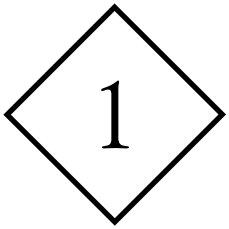
CHAPTER



COGNITION, LANGUAGE, AND READING

Preview

The title of this book indicates that its focus will be practical and centered on deaf students and instructional strategies in the area of reading. Before teaching and learning strategies for classroom use are discussed, however, the reader must first have a general understanding of the foundations of reading. To make good decisions regarding the teaching of reading, teachers must familiarize themselves with the reading process and some of the current theoretical frameworks. Without this knowledge, the reading teacher's application of strategies can be little more than trial and error.

This chapter provides an overview of some of the important information in the foundations of reading. A discussion of the relationship between cognition and language emphasizes the effect of this interaction on deaf students as they begin the process of learning to read. Next, the reader is introduced to the three major groups of reading theories, three popular models of reading, and the roles these theories and models play in instructional practice. As readers progress through the chapters of this book, they will see that almost all of the instructional strategies have their roots in one or a combination of two or more of these theories and models. The final discussion in this chapter focuses on the skills that hearing children and deaf and hard of hearing children bring to the task of learning to read and the unique challenges encountered by children with hearing losses. This section provides some insight to readers on the enormity of the task faced by deaf and hard of hearing children as they embark on their reading journey.

Introduction

Historically, deaf and hard of hearing children have experienced enormous difficulties in learning to read. Their teachers will attest to this statement; the students themselves will proclaim that this is true; and, of course, countless research reports over the past 80 years indicate that deaf and hard of hearing children typically read at levels significantly below those of their hearing peers. Why is this so? What is it about the process that makes reading such a puzzle for these students?

Obviously, a major problem for many deaf and hard of hearing students is that they are trying to learn to read and comprehend English-language text when they do not yet have mastery of the English language. Reading is regarded as a language process and is closely allied to other language processes that children experience as they acquire expressive language (speaking, signing, writing) and receptive language (listening, seeing). Reading is also a cognitive process. It involves an array of complex mental activities such as processing information, constructing meaning, and storing and retrieving information.

Language and Cognition

Attempting to define the relationship between language and cognition is very much like trying to answer the age-old question "Which comes first, the chicken or the egg?" But, however elusive, it is a worthy pursuit, as the nature of the relationship has both theoretical and practical significance, particularly for teachers of students who are deaf or hard of hearing. If cognition is dependent on language, then a language deficit would affect the development of cognition. If language is dependent on cognition, then a cognitive deficit would affect the development of language, including reading and writing. If neither is dependent on the other, then development in one area would not affect development in the other area (Paul & Quigley, 1990).

Language-Dominant Position

Several theories have been developed to try to explain the relationship of language and cognition. At one extreme is the language-dominant position characterized by Chomsky's (1968) nativist hypothesis, which proposes that

children have an innate propensity toward the development of language. Perhaps the strongest version of this position is the theory of linguistic determination (Whorf, 1956), which asserts that the language of an individual determines the thoughts of that individual, thus proposing that there is a one-to-one relationship between language and cognition and that cognition is dependent on language.

Cognitive-Dominant Position

Constructivist hypotheses can be divided into two positions; one that is strongly cognitive dominant and one that proposes a weaker cognitive-dominant position. The first hypothesis asserts that cognition provides the foundation for language development and that cognition can adequately account for children's ability to learn language (Karmiloff-Smith, 1979; J. Miller, Chapman, & Bedrisian, 1977). The weaker cognitive-dominant position maintains that although cognition is necessary for language development to occur, cognition alone cannot account for children's ability to learn language (Cromer, 1976), suggesting that both linguistic skills and cognitive skills are necessary for children to acquire language.

Correlational Position

A fourth hypothesis, the correlational hypothesis (J. Miller et al., 1977) maintains that there is a strong and fairly equal relationship between language and cognition. As individuals engage in linguistic and cognitive tasks, the developmental changes that occur in the underpinnings of both can be observed in the behaviors of the child, particularly children's performance on various Piagetian tasks during the sensorimotor stage that occurs from birth to about 18 to 24 months. In this stage the infant is beginning the process of language development as well as the process of learning how to think. According to Piaget, this stage begins when the child is able to experience objects through senses and interactions with objects, but does not yet have functional representation of them. By the end of the sensorimotor stage the child will have developed object permanence. The infant begins this stage in an undifferentiated state and progresses to one of greater separation of self and environment (Ginsburg & Opper, 1979) and by 18 to 24 months, or the end of the sensorimotor stage, the infant can conceive of objects existing independently. The end of the sensorimotor stage also marks the beginning of thought (Ginsburg & Opper, 1979). This beginning stage of development forms the transition to the next period of development in which the infant acquires the ability to use mental symbols and

words to refer to objects that are not in the immediate environment. Vygotsky (1962) argued that cognition precedes language but, in turn, is influenced by linguistic structures. According to Vygotsky, language leads to new forms of cognitive organization. In the early developmental years, Vygotsky's and Piaget's accounts are similar. The development of language is first influenced by cognition, and later, cognition is influenced by linguistic structures.

Existing evidence does not entirely support any one of the four hypotheses. Although each hypothesis suggests that both language and cognition play important roles in language-development theories, the degree and extent are not yet known. Continued study and investigations are needed to bring about an adequate understanding of the relationship between language and cognition.

Cognitive Functioning in Deaf and Hearing People

In the past, a popular research question was whether deaf children and hearing children develop similarly in their cognitive functioning, both quantitatively and qualitatively. According to Paul and Quigley (1990), from the early part of the century to the present, there have been three successive perspectives regarding the effects of delayed language development on the intelligence of deaf individuals: (a) deaf people are cognitively inferior; (b) deaf people learn through concrete rather than abstract experiences; and (c) deaf people are cognitively normal. The subjects in the studies leading to these conclusions had hearing losses ranging from moderate to profound; thus, the word *deaf* referred to individuals with moderate to profound hearing losses (Quigley & Kretschmer, 1982).

Until the 1970s, most professionals in the field based their opinions on the language-dominant hypothesis, particularly linguistic determination. Both Pintner (1918) and Myklebust (1964) believed that language deficiencies contributed to intellectual lag in deaf individuals. Myklebust argued that deaf people have difficulty understanding abstract concepts and that they perceive the world differently from hearing people.

The researchers who believed that deaf individuals were intellectually normal (Furth, 1966, 1973; Levine, 1976) disagreed with the dominant role of language in the development of cognition. Furth (1971) argued that Piaget's theory supported the development of normal intellectual abilities in deaf children. Indeed, the current view is that the range of intelligence for hearing and deaf individuals is similar. Paul and Quigley (1990) stated that a better understanding of the relationship of language and cognition in deaf and hard of hearing children requires the study of subgroups according to levels of language development, spoken and signed. They also suggested that the development of language "requires instruction in both language (e.g., vocabulary and syntax) and cognition (e.g., inferencing and reasoning skills)" (Paul & Quigley, 1990, p. 74).

Marschark (1993) observed that many of the early investigations examining the academic or intellectual functioning of deaf children found they demonstrated a significant lag when compared to their hearing peers. However, many of the tests were developed and normed on hearing children and required comprehension of English. More recently, many of the tests in use are nonverbal or administered through sign language. Nevertheless, the issues of language development in deaf children and the content and format of such testing remain problematic (Braden, 2001). Research focusing on specific aspects of cognitive development, such as classification and concept learning, also have resulted in confusing and contradictory findings. When using nonverbal paradigms, the performances of deaf and hearing children on these tasks appeared to be similar; however, other investigation results indicated that significant differences remain (Marschark, 2001). Children who have been educated in oral environments and those exposed primarily to sign language have both demonstrated delays in these cognitive areas.

Early access to language is essential for normal cognitive development and academic success in both deaf and hearing children (Calderon & Greenberg, 1997). Marschark and Clark (1998, p. 289) stated, "Social constructivist theory suggests that, to the extent that language is involved in verbal thought, limitations in language ability have a negative impact on verbal thinking and problem solving." Bebko and McKinnon (1998) found that the number of years that deaf children were exposed to language in an accessible modality accounted for the differences in memory for language at different ages. The total number of years of experience with language was not as good a predictor. The reason for this finding is likely that most deaf children have hearing parents who, at least initially, cannot communicate effectively with them. Therefore, in their early, critical language-learning years, they are exposed to language that is only minimally accessible to them.

Bebko and Metcalfe-Haggert (1997) found that the contribution of developing automatized language skills (e.g., automatized word meanings) is an essential contributing factor to the development of other complex cognitive abilities. Marschark (2001, p. 32) summarized this information, stating that "taken together, such findings emphasize the need for care in evaluating language development, cognitive growth, and academic performance while recognizing that they are rarely independent."

Information Processing

Information processing refers to the ability of the mind to perform tasks such as remembering and comprehending. A general model of information processing

explains how information is encoded, stored, and retrieved, and consists of three mental structures: sensory storage, short-term memory, and long-term memory.

Sensory Storage

In the first stage of information processing, the sensory storage takes in new, unanalyzed information for a very short period of time, which is, however, sufficient for other mental structures to do more extensive processing. Much of the information that is not relevant to the individual's needs disappears, and that which is relevant moves into short-term memory.

