not allowed. The results indicated that the pre-position questions improved the comprehension of factual information but that the post-position questions did not have that effect for the deaf readers. The majority of the hearing students performed better in the no-question condition. The author noted that the text was of high difficulty for the deaf readers and that the results might have been different with easier prose material.

Schirmer and Woolsey (1997) studied the effects of teacher questions designed to encourage analysis, synthesis, and evaluation on the reading comprehension of six deaf children, ages 10–12, using conceptual sign language. The students were divided into four reading groups and engaged in weekly 30–45-minute reading lessons that followed the format of a Directed Reading Thinking Activity. The stories began just below or at the students' reading level and became progressively more difficult during the 7 weeks of the study, until the stories were approximately one grade above the students' reading level. After each story was read silently, the students were asked written comprehension questions designed to encourage analysis, synthesis, and evaluation of the material; no literal questions were asked. The students were also asked to complete a story cloze (i.e., story frames with information left out for the students to fill in regarding setting, events, and conclusion) related to the major story structure components. The results showed a high correlation between ability to answer the comprehension questions and inclusion of details in the story cloze. However, the answers were not consistently thorough. Seven factors were related to thoroughness or lack of it: understanding the intent of the question, locating pertinent information, considering consequential details, applying relevant and accurate background knowledge, relying inappropriately on background knowledge, expressing oneself unambiguously, and providing a sufficient answer.

### *Question Generating*

The strategies that the NRP found effective for teaching children to pose and answer their own questions included asking children to generate questions during reading; asking them to evaluate their questions; providing feedback on the quality of their questions; and teaching them to evaluate whether their questions covered important information, were integrative, and could be answered. We found only one study on question generating with deaf readers.

Livingston (1991) examined the strategy use of two college deaf students enrolled in a basic reading course with hearing students. One student used manual English and one used ASL. The class read *In This Sign*, by Joanne Greenberg, in segments of 10 pages per class period. For each segment, they wrote a response paper. Livingston found that the deaf students used self-questioning, as well as paraphrasing and integrating, in their written responses.

### *Mental Imagery*

Mental imagery instruction involves asking readers to construct a visual or spatial representation of what they are reading. Given that sign language involves the visual and spatial modalities, mental imagery would appear to be a particularly pertinent strategy for deaf readers. We found one study on teaching mental imagery to deaf students.

Schirmer (1995) investigated the effectiveness of mental imagery as a reading comprehension strategy with 9 deaf students, ages 7–11, who used conceptual sign. As in Schirmer and Woolsey's 1997 study, the students were divided into four reading groups and engaged in weekly 30–45-minute reading lessons that followed the format of a Directed Reading Thinking Activity. A new story was read every week for 7 weeks. After the first three lessons, the children were told to make pictures in their minds about what they read to help them understand and remember. Before reading, they were asked to make predictions; during reading, in the first 3 weeks, they were asked to summarize what happened after each segment; during reading, in the 4-week intervention phase, they were asked to describe their mental imagery; after reading, they answered literal and inferential questions and retold the story. Quantitative analysis of predictions, summaries, descriptions of mental imagery, answers to the questions, and completeness of retellings showed no relationship between mental imagery and comprehension. Qualitative analysis revealed six qualities of thinking during the mental imagery phase of the study: recollection, representation, analysis, inference, integration, and evaluation.

### *Mnemonic Procedures*

Instruction in mnemonics for improvement of reading comprehension involves teaching students to use a *keyword* to substitute for a person, concept, sentence, or passage. The NRP found that mnemonic procedures were most effective in improving memory for text. We found one study on the use of mnemonics with deaf readers.

Sartawi, Al-Hilawani, and Easterbrooks (1998) taught three strategies to 15 oral deaf students in Grade 3. The first strategy, reciprocal teaching, included four parts: clarifying, predicting, questioning, and summarizing. The second strategy, experience-based activation, involved activating the students' interests before reading. The third was the keyword strategy: The students read three content units and answered nine questions for each unit. The findings showed overall low performance on all three strategies, though highest on the keyword strategy.