Short-Term Memory

Short-term memory (STM), or working memory, is the second stage and provides important temporary storage for the information that the person is currently processing. To solve simple and complex problems, a certain amount of information must remain in the working memory. However, the working memory has a limited capacity; it can store only five to nine items. STM is critical for facilitating the flow of information into long-term memory, where it can be stored and retrieved for later use. STM has been extensively researched for both hearing and deaf and hard of hearing children and results indicate that it is critical in the reading process.

Blair (1957) conducted the first major comparative study on the short-term memory processes of deaf and hearing children. The study compared the ability of the children to remember items presented sequentially and simultaneously (i.e., two or more items presented at a time). The scores on these tasks were related to the reading achievement levels of the children. The results indicated that the scores of the deaf children were lower than those of the hearing children on sequential memory tasks, but there were no differences in the scores of the two groups on the simultaneous memory tasks. Blair concluded that (a) the auditory memory ability of deaf children was inferior to that of hearing children, and (b) auditory memory ability was related to reading ability. Since Blair's study, several other investigations have produced similar conclusions (Greenberg & Kusche, 1989; Hanson, 1990; Rodda & Grove, 1987).

Short-term memory plays an important role in the development of language and reading skills. To understand this relationship, it is important to be familiar with the results of studies that have attempted to determine the mode(s) deaf individuals use for thinking and memorizing.

When reading, hearing individuals convert, or recode, the printed word into phonological forms for storage in STM. Several interesting research

investigations have attempted to determine the form of information held in the short-term memory of deaf individuals. The data from these investigations indicate that many individuals with severe to profound hearing losses use a non-speech-based recoding strategy such as sign, visual or graphemic (print) information, or fingerspelling (Bench, 1992; Greenberg & Kusche, 1989; Martin, 1985; S. Quigley & Kretschmer, 1982). The individuals in the studies exhibited a great deal of variability in the recoding strategies used, and frequently used more than one strategy, especially during reading.

The findings of these investigations on recoding strategies used by deaf individuals in their internal mediating systems have a significant impact on the individuals' reading effectiveness. The mediating system of good readers who hear is predominantly speech based; that is, the reader recodes printed words into their phonological equivalents to access meanings (Gough, 1985). In addition, it is thought that a speech-based internal mediating system plays an important role in the processing of syntactic structures and in developing inferential and metacognitive skills for connected reading (Paul & Quigley, 1990). It is interesting to note that a few investigations have found that some severely to profoundly deaf students also predominantly use a speech-based code (Conrad, 1979; Hanson, 1985; Hanson & Fowler, 1987; Lichtenstein, 1984; Rodda & Grove, 1987). These investigations also indicate that deaf students who predominantly use a speech-based code are better readers than those students who primarily use nonspeech codes. It seems that speech recoders are able to retain more language information such as words and syntax in their short-term memories, enabling them to comprehend the meaning of sentences, particularly the underlying semantic relationships among the words in sentences. This ability allows the speech recoders not only to comprehend sentences written in literal word order in which the surface structure reveals the meaning (e.g., The cat drank the milk), but also to comprehend sentences with hierarchical structures in which the meaning is revealed in the underlying deep structure rather than in the surface structure (e.g., The girl who beats Nori will win the race).

Lichtenstein (1998) conducted another research investigation of the relationships between recoding processes in working memory and English-language skills in a sample of 86 prelingually deaf college students. The results suggested that the speech, sign, or visual codes used by the deaf students were not as efficient as the speech code used by hearing persons for the purpose of maintaining English linguistic information in working memory. His findings also indicated that the ability to use speech-based recoding processes was positively correlated with working-memory capacity, and the use of sign recoding decreased as the ability to make use of speech recoding increased. Additional findings suggested that neither the speech nor sign recoding systems provided

the majority of deaf students with internal representation of linguistic information that was as complete as that received by hearing students. These results support those found by several other investigators (e.g., Belmont & Karchmer, 1978; Blair, 1957; Wallace & Corballis, 1973), which indicated that when tested on different types of linguistic materials, the memory span of deaf individuals is shorter than that of hearing persons. Interestingly, this finding of a limited working-memory capacity applied not only to English materials but also to signed materials (Bellugi, Klima, & Siple, 1975; Hanson, 1982; Kyle, 1980). These findings led the investigators to suggest that the difference in working-memory capacity in deaf individuals may not be due to the use of unfamiliar materials; rather, it appears to be related to cognitive processes involved in the coding of linguistic materials. The information from these investigations becomes quite significant in light of the fact that several investigators have found positive correlations between STM capacity and reading and writing abilities (e.g., Blair, 1957; Carey & Blake, 1974; Garrison, Long, & Dowaliby, 1997; Hartung, 1970; Lake, 1980; Watson, Sullivan, Moeller, & Jensen, 1982). Contemporary thinking and research evidence indicate that working memory is a dynamic, multifunction mechanism (Baddely, 1986; Garrison et al., 1997; LaBerge & Samuels, 1974). Garrison et al. suggested that working memory must maintain just-read information simultaneously with the processing of previously read information for the message of the text to be understood. They indicated that the success with which this effort is accomplished depends on how attentional resources are distributed between storage and processing requirements.

L. P. Kelly (2003) speculated that deaf readers who use a strategy less enduring than speech recoding for sustaining the contents of working memory are more likely to lose words in a sentence before their combined meaning can be constructed and stored in long-term memory. However, two interesting questions remain unanswered: (1) What is the nature of the speech-based representations? (2) How did the deaf students develop those representations (Leybaert, 1993; Paul, 1992)?

Working-memory capacity appears to play a significant role in the reading process. Daneman, Nemeth, Stainton, and Huelsmann (1995) conducted a study investigating whether working-memory capacity could account for individual differences in the reading achievement of deaf and hard of hearing children. They used three tests to assess the processing and storage capacity of working memory and found that all three measures were good predictors of reading achievement in a group of orally educated 5–14-year-old deaf and hard of hearing children. In fact, working-memory capacity was a better predictor of reading achievement than was the degree of hearing loss, even though the sample included children with hearing losses ranging from mild (27–40 dB) to profound (91+ dB).

Long-Term Memory

Long-term memory (LTM) is the third stage in information processing and contains a person's knowledge of the world. This stored knowledge (prior knowledge) is activated to interpret new experiences and knowledge, relate them to what is already known, and incorporate them into the already existing storehouses of information in long-term memory. This process of relating new information to that which is already known facilitates understanding.

Two types of long-term memory are episodic and semantic (Rumelhart, 1977). Episodic memory stores information that is related to a specific event, such as what a person did last year on the Fourth of July, or what a person ate for breakfast yesterday. Thus, episodic memory is different for each individual. The second type of memory is semantic memory, which contains general organized classes of knowledge. Carroll (1986, p. 47) gave examples of some of these classes, such as "motor skills (typing, swimming, bicycling), general knowledge (grammar, arithmetic), spatial knowledge (the spatial layout of your room or house), and social skills (how to begin and end conversations, rules for self-disclosure)." Episodic and semantic memory interact during the processing of information.

Investigations into the nature of long-term memory have mostly been concerned with the transfer of information from short-term memory and information retrieval in performing cognitive tasks such as answering questions and making inferences. The purpose of this research is to present a comprehensive model of knowledge that will account for what we know, how we know it, and where this knowledge is stored in the brain (Paul & Quigley, 1990).

Sachs (1967) and, subsequently, other researchers (Carroll, 1986; Rodda, Cumming, & Fewer, 1993) found that when subjects were asked to repeat a sentence after a short delay from when the stimulus was given, they did not remember the surface structure of the sentence, but were able to convey an accurate meaning of the sentence. Hanson and Bellugi (1982) reported similar results in an investigation with deaf individuals in which the stimuli were presented in American Sign Language (ASL). These results seem to indicate that the long-term memories of both hearing and deaf individuals are semantically based, but it does not necessarily indicate that the encoding processes and storage of knowledge in the brain are also similar. If, as it appears, deaf individuals tend to process and store information visually and spatially in short- and long-term memories, and hearing people tend to process and store information auditorially and temporally, then it would seem likely that storage occurs in different hemispheres of the brain for these two groups of individuals. Paul and Quigley (1990) suggested that if environmental factors such as language and communication environments (sign versus spoken language, ASL versus English) influence hemispheric specialization, then the result may be differences in

hemispheric development and processing in deaf and hearing people. It should be noted, however, that individuals with severe to profound hearing losses have been exposed to a variety of language and communication environments and are not a homogenous group in relation to hemispheric processing and storage; hence, no definitive conclusions can be made regarding hemispheric development and processing (Paul & Quigley, 1990; Wilbur, 1987).

Ursula Bellugi, in her work at the Salk Institute, has been studying the effects of stroke and brain injury on deaf signers since the 1980s. She was motivated by studies with hearing subjects who had brain lesions that indicated that visual–spatial processing occurred in the right hemisphere of the brain, and linguistic processing occurred in the left hemisphere. She was intrigued to know how the brain would handle a language that is also visual and spatial. In her studies she discovered that it was only with left-hemisphere damage that sign-language aphasia occurred, leading her to conclude that "the left hemisphere has an innate predisposition for language—whatever the mode of expression" (Dressler, 1997, p. 7). Bellugi and other researchers have conducted additional investigations into the functions of the left and right hemispheres of the brain and have reached the same conclusions as Bellugi did in her earlier studies; that is, that language is processed in the left hemisphere regardless of whether it is visual or auditory in mode (Emmorey, 2002; Emmorey, Damasio et al., 2002; Emmorey, Grabowski et al., 2003).