### *Inference Making*

The NRP did not identify instruction in making inferences as one of the categories of text comprehension instruction. However, inference making has received some attention in the literature with deaf readers. Brown and Brewer (1996) investigated the role of inference processes in the reading performance of 40 skilled deaf readers, 40 less skilled deaf readers, and 40 college hearing readers. The students were given 40 two-sentence paragraphs containing target words that were not identified as such for the students. After reading each paragraph, the students were asked a question about each target word: whether it represented an inferred concept or a nonword. The students then answered a true/false question about information stated explicitly in the first sentence of the paragraph. The findings indicated that good deaf readers performed similarly to hearing readers in making predictive inferences; less skilled deaf readers made more errors. The authors concluded that the difference between skilled and less skilled deaf readers was more marked than the difference between deaf and hearing readers. In other words, skill level was the significant variable rather than deafness per se.

Walker, Munro, and Rickards carried out two studies, the first designed to assess the inferential ability of deaf readers and the second designed to improve

inferential abilities. In their first study (1998a), they examined the scores from the Stanford Diagnostic Test of Reading for 195 deaf children, ages 9–19. The results showed that literal comprehension was higher than inferential comprehension, particularly for below-average readers. Although literal and inferential scores improved with age and grade level, the gap widened between below-average readers and average or above-average readers. In their second study (1998b), Walker et al. investigated the differential effects of an inferential reading strategy, a conventional reading program, and no specific reading comprehension instruction beyond that included in the regular curriculum. The participants were 60 underachieving deaf readers, ages 9–18, using oral communication, total communication, and cued speech (i.e., a set of hand cues used to distinguish patterns of speech seen on the lips of the speaker). The students who were instructed in the inferential reading strategy showed greater gains in inferential and overall comprehension. There are just a few instances in the literature of researchers who followed up on what they learned in descriptive studies by conducting investigations of intervention efficacy. The abovementioned studies by Walker et al. are examples; the studies by Schirmer and associates (Schirmer, 1993, 1995; Schirmer & Winter, 1993; Schirmer & Woolsey, 1997) are another.

### **Computer Technology and Reading Instruction**

Computer technology is not an instructional strategy per se and cannot be examined separately from strategies for teaching phonemic awareness, phonics, fluency, vocabulary, and text comprehension. As the NRP noted, computer technology must be studied in the context of how well it facilitates instruction in these areas.

Educators of deaf students have been interested in the uses of technology in instruction for decades; yet there is little research on instructional interventions. As we discussed earlier, Prinz and colleagues (Prinz, 1991; Prinz & Nelson, 1985; Prinz et al., 1982; Prinz, Pemberton, et al., 1985) developed a computer software system for improving the sentence writing, vocabulary, and word recognition of deaf children; but we found no continuation of this line of research inquiry beyond 1991. Computer technology provides the capability for simultaneous or successive presentation of written text and ASL graphic representations, and yet we found just one study on this kind of computer use. Andrews and Jordan (1998) developed scripts about Mexican American culture at the elementary, middle, and high school reading levels, with English and Spanish versions as well as ASL translations. The participants were 20 teachers and 10 Mexican American deaf children. The study was in progress when published, and the data from the students' literacy portfolios had not been analyzed.

### **Comparison of the Results with the Findings of the National Reading Panel**

#### *Alphabetic*

#### *Phonemic Awareness Instruction*

Three major findings emerged from the NRP review: (a) Phonemic awareness training improves phonemic awareness and reading but not performance in other subject areas, such as math; (b) phonemic awareness training improves spelling in normally achieving children but not children who have been identified as disabled readers; and (c) the most effective instruction in phonemic awareness involves

focusing on one or two types of phoneme manipulations at a time, teaching within small groups of children, and using explicit and systematic methods. The NRP concluded that teaching children to manipulate phonemes significantly improves their reading. The panel cautioned, however, that no one instructional approach is superior and noted that phonemic awareness instruction is just one component of a comprehensive reading program.