Reading Theories

Three major groups of reading theories have been developed to attempt to explain the reading process. Each group of theories differs in the strategies believed to be used by children as they engage in the process of gaining meaning from printed text.

Bottom-Up Theories

Bottom-up theories (Gough, 1972; LaBerge & Samuels, 1974) are text-driven theories in which the major focus is on the text material as the predominant factor used by children to derive meaning from text. The elements of text that are emphasized are letters, words, phrases, and sentences. Bottom-up theorists believe that these elements are integrated from smaller to larger units to arrive at meaning. Instruction based on these theories emphasizes decoding skills and the teaching of comprehension subskills, usually in some kind of sequential, hierarchical order (King & Quigley, 1985).

Top-Down Theories

Top-down theorists such as F. Smith (1988) and K. Goodman (1970) proposed that prior knowledge and its interaction with the processing of text is a more valid explanation of the reading process. They maintain that skilled readers construct meaning from text using only the most productive and time-efficient cues (K. Goodman & Gollasch, 1980). These theorists argue that skilled readers rely as little as possible on graphemic details and use prior knowledge and context as they strive for comprehension. Thus, instruction based on these theories deemphasizes the teaching of decoding skills and comprehension subskills and focuses instead on activities that will enable students to develop, activate, and apply prior knowledge to a text to effect comprehension.

Interactive Theories

In recent years, interactive theories have been replacing the bottom-up and top-down groups of theories of the reading process. Interactive theories emphasize that the reader is an active processor of information and strives to construct meaning from the text (R. C. Anderson, 1981). Two important premises of interactive theories state that (a) prior knowledge plays a central role in constructing meaning from text, and (b) readers develop and apply a large repertoire of processing strategies ranging from strategies for decoding print to complex metacognitive strategies. Interactive theorists maintain that the bottom-up and top-down theories fail to recognize that even very young children bring a large body of prior experiences to the task of reading and that skilled readers also use extensive graphemic knowledge and skills in their search for meaning. Skilled readers generally use a combination of these strategies, depending on their comprehension needs. One group of interactive theories, schema theories, uses the concept of schemata as an organizing framework for prior knowledge. This concept of schemata provides a powerful tool for organizing knowledge; such ability to organize knowledge aids in its acquisition, storage, and retrieval, thus facilitating comprehension of text.

Reading and Cognition

Reading is not only a language function, it is also a cognitive function. Cognition refers to the acquisition and construction of knowledge and, of course, the act of thinking. When processing text, students are applying thinking skills

that enable them to build their model of meaning as they read. Constructing meaning from the printed word requires a variety of cognitive processing strategies that will differ with the nature of the reading task and with individual differences in selecting and applying problem-solving strategies.

Schema Theory and the Reading Process

One cognitive model of reading is the concept of schemata and their role in the reading process as described by schema theories. Schemata is the term used by cognitive scientists to describe the structure people use to organize and store information in their memories.

The Nature of Schemata

A basic premise of schema theory is that human memory is organized semantically—that is, memory is organized more like a thesaurus than a dictionary. An individual can possess schemata for all kinds of things, ranging from simple objects, such as a car and a ball; to abstract entities, such as love and friendship; to complex events, such as a wedding or a basketball game (B. M. Taylor, Harris, & Pearson, 1988).

Schema activation is the mechanism by which readers access what they know and match it to the information in a text. In doing that, readers build on the meaning they already have and add to the information that is stored in the activated schemata. Rumelhart (1980) referred to schemata as "the building blocks of cognition" because they represent elaborate networks of information that people use to make sense of new information and events.

Schemata play a critical role in reading comprehension and learning. When readers can match their prior knowledge with the text, schema functions in at least three ways (Vacca & Vacca, 1996). First, it functions as a framework for learning that allows readers to seek and select information that fits with their purposes for reading. As they seek and select, readers are more likely to make inferences, that is, to anticipate content, make predictions, and fill in gaps in the material during reading. Second, schema helps readers to organize text information. The process of integrating new information into old information helps the reader to retain and remember. Third, schema helps readers to elaborate information. Vacca and Vacca (1996) suggested that when readers elaborate on what they have read, they engage in a cognitive process that involves critical thinking skills such as judgment and evaluation.

Selecting Schema

The process through which a reader determines what schema or schemata to select to comprehend material being read is complex and involves a great deal

of inferring. Sometimes an author is quite informative and "sets the stage" for the reader with an opening statement such as, "This story is a murder mystery about the dark secrets of a small midwestern village." However, more frequently the reader has to rely on subtle clues and form hypotheses to begin to figure out what a story is about. B. M. Taylor, Harris, Pearson, & Garcia (1995) stated that often the reader must make great "inferential leaps" just to determine the nature of the text.

Once the reader has formed what seems to be a valid hypothesis about the overall nature of a story, the next task becomes one of filling slots, another task that requires inference. For example, if the story is a murder mystery, the reader knows from prior knowledge and appropriate schema selection that among the characters in the story will be one who is the protagonist and one who is the antagonist. When people read, they search for clues that will indicate the roles of the characters. As they gain more information about the traits of the characters in the story, they fill, at least temporarily, the various slots in their schema of "mystery story." As they continue reading and gaining more information, they may change the characters they have put into certain slots. Readers are constantly altering hypotheses, filling slots, and building meaning during the process of comprehending. These strategies that occur during the act of reading take place through inference. Inference is an essential part of schema selection and slot filling; in the process of working one's way through a text, tens, hundreds, even thousands of inferences are necessary (B. M. Taylor, Harris, Pearson, & Garcia, 1995).

Changing Schema

Learning necessitates a change of some kind in a schema. A common kind of learning-within-schema theory is what Rumelhart (1980) calls *accretion*. The idea of accretion is similar to Piaget's (1952) concept of assimilation and to F. Smith's (1975) notion of comprehension. Accretion occurs when an individual experiences an example of an existing schema and the slot filling that occurs is committed to long-term memory. This process is what allows a person to recall specific circumstances from an experience, for example, a particular trip to a favorite park. Although learning usually alters the structure of a schema, accretion does not; it merely fills some of the slots with new information.

A second kind of learning is fine tuning (B. M. Taylor, Harris, Pearson, & Garcia, 1995). The notion of fine tuning would be included in Piaget's idea of accommodation and in what Smith calls learning. Through the process of fine tuning, the reader modifies the components of schemata in important ways; new variable slots may be added or changed. For example, a reader who has encountered only male villains in mystery stories might have a variable constraint

that villains must be male. When a female villain is encountered, this variable slot must be modified to include females.

The third kind of learning is called *restructuring*, and occurs when an old schema is replaced with a new schema necessary to accommodate existing and new information. Restructuring occurs continually in daily life; for example, very young children may label all four-legged animals as dogs; but as they gain new information, they develop new, specialized schemata for cats, horses, and cows. There are two aspects of restructuring: schema specialization and schema generalization. The previous example is an example of schema specialization, that is, an instance in which several new schema are needed to replace a single old schema. Schema generalization occurs when the learner realizes that several subschemata share some common variable slots and can be seen as components of the same schema; for example, myths and fables are both stories.

Two strategies that readers use to control their schemata during reading are top-down processing and bottom-up processing (B. M. Taylor, Harris, Pearson, & Garcia, 1995). When readers apply top-down processing, they are usually actively engaged in the reading task, are generating hypotheses, and are applying new information from the text to already existing schemata. The match or lack of a match between the new information and prior knowledge determines whether a hypothesis is confirmed or disconfirmed, in which case it must be modified.

Sometimes readers are more passive and engage in bottom-up processing. In that case, the reader decides to wait before forming an opinion or making a judgment and reads on for more information before drawing any conclusions. This kind of processing frequently occurs when a reader first encounters a text, when a hypothesis has been disconfirmed, or when the reader simply is not understanding what the author is trying to convey. When readers are using bottom-up processing, they seem to be trying to operate within the author's schemata; when they are using top-down processing, they are operating within their own schemata. Skilled readers shift back and forth constantly between the two processing strategies in their attempts to comprehend text.

Using Schema Theory in Instructional Decisions

Schema theory not only offers a plausible explanation for at least some parts of the reading process, it also provides an explanation for some of the problems students exhibit when they fail to comprehend. Pearson and Spiro (1980) found five kinds of problems that students exhibit can be explained within the framework of schema theory.

Schema Availability

If students are reading a selection on a topic about which they do not have a well-developed schema, they will have difficulty understanding the text. In, fact, Johnston (1981) and Johnston and Pearson (1982) determined that prior knowledge explains individual differences in comprehension better than measured reading ability does. To assess the extent of students' prior knowledge of a particular topic, several instructional strategies can be used. A simple instructional strategy called *semantic mapping* is one of these strategies. It can also be used for remediation to enable students to develop a more complete schema (see Chapter 8).

Schema Selection

Some students have the prior knowledge but fail to activate it and to apply what they already know to the material they are reading. These students frequently rely too much on bottom-up processing and do not realize which of their schemata can be used to comprehend the text. In fact, many times students who fail to activate and apply prior knowledge fail to do so because they do not understand that they are allowed to use anything other than what is in the text to help them understand. Any prereading teaching strategy, such as semantic mapping, that focuses on appropriate schemata should help these students become more active processors of text.

Schema Maintenance

A reader may have available and select a schema for comprehending a passage but fail to maintain that schema through the reading, thus exhibiting a schema maintenance problem. One possible reason this happens is that readers rely too much on bottom-up processing and direct all their attention to decoding strategies, thus leaving little cognitive capacity for the integrative thinking that is necessary for comprehension (B. M. Taylor, Harris, Pearson, & Garcia, 1995). Another possible reason is that the text does not make clear how different ideas should be connected; this is more a problem for poor than for skilled readers. Skilled readers seem more able to create connections when none are offered by the author. No investigations have focused on which instructional strategies to use when students display problems with schema maintenance. B. M. Taylor, Harris, and Pearson (1988) suggested that helping students develop schemata for the ways in which stories and expository text are organized may help overcome the problems of schema maintenance.

Overreliance on Bottom-Up Processing

Readers who rely too much on bottom-up processing will make reading errors because they are attending too much to graphic features and not enough to semantic concerns. They also tend to give verbatim answers from the text when inferences should be made and prior knowledge applied. Helping students change this reading strategy is not easy. Basically, they need to learn that reading should make sense and that comprehending often requires going beyond the text.

To help students focus on the idea that reading should make sense, strategies such as anomaly detection techniques can be used. Students are given texts that contain anomalous words, phrases, or sentences, and they must delete the parts that do not make sense. To do this, they must have a good idea of what the text is about. Helping students understand that they can go beyond the text is more difficult, but strategies such as teacher modeling may help. In the strategy called *Teacher Think-Alouds* (see Chapter 8), the teacher reads passages to the students, modeling the comprehension process by explaining how he or she constructs meaning from the printed word. Another strategy that may help is the strategy known as *question–answer relationships* (QAR), which is also discussed in Chapter 8.

Overreliance on Top-Down Processing

Sometimes students rely too much on top-down (schema-based) processing, which may lead to errors that are semantically appropriate. Students' answers to questions may seem sensible but reflect a cursory or careless reading. Although a cursory reading (skimming) may be appropriate for some kinds of text, it is not appropriate if understanding details is important, such as in reading science text, directions, and poetry.

This question-answering behavior is similar to that of students who rely too much on bottom-up processing; the students need to develop an understanding that good answers to questions may come from within or outside the text. In the case of overreliance on top-down processing, the students must realize that good answers can also come from within the text. Having students supply answers to questions and then noting the pages and paragraphs where answers can be found may help to channel them toward more frequent use of this resource. For the careless reading problem, students can be given fill-in-the-blank exercises in which all answers are semantically correct (e.g., smiled, giggled, guffawed) but only one conveys the appropriate connotations for the sentence (The little girl was so happy to see her new puppy that she _____ with delight.).

Simultaneous and Successive Cognitive Processing

Simultaneous and successive cognitive processing is one model of dichotomous thinking that refers to how students solve problems, recognizing and restructuring information in a problem-solving situation such as reading (Walker, 1996). When students read, they vary their cognitive-processing techniques depending on the nature of the reading task. For example, when determining a main idea from a text, readers organize the important topics (successive processing) while forming relationships among the topics (simultaneous processing). When reading requires a step-by-step analysis of a text, as in determining the sequence of events, readers use successive processing and sequentially order the information to solve the problem. When reading requires the analysis of several ideas at the same time, as in predicting the author's purpose and interpreting character motives, readers use simultaneous processing; they relate ideas according to a general category to solve the problem.

Students who have a preference for simultaneous processing of information tend to think about the multiple relationships among ideas, relating the most important characteristics (Kaufman & Kaufman, 1983). Such readers build their models of meaning using large, inclusive categories of meaning. This type of cognitive processing frequently precludes careful analysis of text. *Simultaneous strength* means that the student thinks first about the overall meaning and then organizes the parts as they relate to the entire meaning (Walker, 1996). This type of cognitive processing seems to fit with top-down strategies.

Students who have a successive preference for processing information tend to develop models of meaning by arranging information in a logical, hierarchical sequence (Kaufman & Kaufman, 1983). They develop their model of meaning from precise words and look for the logical organization of the text to gain meaning. After reading a text, they can usually sequence the events but cannot tie the events together to form the main idea. A propensity for this type of cognitive processing frequently precludes using the overall meaning of the text to decode words, resulting in a reader who is word bound. Successive strength means that the student thinks about the parts first and then orders the parts to form the general meaning (Walker, 1996). This type of cognitive processing seems to fit with bottom-up strategies.

Effective readers do not operate exclusively in either a successive or a simultaneous processing mode, but flexibly and fluently shift between the two to construct a model of meaning. They incorporate both a successive analysis of textual elements and a simultaneous connecting of textual and nontextual information to comprehend what they are reading. The teacher, when selecting instructional strategies, should be aware of the student's preferences for cognitive processing. The teacher should select techniques that will encourage the student to use areas of weakness that interfere with comprehension, as well as

strategies that will utilize the student's strengths. It is clear that teachers cannot focus on a few favorite teaching techniques but must employ a variety of strategies; they must identify the key features of the strategies and determine how those features affect the reading process and meet the individual needs of the readers. It is unclear at this time how these two approaches interact for deaf and hard of hearing readers. It is also unclear whether skills in one approach can compensate for weaknesses in the other (P. M. Brown & Brewer, 1996).

Models of Reading

Teachers need to know what is currently understood about reading and reading comprehension to assess students' reading processes. Without an understanding of how good readers process and comprehend text, it is impossible to identify a reading problem or a potential area of development. A solid knowledge of the reading process is also a prerequisite for deciding what to do instructionally once a reading problem is identified.

Three popular models of the reading process have influenced current thinking about how the reading process develops and how it operates. These models represent the most important influences on reading practices, and on the whole-language movement especially, over the last 25 years (L. Rhodes & Shanklin, 1993).

Transactional Model

Rosenblatt (1978) believed that readers bring to text all of their personal experiences and cultural learnings. The text is a black-and-white graphic display created by the author. The transaction that occurs between the reader and the text produces meaning, but this meaning is not the same for every reader because each reader brings different personal and cultural experiences to bear on the interpretation of the text. Consequently, readers may interpret the same text in different ways depending on their background knowledge. These interpretations are each equally valid, and what constitutes *knowledge* then is socially constructed among readers in a group (L. Rhodes & Shanklin, 1993).

Teachers frequently choose reading activities that exploit the social nature of the reading and learning processes. These activities include shared book experiences, literature discussion groups, partner reading, and dialogue journals. In all of these situations, the reader is clearly reading and performing transactions in a social context. They are sharing the act of reading with other readers,

thereby providing opportunities for all participants to learn more about reading and to increase their knowledge through active participation in transactions with other readers. In such social contexts, readers provide demonstrations to each other of the strategies they use during the reading process, the personal perspectives they apply to their reading, and the ways in which they respond to and connect with text (L. Rhodes & Shanklin, 1993). These shared experiences offer opportunities for readers to create and confirm shared meanings of the text as they work with one another to clarify what they have read and understood.

Psycholinguistic Model

A psycholinguistic perspective of reading combines an understanding of how language works and an understanding of the psychology of the reading process. Psycholinguistic inquiries into the reading process suggest that readers act on and interact with written language in an effort to construct meaning from text (Vacca, Vacca, Gove, Burkey, Lenhart, & McKeon, 2003). When reading, in order to construct meaning, the reader coordinates information cues from three distinct systems of language: the graphophonemic, the syntactic, and the semantic.

In the graphophonemic system, print, (the graphic symbols which represent speech sounds) is a major source of information for the reader. Experienced readers acquire enough knowledge of the letter–sound associations that they do not have to use all of the graphic information in a word to decode or recognize it (Vacca, Vacca, Gove et al., 2003).

In the syntactic system, readers who understand how language works get information from the grammatical relationships within the sentence patterns. They use their knowledge of the arrangement of words in sentences to construct meaning from the text. They also use syntactic information to anticipate the word or phrase that will come next because of its grammatical relationship to other words in the sentence. For example, in the sentence "I saw a pretty _____.", the reader would probably fill in the blank with a noun because they intuitively know how language works and that a noun usually follows an adjective (Vacca, Vacca, Gove et al., 2003).

The semantic system is the storehouse of information in the schemata networks of long-term memory. It is this storehouse of information, or prior knowledge, that readers apply to text in order to construct meaning.

The psycholinguistic model of reading (K. Goodman, 1984, 1989) developed from Goodman's interest in analyzing the errors that readers make. He maintained that readers were bound to make errors because they were continually anticipating meaning from the coordination of cues from the three

language systems when reading. He looked specifically for evidence of an interrelated use of the three language cuing systems—semantics, syntax, and graphophonemics. Goodman believed that studying these errors, or miscues, provided the investigator with windows to the cognitive processing that occurs during reading. He maintains that miscues are natural to the reading process and that by monitoring for meaning, readers can then make corrections. Goodman views reading as a process in which readers are constantly searching for meaning. The reading process requires that readers make predictions, confirm or disconfirm those predictions while reading, and integrate text information with their background knowledge to construct appropriate meanings from the text.

Socio-Psycholinguistic Model

F. Smith's (1988) socio-psycholinguistic model of reading incorporates some of the important premises of schema theory. He argues that the more background knowledge (nonvisual information) a reader can apply to the reading situation, the easier the reading will be and the more likely the reader will comprehend and retain information. He also argues against phonics as the key to reading, pointing out that there are 166 different phonics rules to explain English pronunciation. He maintains that it would be virtually impossible for beginning readers to memorize all of those rules and to figure out when and when not to apply them. Furthermore, he argues that although many adults can articulate some phonics rules, they cannot articulate all 166 rules; yet they can still read. Therefore, something in addition to decoding has to occur for the reader to be successful.