On the basis of the results of the NRP review of the research literature, we expected to find that phonemic awareness training would improve the phonemic awareness and reading of deaf readers, or of those deaf readers who had some ability to access phonological information. We thought that phonemic awareness training probably would not improve spelling, given that deaf readers would be more similar to disabled readers than to normally achieving children. We also expected to find that the most effective instruction would involve focusing on one or two types of phoneme manipulations at a time and using explicit and systematic methods. Because instruction with deaf children frequently takes place in small groups, we expected to find little or no research focusing specifically on group size.

Although there is a substantial body of research on phonemic awareness training with hearing readers, the research provides little information on the effectiveness of such training with deaf readers. Clearly, if knowledge of the relationship between sounds and letters is fundamental to reading success, as the NRP review demonstrates, educators need to know how best to teach phonemic awareness to children who have little or no access to the sounds of spoken English. Alternatively, the NRP's review may have overstated the importance of this kind of knowledge, in part because it was based on a narrow band of studies and in part because of potential biases among panel members. Phonemic awareness may be beneficial but not necessary to reading success. If so, instruction aimed at visual access to meaningful word parts might be as beneficial as phonemic awareness. At present, it is not known whether phonemic awareness training is effective for deaf readers or whether instruction in fingerspelling and sign language can make a comparable connection through the visual modality that phonemic awareness appears to provide through the auditory modality.

### *Phonics Instruction*

The NRP found that systematic phonics instruction is beneficial for children in Grades K–6 and for children identified as disabled readers. For kindergartners, it improves ability to read and spell. For first graders, it improves word recognition, spelling, and comprehension. For children beyond first grade, it improves decoding and spelling but not comprehension. The NRP found that systematic phonics instruction is more effective than incidental approaches or no phonics instruction.

The NRP concluded that systematically and explicitly teaching children to blend sounds together to identify written words, and to break spoken words apart to write words, significantly improves their reading. However, as it did with phonemic awareness instruction, the panel cautioned that no one instructional approach is superior and that phonics instruction is just one component of a comprehensive reading program.

On the basis of the results of the NRP review of the research literature, we expected to find that systematic phonics instruction would improve the word recognition and spelling of deaf children or of those deaf readers who can connect letter



sounds with letters. However, the lack of research on the strategies that are taught as part of phonics instruction—phonic analysis, analogy, and structural analysis—leaves an open question as to whether deaf readers can benefit as much as hearing readers from systematic phonics instruction.

### *Fluency*

Three major findings on fluency emerged from the NRP review: (a) Guided repeated oral reading procedures positively influence word recognition, fluency, and comprehension in readers across the grade levels; (b) guided repeated oral reading procedures are effective with students who are experiencing reading difficulties, as well as with good readers; and (c) independent silent reading with minimal guidance or feedback is not directly related to fluency or general improvements in reading skills, though better readers have been found to do more independent silent reading. The NRP concluded that engaging students in repeated oral reading with guidance and feedback significantly improves reading ability. The NRP also noted that independent silent reading might, indeed, have a positive effect on reading fluency; however, the research to date does not provide sufficient evidence for that conclusion.

On the basis of the results of the NRP review of the research literature, we expected to find that guided repeated oral reading procedures would be an effective approach for increasing the fluency of deaf readers. Given the absence of any research relating guided repeated reading to teaching fluency, we are unable to determine if encouraging deaf students to read passages orally or in sign language, and providing them with systematic and explicit guidance and feedback, would improve fluency and increase comprehension. The limited research of two studies on independent silent reading appears to be promising as an approach for teaching fluency.

### *Comprehension*

#### *Vocabulary Instruction*

Two major findings emerged from the NRP review: (a) Vocabulary instruction is positively related to comprehension; and (b) no particular instructional method or combination of methods is the most effective. The NRP noted that the use of computer technology appears to have potential as an aid for vocabulary instruction, that vocabulary could be learned incidentally through reading and listening, that vocabulary instruction before reading is beneficial, and that multiple encounters with words in various contexts improves vocabulary learning. The NRP concluded that more than one method for teaching vocabulary should be used, incorporating both direct and indirect instruction, repetition, and rich contexts.