One of F. Smith's most important contributions to models of reading has been his rethinking of how short-term memory and long-term memory relate to the reading process. Smith demonstrated that the short-term memory could take in and retain three to seven bits of information each second. Although the number of bits of information does not vary a great deal, the actual amount of information processed depends on the makeup of each bit. F. Smith found that readers took in fewer than 10 random letters in a section, but if those letters are organized into words, readers take in more letters because the brain can then process meaningful units. Subsequently, if the words are organized into phrases or sentences, still more letters can be processed because they are arranged in meaningful syntactic units.

F. Smith (1988) presented a diagram of how he perceives short-term and long-term memory working (see Figure 1.1). His diagram indicates that short-term memory exists within long-term memory. One important feature to note is that Smith suggested that although the STM processes incoming informa-

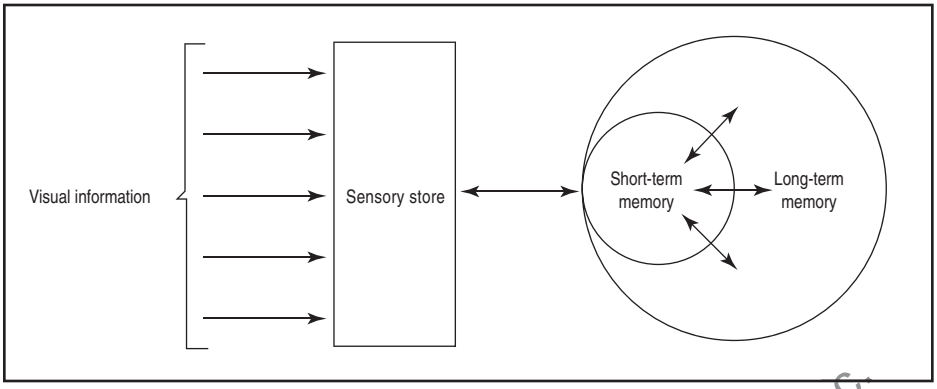


Figure 1.1. STM/LTM model. From *Windows into Literacy: Assessing Learners, K–8*, by L. Rhodes and N. Shanklin, 1993, Portsmouth, NH: Heinemann. Copyright 1993 by Frank Smith. Reprinted with permission.

tion into meaningful units, it is the LTM that guides and suggests the nature of those meaningful units. When the STM becomes overloaded, it cannot process information; hence, bits of information never get moved into long-term memory, where they can be stored and retrieved for later use. This phenomenon happens frequently when students do not have enough prior knowledge (or well-developed schemata) to apply to the text; hence, automaticity is obstructed, and the reader must spend time and assert cognitive energies toward figuring out meaning (L. Rhodes & Shanklin, 1993). This delay allows information to "drop out" of STM without ever reaching LTM; as a result, such information is not processed by the reader for comprehension.

This hypothesis, when applied to deaf and hard of hearing children engaged in the reading process, explains a great deal of the difficulty experienced by this population in the act of comprehending. Deaf and hard of hearing children frequently do not have adequate prior knowledge, or at least do not have adequate prior knowledge that has been linked to language, resulting in schemata that are not well developed or are not developed at all. In addition to lacking well-developed schemata, these children usually do not have a mastery of the English language, which creates additional overload on the short-term memory as it attempts to process incoming language into meaningful units. If, as F. Smith suggested, the STM cannot process information when it is overloaded and begins to lose bits of information, then it is not surprising that deaf and hard of hearing students have difficulties in comprehending English text. It is probably safe to assume that some or much of the information needed to construct meaning from text never reaches the LTM, where it can be processed for comprehension, stored, retrieved, and applied.

F. Smith (1988) also discussed the social nature of reading and his concept of learning to read through demonstration, engagement, and sensitivity. He suggested that parents, teachers, and peers are literacy models for children and demonstrate to them what reading is and what the strategies are for doing it. Through these demonstrations, the literacy models also demonstrate the social aspects of reading and learning to read. Engagement is the amount of time actually spent in a literacy task. Engagement can occur with one student alone, or it can involve others and thus become a social event. When it is social, some students will engage for longer periods of time and be more successful because they are assisting each other (L. Rhodes & Shanklin, 1993). Sensitivity refers to the extent to which the learner expects to learn. Sensitivity is also social, in that others can greatly encourage or discourage the act of reading. Smith states that these three terms can be defined separately, but they are best understood as acting together in real social contexts.

Although there are some differences in these models, they are more similar than not. All of the models view reading as a constructive cognitive process and the reader as an active participant in the act of reading. They all reject the notion of a reader as a passive receptor of visual information acquired from moving the eyes back and forth across a page of print. All recognize that readers bring to the task of reading their prior knowledge, which is organized into mental structures called schemata. The nature of such schemata greatly influences the reader's ability to read and comprehend passages. And all of the models recognize the importance of sociological variables in almost all reading contexts.

Reading and Hearing Children

Reading is a complex skill composed of many components. Hearing children, when they begin the task of learning to read, are already familiar with many of these essential parts. In the first 5 or 6 years of their lives, they have developed a substantial vocabulary and have mastered most of the major syntactic structures of the English language (King & Quigley, 1985). They bring to the reading task a rich background of experiential knowledge with which they have developed various schemata, enabling them to manipulate prior knowledge and understand current information. King and Quigley stated that prereading hearing children generally have the strategies to link textual information, which indicates that they have already developed some inferential and figurative language skills that are critical to the comprehension process.

In summary, hearing children bring the following to the task of learning to read: a substantial vocabulary, experiential knowledge, a wide variety of devel-

oping schemata, cognitive development, linguistic competence in the English language, inference skills, and skills in figurative language. All of these attributes involve higher-order thinking skills and are complex components of the reading process. What hearing children do not bring to the task of learning to read is a repertoire of decoding skills; thus, a large part of a kindergartner's and first grader's reading instruction is devoted to the acquisition of those skills.

Figurative Language

Figurative expressions are elements of language that add interest and color to the message being communicated; at the same time, they are complex components of language that frequently confuse young readers. Some examples of figurative language include figures of speech such as similes (*She is as busy as a bee*), metaphors (*He's an old bear*), and onomatopoeia (*The constant varoom of the jets overhead*). Another form of figurative language is idiomatic language, including such examples as *You put your foot in your mouth; I looked over your report last night;* and *That noise drives me up a tree.*

Few investigations have been conducted on figurative language, probably because of the complex interactions of its components. For example, figurative language can involve interactions of grammar (syntax), meaning (semantics including vocabulary), and function (pragmatics) (Paul & Quigley, 1990). It should also be noted that geographical and cultural differences in figurative and idiomatic expressions influence the comprehension of those expressions by readers.

Inference

Inference is essential to reading comprehension once the reader moves beyond literal text material, which is at about the third-grade level (King & Quigley, 1985). R. C. Anderson (1981) discussed a functional, four-level classification of inferences that should be beneficial to reading teachers for organizing instruction. The first level is lexically based: inferencing depends a great deal on the reader's knowledge of language; understanding inferences is relatively independent of the particular context in which the lexical items occur. For example, in the sentence *She was so petite that she had difficulty buying appropriate clothes,* the reader must have some knowledge of the word *petite* to infer that the person was exceptionally tiny and beyond the age at which she could wear little-girl clothes. At the second level, inferring occurs when the reader uses prior knowledge to figure out that two text propositions must be connected even though, objectively, there does not appear to be a connection. For example, in

the sentences *One sunny day, Joe decided to go to the store. Fortunately, he looked out the window and then grabbed his umbrella before he left the house,* there is no apparent connection between the two propositions *he looked out the window and then grabbed his umbrella.* However, by applying prior knowledge (the sun may be shining, but black clouds could be approaching), the reader can make sense of the text and see the logical link between the two propositions. The third level of inferring occurs when the reader has activated a schema with unfilled slots and must supply the slot-filling information. The fourth level occurs when there is constant and repeated interaction of text and schemata to refine the schemata and provide an interpretive framework for the text. This last level of inferring occurs frequently in technical materials or advanced textbooks as the reader struggles to understand and, in doing so, brings to bear all prior knowledge and experiences (schemata) available to try to construct meaning. All of these levels of inferring occur automatically for skilled readers, to the point that, after reading a passage, they frequently cannot recall what they read from the page and what information they added through use of inferences (Brewer, 1975; Spiro, 1977).

Metacognitive Skills

Reading comprehension is a metacognitive process in which readers are aware of and have control over their comprehension. There are two components of metacognition; the first, metacognitive knowledge or the knowledge of oneself as a reader and the awareness of task requirements; the second involves knowledge about and the ability to use self-monitoring skills (Paul, 2003). Awareness of task requirements implies that the reader must be aware of and know the skills, strategies, and resources that are necessary to complete a task successfully. Self-monitoring of metacognitive skills refers to the reader's use of self-regulatory activities to keep track of how well they are comprehending (Vacca, Vacca, Gove et al., 2003). These activities include checking the outcome of problem-solving attempts, planning and evaluating the effectiveness of any attempted actions, testing and reviewing strategies used in learning, and taking remediating action to overcome difficulties encountered.

Skilled readers of text understand that the purpose of reading is to read for meaning. They know how to use specific strategies to facilitate comprehension, and they monitor their own comprehension as they read, implementing "fix-up" strategies when they realize they are not comprehending. Readers who are not as skilled may have difficulty with reading comprehension for a number of reasons. They may not actively read for meaning, focusing on reading more as a decoding process than as a meaning-getting process (B. M. Taylor, Harris, Pearson, & Garcia, 1995). They may not select and apply a variety of

comprehension strategies to match the task requirements, and they are probably not as effective at monitoring their own comprehension. When they are not comprehending, they may not realize it; thus, they may not apply fix-up strategies and continue reading without comprehension.