On the basis of the results of the NRP review of the research literature, we expected to find that teaching vocabulary to deaf readers would improve their comprehension, particularly if more than one method were used and vocabulary were presented in multiple and rich contexts. The research with deaf readers shows the importance of vocabulary in reading comprehension and provides limited evidence for the use of multimedia methods, including computer technology, and indirect instruction with rich contextual material. With only one study on indirect instruction, four relatively dated studies from the 1980s on computer technology, and only two studies on using ASL for instruction, these interventions appear to offer

promise; but there is not enough empirical investigations to draw definitive conclusions about the superiority of particular instructional approaches to teaching vocabulary to deaf readers.

### *Text Comprehension Instruction*

Two findings emerged from the NRP review: (a) Comprehension monitoring, cooperative learning, graphic and semantic organizers, story structure, question answering, question generating, and summarization are effective in improving comprehension; and (b) the use of these strategies in combination, flexibly and appropriately, is more effective than any one technique alone. The NRP concluded that comprehension instruction can motivate and teach children to use comprehension strategies effectively.

On the basis of the results of the NRP review of the research literature, we expected to find that text comprehension instruction in comprehension monitoring, cooperative learning, graphic and semantic organizers, story structure, question answering, question generating, and summarization would improve the comprehension of deaf readers. We further expected that teaching deaf readers to flexibly use combinations of these strategies would be particularly effective.

The research with deaf readers provides evidence for the importance of many of these strategies in reading comprehension but relatively little research on the effectiveness of teaching these strategies to deaf readers. Of the 12 intervention studies, we found none on prior knowledge of syntax, three on prior knowledge of topic, four on knowledge of text structure, none on comprehension monitoring, two on question answering, none on question generating, one on mental imagery, one on a mnemonic procedure, and one on inference making. We also found modest intersection between the topics investigated in the research on normally developing and disabled readers and the research on deaf readers. For example, we could find no research on using cooperative learning, graphic organizers, summarization, curriculum plus strategy, listening actively, or psycholinguistic strategy with deaf readers. The largest body of research on text comprehension instruction with deaf readers has concentrated on the role of syntax, a topic not included in the NRP review except within the related topic of psycholinguistic strategy, which has not been investigated with deaf readers.

Given the relatively limited research on text comprehension instruction with deaf readers and the modest intersection of instructional strategies investigated in the NRP review and those investigated with deaf readers, we cannot conclude with any degree of certainty that the strategies found to be effective with hearing readers would prove to be effective with deaf readers.

### *Computer Technology and Reading Instruction*

The major finding that emerged from the NRP review was that computer technology could be used effectively for reading instruction. Three areas showed particular promise: (a) addition of speech to computer-presented text, (b) use of hypertext, and (c) use of word processing software to combine reading and writing instruction. The NRP noted the absence of research on Internet applications in the context of reading instruction. The NRP concluded that the limited research to date shows the promise of technology for delivering effective reading instruction; however, questions regarding instructional applications far exceed answers at present.

On the basis of the results of the NRP review of the research literature, we expected to find that computer technology is a promising tool for reading instruction. The research with deaf readers provides little to support this conclusion; yet we would be foolhardy to dispute it. The research to date offers some direction for future research. Computer programs developed specifically for students who are deaf appear to have limited usefulness, undoubtedly because those programs are labor intensive to create; the costs are prohibitive, given that deaf students constitute a relatively small population of students and applications become obsolete every few years because of advances in technology. The use of hypertext to provide sign versions of print text may be found effective in reading instruction; however, two factors are likely to mitigate against widespread use. The first is the amount of time and degree of expertise needed by teachers to create these texts. The second is the improbability that publishers will create this type of specialized computer text for such a small population. The application most likely to be used successfully and broadly with deaf students is word processing software that combines reading and writing instruction. Finally, we agree with the NRP that Internet applications hold promise for reading instruction.