Metacognitive skills become increasingly important in the later elementary grades and on through high school, when the emphasis in reading shifts from learning to read to reading to learn (King & Quigley, 1985). This can be a difficult transition for readers who focus on reading as a decoding process rather than a comprehension process. Sullivan (1978) reported that unskilled readers, even at the high school level, lacked the metacognitive awareness that text must be interpreted in relation to what the student already knows about the topic and were still viewing reading as a decoding process.

Reading and Deaf Children

Hearing children bring most of the high-order cognitive skills to the task of learning to read: They have a well-developed vocabulary, a substantial assortment of schemata, adequately developed cognitive structures, linguistic competence in the English language, inference skills, and skills in figurative language. What hearing children lack as they begin to learn to read are decoding skills. Unfortunately, the same is not true for most deaf and hard of hearing children.

Vocabulary

The vocabularies of deaf and hard of hearing students are far below those of their hearing peers (R. C. Anderson & Freebody, 1985; Paul & O'Rourke, 1988; Paul, 1996b, 1998), and to compound the problem, deaf and hard of hearing students acquire new words at a slower rate than do their hearing peers (LaSasso & Davey, 1987; Paul, 1984). One reason for this is that although hearing students can acquire new words through context clues, deaf and hard of hearing students frequently do not have the skills (or the English-language facility) to use context clues to figure out meanings. Deaf and hard of hearing students quite likely have experiential backgrounds that are similar to their hearing peers; however, there is one important difference: For the most part, the experiences of deaf and hard of hearing children have not been linked to language because of the inaccessability of an oral language and because of the frequent lack of communication between the child and the rest of the family.

Without the link to language, deaf children have difficulty connecting their experiences to the printed words.

Marschark (1993) proposed that processes at the word-recognition level contribute to the difficulties that deaf children have in reading and suggested that when word recognition is not automatic, a greater demand is placed on the working memory. This greater demand on the working memory results in less capacity being available for integration of semantic information, which aids in syntactic processing.

Cognition

Earlier in this chapter, the discussion indicated that the cognitive structures of deaf and hard of hearing children and hearing children are probably similar, but whether they follow similar developmental patterns and timelines has not yet been determined. However, the linguistic competence of deaf children has received considerable attention (S. Quigley & Paul, 1984; S. Quigley, Wilbur, Power, Montanelli, & Steinkamp, 1976; Wilbur, 1987).

Linguistic Competence

Similar to the findings on vocabulary development, the results of investigations on the syntactic development of deaf students have indicated that most 18–19-year-old students performed at levels somewhat lower than 8–9-year-old hearing students (S. Quigley, Wilbur, Power, et al., 1976). Deaf students usually do not have highly developed inference skills. Although research on this topic is limited, all of the findings so far indicate poor inference skills (K. Wilson, 1979; see discussion in King & Quigley, 1985) and difficulty in answering nonliteral questions. The poor inference skills of deaf and hard of hearing students probably promote their use of inappropriate strategies such as word association, copying, and visual matching on vocabulary and reading tests (Davey & LaSasso, 1983; LaSasso, 1986; Wolk & Schildroth, 1984).

On multiple-choice tests, deaf children frequently seem to find a word in a response item that they commonly associate with a key word in the test item and mark that response. For example:

> Careless reading leads to
>
> school books mistakes pictures math

The student associated *reading* with *books* and thus, made that selection. This strategy is referred to as a *word-association strategy*.

A visual matching strategy is another unproductive strategy that is frequently used by deaf students on multiple-choice tests. The students find a key word in the test item, then find the same word in the passage, and select the response that has words in the closest physical proximity to the key word in the passage. For example, the students would read the following passage:

> *Ramon was riding his bike to the store. He saw Sam mowing the grass in his front yard. "Hey, Sam!" he yelled, "I have to go get some sugar for my Mom. Do you want to ride to the store with me?"*
>
> The question: *Why is Ramon going to the store?*
>
> To find Sam To ride his bike To buy some sugar To mow the grass

Using a visual matching strategy, the student would match the phrase in the question (to the store) with the same phrase in the first sentence and then select the response that has words in close proximity to the key phrase in the passage. In this case, the student would respond with *To ride his bike*.

Copying occurs when the test item is a free-response question. This strategy involves matching a word or a phrase in the question with a sentence from the passage that also contains that word or phrase. Then the student copies the whole sentence. For example, using the same passage as above, the question might be: *Who did Ramon ask to ride to the store with him?* The student would match the phrase (*to ride to the store with*) to the same phrase in the last sentence of the passage, and then copy the entire sentence as the answer to the question.

Figurative Language

Deaf and hard of hearing students have difficulty with many aspects of figurative language. This finding is not surprising in light of the fact that figurative language contains a great deal of interaction among linguistic components such as vocabulary and syntax, two areas in which deaf and hard of hearing students have considerable problems. Knowledge of some figurative elements requires more than knowledge of grammar and vocabulary, as in such examples as *He is knocking his head against a brick wall.* The sentence has a simple syntactic structure, and the vocabulary is not difficult; yet attention to vocabulary and syntax alone will not reveal the meaning of the statement. Fruchter, Wilbur, and Fraser (1984) found that deaf and hard of hearing students' knowledge of figurative language is related to their reading achievement levels, indicating that increased exposure and practice with figurative language in print and

in context may help to increase their skill in understanding this language form.

Metacognitive Skills

Very few studies investigating the metacognitive abilities of deaf and hard of hearing students have been conducted. S. Quigley, Wilbur, Power, et al. (1976) conducted research in which students judged the grammaticality of English sentences. Although they were not directly investigating metacognitive skills, through extrapolation they inferred that most deaf and severely hard of hearing students do not have effective metacognitive skills for reading. This finding should not be attributed to innate deficiencies in the cognitive structures of deaf and hard of hearing students; instead, it is probably due to the fact that the students had not been taught how to use metacognitive strategies during the process of reading.

One line of metacognitive research conducted with deaf and hard of hearing students has focused on the task-awareness component of metacognition, specifically, text investigation (e.g., text lookback or rereading text). One study (Davey, 1987) found that deaf readers were not aware that the repair strategy (text lookback) improved their comprehension. Another metacognitive task involves the detection of inappropriate information within text. Good readers, hearing or deaf, are able to identify information that does not belong within the passage they are reading. There is a relationship between this type of metacognitive awareness and reading comprehension (Gibbs, 1989). However, the investigators found that poor readers, hearing and deaf, rarely recognize when information is inserted that does not make sense. J. F. Andrews and Mason (1991) conducted a study in which they found that the deaf students in their investigation reported the use of fewer strategies during reading when compared to the group of hearing students. The researchers recommended that the deaf students receive instruction to assist them in developing more effective reading strategies.

Metacognitive skills are essential for effective reading. Such skills are dependent on prior knowledge and other reading variables; however, there must also be consistent and systematic instruction on these strategies for deaf students to be able to apply them successfully. Strassman (1997) considered the possibility that deaf students might not have enough opportunities to engage in metacognitive activities. If reading materials are too difficult, the students will not be able to develop and apply a range of metacognitive strategies but will, instead, regress to strategies used by younger readers. The use of effective instructional techniques and materials should assist in improving metacognitive skills.

Marschark and Spencer (2003) stated that the body of research on comprehension highlights the importance of prior knowledge and cognitive strategies. However, few studies have provided evidence of effective approaches for teaching deaf readers to develop and use metacognitive strategies to improve their reading comprehension.

Environmental Factors

Teachers have always known that nearly everything that happens in a student's home environment affects what happens to the student at school. However, in terms of the child's reading performance, some factors are more influential than others. The most important home environment factors affecting a child's progress in reading are the language environment of the home and the types of values that a child learns from the home environment (B. M. Taylor, Harris, & Pearson, 1988). Although Taylor and her associates were referring to hearing children, the same is true for deaf and hard of hearing children.

Because the reading process is also a language process, it is not surprising that a great deal of importance is placed on the child's home language environment. The absence of a mutually shared communication system between the deaf child and the rest of the family has an adverse effect on the child's development of language and, subsequently, on the process of reading. Most deaf children with hearing parents who communicate using oral English are unable to develop a mastery of the English language before they begin the task of learning to read (McAnally, Rose, & Quigley, 2004). The same is true of deaf children with deaf parents who use American Sign Language for communication. The difference between the two groups is that deaf children of deaf parents have already acquired one language (ASL), making it easier for them to acquire a second language, in this case English (Israelite, Ewoldt, & Hoffmeister, 1992). In a study of the relationship between American Sign Language skills and English literacy among deaf children (Strong & Prinz, 1997), the results indicated that deaf children's learning of English appeared to benefit from the acquisition of even a moderate fluency in ASL.

Success in school is also facilitated when there is a match in home values and school values. Failure is more likely when the two sets of values do not match, thus causing a value conflict within the child. Some schools appear better able to accommodate differences in value orientation than others. If the school does not make accommodations for the differences, then the child must do so. Usually, the students who succeed are those who are able either to change their values or to accept the school's values, at least within the context of the school environment (B. M. Taylor, Harris, Pearson, & Garcia, 1995). If academic achievement is not valued in the home, then it is usually difficult to

motivate that child to devote time and attention to learning to read. The same is true if other more basic factors (such as lack of money to buy food, concern over gang and drug activity in the neighborhood) are taking precedence over a desire to learn to read. This discussion is not intended to imply that all children from lower socioeconomic environments are, or will be, poor readers. Socioeconomic levels are probably related factors, but if the parents in the home value reading; have high expectations for the child; and provide plenty of reading materials, encouragement, and assistance in reading, the child is highly likely to be successful in reading endeavors regardless of socioeconomic status (King & Quigley, 1985).