### **Conclusions and Implications**

The purpose of this article was to review the research on the reading development and reading instruction of children who are deaf and to compare the findings with the NRP's review of the research on normally achieving children and children identified as disabled readers. As we noted at the outset of this article, though the NRP's conclusions were drawn from a narrow range of studies, those studies constitute an important body of research about the teaching of reading. Given the historically low reading achievement levels of deaf students graduating from high school, a comparison of findings would show the commonality of issues for deaf and hearing readers and would indicate whether instructional practices and future research with deaf readers might benefit from the instructional practices found to be effective with hearing readers and disabled readers.

We compared findings in four topic areas: alphabetics, fluency, comprehension, and computer technology (for a summary of the comparison, see Appendix). The first topic area, alphabetics, includes phonemic awareness instruction and phonics instruction. The NRP review demonstrated that knowledge of the relationship between sounds and letters is fundamental to reading success. That review identified effective instructional approaches for teaching phonemic awareness and phonics. We found that deaf readers, particularly the more skilled readers, are able to access phonological information but that the research provides no evidence to indicate whether deaf readers can be taught to use phonological information effectively in word recognition. We drew similar conclusions about the use of fingerspelling and sign codes for word recognition. Deaf readers appear able to use these visual codes, particularly the better readers, but the research provides no evidence for the effectiveness of the codes in word recognition and no proven strategies for teaching deaf readers to use visual codes. The two bodies of research on alphabetics overlap relatively little. Unlike the research with hearing readers, which has largely focused on the relationship between phonemic awareness and reading ability, the research on alphabetics with deaf readers has focused on determining if deaf readers can access phonological information. These researchers have assumed that

phonemic awareness plays a crucial role in learning to read and have sought to determine if lack of phonemic awareness is an underlying cause of the reading difficulty experienced by deaf readers. Given the finding that deaf readers can access phonological information, as well as the finding that visual codes may be used by deaf readers, we were surprised by the lack of research on instructional interventions.

The second topic area that we compared was fluency. The NRP review demonstrated that guided repeated oral reading procedures are effective for teaching fluency and that independent silent reading is not directly related to improvement in fluency. We found two studies on fluency ability in deaf readers showing the relationship between reading ability, time engaged in reading, and fluency. We also found related research on sight word recognition, showing that deaf readers can learn to recognize words automatically. We found no research on guided repeated reading for fluency instruction with deaf readers. In comparing the two bodies of research on fluency, the most striking observation is the very limited research with deaf readers. Fluency ability apparently is not considered to be as important as other literacy skills for deaf readers, in spite of the research with hearing readers that would indicate the important role of fluency in reading achievement.

The third topic area that we compared—comprehension—includes vocabulary instruction and text comprehension instruction. The NRP review demonstrated that vocabulary instruction is positively related to comprehension and that direct and indirect instructional methods for teaching vocabulary should be used. The two bodies of research on vocabulary overlap little. We found three studies on the relationship between vocabulary knowledge and reading comprehension, several studies on vocabulary development within classrooms in which ASL is the language of instruction, one study of an indirect instructional method, and four studies of direct instructional methods using computer technology. None of the intervention studies assessed the relationship between vocabulary learning and comprehension. Unlike the topic of fluency, vocabulary clearly is viewed as important for deaf readers. Yet, as in the areas of alphabets and fluency, vocabulary instruction for deaf readers has received relatively little attention from researchers.

For text comprehension instruction, the NRP review found seven strategies to be effective in improving comprehension: comprehension monitoring, cooperative learning, graphic and semantic organizers, story structure, question answering, question generating, and summarization. The NRP further found that these strategies are more powerful when used in combination. Of the seven strategies, we found only four addressed in the research with deaf readers—comprehension monitoring, story structure, question answering, and question generating. Within this body of research, we found nine investigations of deaf readers' abilities and six intervention studies. In terms of abilities, we could draw no conclusions except the consistent finding that deaf readers have weak comprehension monitoring abilities. The intervention studies involved just two of the strategies, story structure and question answering. The conclusions overlap substantially with those of the NRP review in finding story structure and question-answering strategies to be effective in improving the comprehension of deaf readers. Text comprehension research with deaf readers includes topics outside the seven strategies identified as effective in the NRP review, including several reviewed by the NRP as well as several not reviewed. Given the few studies on any one topic and the lack of conclusive results for several techniques, we cannot conclude that instruction in prior knowl-

edge of text topic, mental imagery, mnemonic procedures, inference making, or syntax will improve the comprehension of deaf readers. Alternatively, the limited research indicates the promise of these strategies. As in the body of research on hearing readers, the topic of text comprehension instruction has received substantial attention in the research literature on deaf readers. Yet, as with alphabets and vocabulary, there is little overlap between the two bodies of research. Relatively few studies of deaf readers involve the assessment of intervention strategies; just over half of the strategies found to be effective by the NRP have been investigated with deaf readers; and fewer than half of the text comprehension strategies reviewed by the NRP have been investigated with deaf readers.

The fourth topic area that we compared was computer technology and reading instruction. The NRP review demonstrated that computer technology could be used effectively for reading instruction. Three areas showed particular promise: the addition of speech to computer-presented text, the use of hypertext, and the use of word processing software to combine reading and writing instruction. We found no research on these three promising areas. One study on hypertext with ASL was incomplete when published. Four studies examined a computer program designed to teach vocabulary that had been created more than a decade ago, and we could find no current applications of the program. The relatively small number of studies that the NRP found is certainly echoed by the research literature with deaf readers. While the use of the visual medium is well suited for students who are deaf, we must agree with the NRP that many questions remain to be addressed.

Our investigation leads us to a conclusion not unlike that of Braden (1992) when he reviewed the research literature on the intellectual assessment of deaf and hard-of-hearing individuals. He noted that the research has shown a slow rate of growth and is isolated from mainstream psychological research. He concluded, "The net effects of this journalistic isolation are that psychologists who do not read journals related to deafness and hearing disorders are unlikely to be familiar with the research, and the field of deafness is unlikely to attract high-quality psychological researchers because of the low visibility of research about deafness and hearing disorders" (p. 90). The intersection between the research literature on normally developing and struggling readers and the research literature on deaf readers apparently is slight. The result is a body of research on topics that are not in the forefront of the field of literacy and a lack of research on topics that are receiving intense attention by researchers, educators, and public policymakers.

Do the conclusions of the National Reading Panel apply to the reading development and instruction of children who are deaf? Our review indicates that in areas for which there is sufficient research on deaf readers to compare with the NRP review, the answer is yes. Are deaf readers different enough from hearing readers to suggest that there are paths worth following in the research on deaf readers that are unique to this population of students? This answer is also yes; for example, research on the use of fingerspelling and sign codes for word recognition certainly would be worth pursuing. However, in light of the research that shows greater similarities than differences between the reading processes of deaf and hearing readers, we suggest that future research with deaf readers should investigate the instructional practices found to be effective with normally achieving and disabled readers.