Diverse Student Populations

Changes in the composition of public school populations have been dramatic in the past 15 years. The same is true for schools and programs for deaf and hard of hearing students. Recent data from the U.S. Bureau of the Census indicate that the trend toward classroom diversity will continue. By the year 2020, 1 of 2 public school students will be from a minority background, and the number of children living in poverty will increase by 37%. Schools will probably be serving 5.4 million more children living in poverty in 2020 than they served in the early 1990s (Au, 1993). Classrooms, including classrooms for deaf and hard of hearing students, are not only becoming more linguistically, culturally, and economically diverse, they are also becoming more diverse in the disabilities and various types of learning problems exhibited by students. More and more students entering schools and programs for deaf and hard of hearing youngsters are being diagnosed with additional problems that affect learning. Some of the additional problems with which teachers are now trying to cope are attention-deficit/hyperactivity disorder (ADHD), specific learning disabilities (SLD), and a variety of behavioral and emotional problems. This change in the population has occurred rather rapidly, and no research has yet produced results that will help teachers deal with these complex students. In fact, it is not yet known what the interplay between the hearing loss and the additional disability might be and whether one compounds the effects of the other. Many of these students do not seem to respond to the regular instructional strategies employed by teachers; they seem to require instructional and behavioral strategies that have yet to be defined.

The different student population has made teaching more challenging and demanding than ever before (Vacca, Vacca, Gove et al., 2003). Diverse learners become quite academically and emotionally vulnerable when placed in instructional contexts that require them to engage in reading and writing. More often than not, students with diverse backgrounds become caught in a cycle

of school failure that contributes to very marginal achievement and a sense of helplessness and frustration in learning situations.

Reading Achievement Levels

Studies conducted over the past 80 years have consistently indicated that deaf students have a great deal of difficulty in reading English text. As early as 1916, Pintner and Patterson administered a reading test on following directions to deaf students who were 14–16 years of age and reported results indicating that the deaf students were reading at levels similar to those of 7-year-old hearing students. Unfortunately, investigators who have conducted studies since that time have reported similar results.

The accuracy of the results of earlier investigations has been questioned because deaf and hard of hearing students were not included in the norming samples. However, an adapted version of the Stanford Achievement Test (Stanford Achievement Test—Hearing Impaired or SAT-HI) was developed and normed on national samples of deaf and hard of hearing students. Despite the adaptations, the results using the SAT-HI consistently indicate that 18–19-year-old severely to profoundly deaf students are reading at levels similar to those of 9–10-year-old hearing students. These test results also show that deaf students increase their reading levels by only about 0.3 grade level per year and seem to plateau at about the third- or fourth-grade reading level (Center for Assessment and Demographic Studies [CADS], 1991). It must be noted, however, that some deaf students do become adept at processing English text. Approximately 3% of profoundly deaf 18 year olds read at a level equal to that of their hearing peers (CADS, 1991). L.P. Kelly (1993) found that knowledge of English grammatical conventions, regardless of how difficult they are for deaf children to acquire, seem to make a significant contribution to reading competence in skilled deaf readers.

Reading Challenges

Throughout this chapter, several challenges encountered in reading by children with hearing losses have been described. As teachers of deaf and hard of hearing students design their reading programs, they should make sure that all of these challenges are addressed in ways that will minimalize them to the greatest extent possible. Below is a summary discussion of these challenges and the implications for instruction; information on strategies that should help to reduce some of the challenges is presented in Chapter 8.

Insufficient English-Language Skills

Because most (over 90%) deaf children are born to hearing parents, they do not have early exposure to a language environment they can easily access. Deaf children born to deaf parents who use ASL develop language in a manner similar to that in which hearing children develop English. However, neither the deaf child with hearing parents nor the deaf child with deaf parents has mastery or near mastery of the English language when they begin the task of learning to read in kindergarten and first grade. Therefore, they are faced with the tremendous challenge of trying to learn to read a language that they do not know—an extremely heavy cognitive task that is likely not possible for most youngsters to accomplish. Deaf children of deaf parents have the advantage of an intact language system (ASL) which generally facilitates the acquisition of a second language (Marschark & Harris, 1996). Kuntze (1998) stated that deaf children who have ASL as their primary language would be better able to acquire written English in the framework of second-language learning. Nevertheless, the fact remains that neither group of deaf children have the English-language skills necessary to begin the task of learning to read. However, the teacher must realize that these two groups of children, while having the same ultimate goals, are starting at two different places: one group must develop a primary language (which may be either English or ASL leading to English as a second language), and the other group must develop English as a second language. The difficult instructional decision that the teacher must make is *when* to begin instruction in reading—at the same time that the child is learning English, after the child has a little knowledge of the English language, or after the child has developed near mastery of English?

Implications for Instruction

Optimally, every deaf infant and toddler would have access to a complete language. The literature strongly indicates that deaf children of deaf parents who have early exposure to ASL, a completely accessible language, outperform in reading and academic achievement their deaf peers who did not have complete and early access to a language. This information indicates that effective early-intervention programs, whose ultimate goal should be to work with parents to ensure that their deaf infant has an appropriate language environment as early as possible, are critical to the academic success of deaf children. It also indicates the importance of preschool programs wherein the ultimate goals should be to continue the development of language, to provide experiences linked to language to develop the children's prior knowledge, and to present activities to develop early literacy skills that will prepare them for the task of learning

to read. If deaf children do not have a strong language base developed by the end of their preschool and kindergarten years, the first-grade teacher will have to make language development the focus of classroom activities and present beginning reading activities as the students become prepared. Although it is tempting to begin teaching children to read thinking that they will learn English language faster through print, children generally do not learn a first language through written text. However, deaf children whose primary language is ASL may be able to acquire English as a second language through the written form. As mentioned above, teachers may have two kinds of deaf children who need to develop English-language skills before they begin the task of learning to read, and the methods used will need to be very different and appropriate for each group. Children who are learning English as a first language must learn through experiences linked to language; children learning English as a second language can learn through written text, but the printed words must be linked to ASL (which then links to their experiences).

Insufficient Vocabulary Development

Several investigations show that deaf children have far fewer lexical items in their vocabularies than do their hearing peers (R. C. Anderson & Freebody, 1985; Lederburg & Spencer, 2001; Marschark, 1993; Paul & O'Rourke, 1988). In addition, deaf and hard of hearing students acquire new words at a slower rate than do their hearing peers (LaSasso & Davey, 1987; Paul, 1984). DiFrancesca (1972) stated that most deaf students 18 years old and younger score at or below a fourth-grade level on vocabulary achievement tests. Add to this information the fact that vocabulary knowledge is a primary component of reading and is correlated with reading comprehension (Karchmer & Mitchell, 2003; LaSasso & Davey, 1987; Marschark, 1997; Paul & Gustafson, 1991) and it becomes obvious why insufficient vocabulary knowledge is a significant challenge encountered by deaf children in reading.

Implications for Instruction

The obvious implication of the information presented above is that there must be a strong focus on vocabulary development so that every student acquires a vocabulary sufficient for comprehension of text. Comprehension of text depends, in large part, on an in-depth and extensive knowledge of words as well as multiple exposures to these words in various reading contexts (L. P. Kelly, 1995; Musselman, 2000; Paul, 1996b). In-depth word knowledge involves the integration of conceptual and interrelated associations, for example, meanings, concepts, nuances, examples, uses, associations, and figurative usage (Paul,

1998). Conway (1990) wrote the following statement that is very relevant to this discussion on instructional implications:

> Traditional programs of learning definitions for lists of words should give way to learning words in semantically rich contexts. The contexts can serve as bridges to old information and as foundations for developing further conceptual interrelationships... Such rich contexts should also include use of semantic mapping...and adaptations of networking strategies. (p. 346)

Several of the most effective approaches for the development of word knowledge, or vocabulary, are those that emphasize semantic elaboration techniques. Several of the techniques are described in Chapter 8 and include descriptions of strategies such as semantic maps, semantic feature analysis, word maps, and concept analysis.

World Experiences Not Linked to Language

One of the difficulties in reading that deaf students encounter may be attributed to experiential or world knowledge (S. Quigley & Paul, 1994). World knowledge is also referred to as background knowledge or prior knowledge. Prior knowledge plays a critical role in reading as it not only enables children to comprehend text, it also helps them to improve their comprehension and memory of text (R. Anderson, 1984; Dewitz, Carr, & Patberg, 1987; J. Hansen & Pearson, 1983). Although deaf children generally have experiences similar to those of hearing children, there is one significant difference. Because deaf children and their hearing parents frequently do not share a mutual communication system, the experiences of most deaf children are not linked to language. Experiences that are linked to language enable children to develop and access prior knowledge that is a critical component of reading comprehension. For example, when hearing children encounter the printed word *cat*, they decode the word (*k-a-t*) and recognize the word as the label for a common animal. They can then access the appropriate schema for that concept and have available to them a wealth of information about cats that they have gained from their past experiences. When past experiences have not been linked to language, as in the case of most deaf children, the child has no avenue to access the schema that includes the concept of *cat* and other information relating to that concept. An accompanying picture may help, but only if the child knows that *c-a-t* is a label for that picture.