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## APPENDIX

### *Summary comparison of National Reading Panel and deaf literacy findings*

Reading topic areas	National Reading Panel findings	Findings for deaf readers
<b>Alphabetsics</b> Phonemic awareness	<ul style="list-style-type: none"> <li>Phonemic awareness training improves phonemic awareness and reading but not performance in other subject areas such as math.</li> <li>Phonemic awareness training improves spelling in normally achieving children but not in children identified as disabled readers.</li> <li>The most effective instruction in phonemic awareness involves focusing on one or two types of phoneme manipulations at a time, teaching within small groups of children, and using explicit and systematic methods.</li> <li>No one instructional approach is superior, and phonemic awareness instruction is just one component of a comprehensive reading program.</li> <li>Systematic phonics instruction is beneficial for children in Grades K–6 and children identified as disabled readers.</li> <li>Systematic phonics is more effective than incidental approaches or no phonics instruction.</li> <li>No one instructional approach is superior, and phonics instruction is just one component of a comprehensive reading program.</li> </ul>	<ul style="list-style-type: none"> <li>Deaf readers particularly more skilled readers, are able to access phonological information, but there is no research evidence to indicate the strength of phonological knowledge.</li> <li>Deaf readers appear to use fingerspelling and sign language as visual codes for word recognition, but there is no research evidence on the effectiveness of these codes in word recognition and no proven strategies for teaching deaf readers to use visual codes.</li> </ul>
<b>Phonics instruction</b>	<ul style="list-style-type: none"> <li>Guided repeated oral reading procedures positively influence word recognition, fluency, and comprehension in readers across the grade levels.</li> <li>Guided repeated oral reading procedures are effective with students experiencing reading difficulties, as well as with good readers.</li> <li>Independent silent reading with minimal guidance or feedback is not directly related to fluency or general reading achievement.</li> </ul>	<ul style="list-style-type: none"> <li>There is no research specifically on phonics instruction with deaf readers. Of the strategies available to readers for word recognition, research with deaf readers has focused on sight word recognition.</li> <li>Deaf readers can learn to recognize words automatically, and young readers may benefit by matching written words with signs and/or sign print.</li> </ul>
<b>Fluency</b> Guided repeated oral reading	<ul style="list-style-type: none"> <li>Guided repeated oral reading procedures positively influence word recognition, fluency, and comprehension in readers across the grade levels.</li> <li>Guided repeated oral reading procedures are effective with students experiencing reading difficulties, as well as with good readers.</li> <li>Independent silent reading with minimal guidance or feedback is not directly related to fluency or general reading achievement.</li> </ul>	<ul style="list-style-type: none"> <li>There is no research specifically on guided oral reading with deaf readers.</li> </ul>
Independent silent reading	<ul style="list-style-type: none"> <li>Independent silent reading with minimal guidance or feedback is not directly related to fluency or general reading achievement.</li> </ul>	<ul style="list-style-type: none"> <li>On the basis of findings of two studies, higher reading ability and greater time engaged in reading appear to</li> </ul>

eral improvements in reading skills, though better readers have been found to do more independent silent reading.

- Vocabulary instruction is positively related to comprehension.
- No particular instructional method or combination of methods is the most effective; more than one method should be used, incorporating both direct and indirect instruction, repetition, and rich contexts.
- Comprehension monitoring, cooperative learning, graphic and semantic organizers, story structure, question answering, question generating, and summarization are effective in improving comprehension.
- Use of these strategies in combination, flexibly and appropriately, is more effective than any one technique alone.

### *Comprehension* Vocabulary instruction

- be positively correlated with better fluency in deaf readers.
- Vocabulary is important to the reading comprehension of deaf readers.
  - Direct instruction and indirect instruction appear to improve the learning of vocabulary by deaf readers.

### Text comprehension instruction

- The deaf readers' syntactic abilities are an important factor in reading comprehension; however, simplifying the syntactic structures in reading material does not improve their comprehension.
- Background knowledge directly influences the reading comprehension of deaf readers; however, no strategy is superior in building and activating prior knowledge before reading.
- There is no conclusive evidence to indicate whether deaf readers develop knowledge of text structure more slowly than hearing readers do. No strategy is superior in teaching text structure.
- Deaf readers demonstrate weak comprehension-monitoring skills; however, no research specifically addresses improving comprehension monitoring.
- No strategy is superior for teaching deaf readers to answer and generate questions to improve comprehension.
- Instruction in mental imagery and inference making appears to improve the deaf reader's comprehension.

### *Computer technology*

- Computer technology shows promise to improve reading instruction in three areas:
  - Addition of speech to computer-presented text.
  - Use of hypertext.
  - Use of word processing software to combine reading and writing instruction.