Implications for Instruction

This challenge emphasizes the importance of providing a language-rich environment that is accessible to all children. Most hearing children enter school with a large and intact network of schemata (prior knowledge) that has been

linked to language, so that all they have to do in the task of learning to read is decode the word and then they automatically link it to an already developed schema. Most deaf children do not enter school with this level of schematic development, and so the development of schemata and networks of schemata that are linked to language becomes one of the teacher's instructional priorities.

Lack of Phonological Recoding Skills

Findings from several investigations (e.g., Bench, 1992; Greenberg & Kusche, 1989) indicate that most individuals with severe to profound hearing losses use a non-speech-based recoding strategy such as sign, fingerspelling, or visual information. The mediating system of most hearing readers is predominantly speech based, which is thought to play an important role in the processing of syntactic structures and in developing inferential and metacognitive skills for reading (Paul & Quigley, 1990). Several investigations have found that some deaf students use a speech-based code (e.g., Conrad, 1979; Hanson & Fowler, 1987; Lichtenstein, 1998; Rodda & Grove, 1987) and that these students are better readers than those who primarily use nonspeech codes. L. P. Kelly (1995) speculated that deaf readers who use a strategy less enduring than speech recoding are more likely to lose words in a sentence before their combined meaning can be constructed and stored in long-term memory. It appears that speech recoders are able to retain more language information such as words and syntax in their short-term memories, enabling them to comprehend the meaning of sentences. Although the lack of phonological skills presents a challenge for deaf readers, it also presents a challenge for teachers; that is, how do we help deaf children develop *phonological* recoding skills when they cannot hear?

Implications for Instruction

The evidence indicates that at least some deaf readers use phonological recoding skills and that they are generally better readers than those students who use nonphonological recoding skills. The question becomes, how have they gained access to phonology? There is no empirical evidence available at this time that would lead to any clear answers to this question; however, teachers and investigators have begun to extrapolate from related studies and from their experiences and have offered some educated guesses. One logical premise would be that developing the use of any residual hearing that children have would enable them to access at least some form of phonology to some extent that could be applied to the recoding process. Perfetti and Sandak (2000) suggested that access to phonology can be obtained by means other than speech. If so, then some phonology might be accessed through lipreading and fingerspelling. Leybaert

and Alegria (2003) proposed that early exposure to cued speech is an approach that can enable deaf children to access phonology and develop phonological representations of words. However, due to the lack of research at this time, no definite instructional approaches or strategies can be offered.

Perception of Reading as a Decoding Task

Deaf children frequently perceive the goal of reading as the ability to identify each word in the text. When they can recognize each word on a page, they believe that they have successfully "read" that page. Because of this misconception, many deaf readers are word-by-word readers, which greatly reduces or prohibits their comprehension of what they are reading. Related to this challenge is an additional challenge—because they do not understand that they should be constructing meaning from the printed word, they do not develop the metacognitive skills that help them monitor their comprehension of text.

Implications for Instruction

Clearly, teachers must help children understand that the goal of reading is to construct meaning. One effective strategy for accomplishing this is demonstration by the teacher using the think-aloud strategy (see Chapter 8). Teaching children *how* to comprehend and how to monitor their comprehension are also instructional activities necessary for them to develop a different perspective of reading.

Underdeveloped Repertoire of Comprehension Strategies

During reading, teachers sometimes become so focused on checking to make sure their students are comprehending that they neglect to teach them *how* to comprehend. Reading is not developmental; it does not develop naturally in children regardless of whether they are hearing or deaf. Reading must be taught, and comprehension skills, as well as decoding skills, must be taught. In fact, explicit instruction models (see Chapter 8) encourage teachers to model comprehension strategies for the students and to explain to them *what* the strategy is, *why* it is important, *how* to use the strategy, and *when* to use it.

Implications for Instruction

Several studies (Chall, Jacobs, & Baldwin, 1990; Dolman, 1992; L. P. Kelly, 1995; Stahl & Miller, 1989) have indicated that children who are not profi-

cient in English-language skills benefit more from direct, or explicit, instruction in reading than they do from instruction in which they have to intuit the strategies being used. Almost all deaf students fall into the category of low English-language proficiency, which should indicate to teachers that much of the instruction in the classroom should be direct. Strategies important for successful reading should be taught with the use of an explicit instructional model.

Lack of Automaticity

If a child has reached automaticity on a skill, it means that the skill can be performed instantaneously and without conscious attention (Graves, Watts-Taffe, & Graves, 1999). The importance of this concept to reading has been universally recognized since LaBerge and Samuels first explained the significance of automaticity to reading in 1974. In reading, a number of processes must be performed simultaneously, for example, recognizing letters and words, assigning meaning to words, linking words to form propositions, and linking propositions to form larger units of meaning. If these processes are not automated, then they demand cognitive attention and more time to process in short-term memory, which has a limited capacity. If the processing demand overburdens the limited capacity of short-term memory, then the information will deteriorate and the reader will not be able to comprehend. The reader must reach automaticity in two of the processes mentioned above, that is, recognizing words and assigning meaning to words. If these two processes (decoding and vocabulary knowledge) are automated, then the reader will be able to focus cognitive attention on the higher-level skills of comprehension.

Implications for Instruction

The two important processes in reading that must be automated, that is, word recognition and assigning meaning to words, are both part of developing word knowledge, or vocabulary instruction. Not only must children be able to identify words and understand their meaning, they must also be able to do this instantaneously and without effort. Whenever children have to stop and think about a word in reading, they are consuming more space in short-term memory (that has limited capacity), thereby leaving less cognitive attention available for comprehension of connected text. Much instructional time must be devoted to developing vocabulary knowledge, and a variety of instructional activities must be provided to maintain student motivation.

The information presented above assumes even greater significance when considered in the context of the findings set forth in the research synthesis, *Thirty Years of Research: What We Now Know about How Children Learn to Read*

(Grossen, 1997). The research team concluded that the years from kindergarten through third grade were indeed critical years for the development of reading skills. Children who fall behind at an early age (kindergarten and first grade) fall further and further behind over time. Longitudinal studies show that of the children diagnosed as reading disabled in third grade, 74% continue to have reading difficulties in ninth grade (Fletcher et al., 1994). These results indicate that deaf children have a limited amount of optimal time to develop skills to become effective readers. The results also strongly suggest that the major focus in kindergarten through third-grade classrooms should be on the development of strong English-language skills and the teaching of reading.

Clearly, educators must continue to search for reading approaches and instructional strategies that will prove to be a better match for the learning aptitudes of deaf and hard of hearing students. These students have the ability, the potential to learn to read, and researchers and teachers must continue in their quest to find information that will answer the question "How?" In the meantime, teachers must strive to remain current in what is happening in reading. What are the most promising practices being used with hearing children, and how can these be used or adapted for use with deaf and hard of hearing students? Some of the most promising strategies being used today are interactive strategies within a balanced reading program. Both of these topics are discussed in later chapters in this book.

Summary

Reading is both a language and a cognitive process and, as such, is closely associated with other language processes—listening/seeing, speaking/signing, and writing. As with language and cognition, reading deals with the subsystems of phonology, graphemes, semantics, and syntax. As a cognitive process, it involves the mental operations that comprise most kinds of thinking—attention, perception, encoding, memory, and retrieval.

In the research on information processing and the relationship of short-term memory to reading, it was found that most severely to profoundly deaf readers use a mediating system consisting of a combination of non-speech-based codes such as signing, fingerspelling, and visual imagery to derive meaning from the printed word. However, readers who mediate primarily with a speech-based code were found to be much better readers than those using nonspeech codes. This advantage was attributed to the speech recoder's ability to hold more language information in short-term memory, and such information may be necessary for comprehending hierarchical structures in the English language. The

research on STM emphasizes the importance of the development of cognition and language to the development of reading.

The group of interactive theories known as schema theories probably provide the most convincing account of reading as a cognitive process. Schema theory helps to explain five common processing problems frequently encountered by readers: schema availability, schema selection, schema maintenance, overreliance on bottom-up processing, and overreliance on top-down processing. Schema theories also emphasize the critical role that prior knowledge plays in comprehension.

When hearing children approach the task of learning to read, they have already developed most of the higher-order skills involved in reading. They bring to the task a substantial store of background experiences that have been linked to language, along with the development of cognition, language, and schema, inferring skills, and figurative language abilities. Subsequently, they are free to focus on a lower-order reading skill—decoding. Deaf and severely hard of hearing children are not as fortunate. They have not yet developed most of the higher-order skills that are prerequisites for reading, and they are trying to learn to read the printed form of a language (usually English) that they have not yet mastered in oral/auditory or any other form. So, there is no language base for reading. It is not surprising, therefore, that the reading achievement levels of deaf children are distressingly below those of their hearing peers.

Children's home environments also influence the process of learning to read. Two very important home-environment factors are the language environment and the types of values that children learn from their families. Success in reading is more likely when there is a shared communication system in the home that gives the child access to language, and when there is a match between the home value system and the value system of the school. The lack of language access in the home or a mismatch between the value systems of home and school compounds the difficulties that deaf and hard of hearing children will encounter as they approach the task of learning to read.

Several significant challenges encountered by deaf children as they learn to read can be derived from research findings. Teachers should consider these challenges and the instructional implications as they design their reading programs and units so that strategies and techniques that will diminish these difficulties can be incorporated in their instructional plans.