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ABSTRACT

Research studies on how adults learn and develop second-language reading competence were considered in the context of a componential theory of reading. In particular, C. A. Perfetti's Verbal Efficiency Theory (VET) was used as a framework in which to organize and evaluate the studies' contribution to the field of second-language reading. The review focused on empirical studies of second-language reading processes ranging from low-level letter recognition processes to higher-level reading processes such as metacognitive strategy use. This research suggested that there were a variety of skills (or components) that must be acquired to become a fluent reader in a first or second language. The review covers a broad variety of studies on adults learning to read a second language--not just English, but also Japanese, Chinese, Korean, Spanish, French, German, Dutch, and Hebrew. Among the implications for instruction and evaluation in English as a Second Language were the following: the need to consider both accuracy and speed in the processing of basic reading skills as indicators of second-language reading gains; the importance of developing fluency in word decoding and developing flexible strategies for dealing with unfamiliar words, and the need to attend to changes in the nature of the cognitive processes that support skilled reading as indicators of reading progress. (Contains 105 references.) (Author/YLB)

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Abstract

The present paper reviews the research literature on how adults learn and develop second-language reading competence. The review focuses on empirical studies of second-language reading processes ranging from low-level letter recognition processes to higher level reading processes such as metacognitive strategy use. This research suggests that there are a variety of skills (or components) that must be acquired in order to become a fluent reader in a first or second language. The review covers a broad variety of studies on adults learning to read a second language—not just English but also Japanese, Chinese, Korean, Spanish, French, German, Dutch, and Hebrew. The paper concludes with implications for instruction and evaluation in English as a Second Language. Among these are the need to consider both accuracy and speed in the processing of basic reading skills as indicators of second-language (L2) reading gains, the importance of developing fluency in word decoding and developing flexible strategies for dealing with unfamiliar words, and the need to attend to changes in the nature of the cognitive processes that support skilled reading as indicators of reading progress.

Introduction

Importance of Second-Language Reading Research for the Field of Adult Literacy

A number of existing conditions in the field of adult literacy require that adult educators become familiar with research on the acquisition and development of second-language (L2) reading competencies. One of these conditions concerns the current demand for English-as-a-Second-Language (ESL) services. At present it is estimated that 12–14 million adults living in the United States have limited proficiency in the English language. Of these, approximately 1.8 million adults are served each year through federal, state, and local agencies. However, the demand for ESL services far exceeds the supply. Chisman, Wrigley, and Ewen (1993) have pointed out that in many large urban centers the demand for ESL services exceeds the demand for adult basic education (ABE) services even though the absolute number of adults in need of ABE is greater. Given these facts, it is important that adult literacy educators become familiar with issues surrounding learning and instruction in ESL reading.

A second reason that familiarity with L2 reading research can be helpful to adult educators concerns the diversity of literacy needs in the population of learners seeking ESL literacy instruction. As the literacy needs of learners have changed, so have instructional approaches. For example, Wrigley and Guth (1992) argue that in the 1980s ESL literacy educators had to experiment with instructional approaches that were developed for first-language (L1) literacy instruction (e.g., whole language, the Language Experience Approach, and Freirian methodology) as it became apparent that the methods currently in use were inappropriate for the large number of immigrants who were enrolling in ESL classes with little formal schooling experience. Knowledge of the acquisition and development of L2 reading can aid educators in making choices about how to adapt these methodologies to accommodate differences between first- and second-language literacy development.

In this paper, we address these needs by reviewing the quantitative research literature on the way in which adults learn and develop L2 reading competencies. We will also discuss ways in which this research can help inform choices and practices in the instruction and evaluation of ESL learners.

Theoretical Influences on Second-Language Reading Research

Current knowledge about L2 reading has not resulted from the contributions of a single field of research. Rather, it has developed through work in diverse fields such as linguistics, psychology, education, anthropology, and literary criticism. The knowledge generated within these fields intersects in several places. A good example is the literature on the role of social context for understanding L2 reading. This literature has highlighted how the culturally shared knowledge that the reader brings to the text and the purposes and motivations for reading differentially impact on the reading processes (Hornberger, 1989). There are, however, issues on which the knowledge generated by these fields conflicts. One point of contention concerns the relative contribution of lower level reading skills to L2 reading performance (e.g., letter recognition or word decoding) as compared to that of higher level reading skills (e.g., schema activation, reading strategies, and language proficiency). The literature on L2 reading instruction has generally emphasized the importance of higher level processes on the ability to read in a second language and has minimized the involvement of lower level skills (Bernhardt, 1991; Grabe, 1991; Haynes & Carr, 1990). The psychological literature has, on the other hand, focused almost exclusively on skills at or below the level of word recognition.

There are several factors within the short history of L2 reading research that have influenced the tendency to emphasize top-down processing. Many of these factors can be linked to language teaching considerations (Carrell, 1988). First, the audio-lingual method of language teaching, prominent through the 1960s, focused little attention on reading and writing in a second language. Oral and aural skills were seen as the most valuable L2 skills. In fact, reading skills were viewed as a possible source of interference with oral language development. As a result, reading instruction began late in the language acquisition process, and, when included, it was often used mainly to support oral and aural skills through the acquisition of new vocabulary.

As communicative teaching methods came into prominence in the 1970s, reading became a more central component of L2 teaching. At that time, very little research was available on the differences between first-language (L1) and L2 reading processes. As a result, when L1 reading theorists began to focus on the role of the reader (i.e., reader-response theory), many L2 teachers felt as though something they had intuitively known—that students read differently due to differences in language background, prior knowledge, available schemata, and reading strategies—was given academic attention. This shift in L1 reading theory provided an opening for multiple studies on how L2 readers might read differently than L1 readers. This emphasis on top-down processes was influenced not only by teachers' need for knowledge about how L2 readers read, but also by their interest in motivating their students. The research on top-down processes further reinforced instructional and motivational justifications for the meaning-centered reading activities advocated by the newly embraced communicative language teaching methodology. Although these higher level processes are still of importance to L2 reading researchers, many now recognize that the gap in knowledge concerning lower level processes and the interaction of higher and lower level processes need to be addressed in order to better understand the process of reading in a second language.

More recently, L2 researchers have begun to conceptualize the reading process across a wider spectrum of skills (Bernhardt, 1991; Eskey, 1988; Eskey & Grabe 1988; Grabe, 1991; Hornberger, 1989). This trend may be due, in part, to the influence of the research and the theoretical work that has been done in the field of native language reading. This work characterizes the reading process as consisting of component skills in interaction (Grabe, 1991; Perfetti & Curtis, 1986; Sinatra & Royer, 1993). The consideration of L2 reading in terms of a wider spectrum of skills might also be due to the understanding that the cognitive processes underlying reading performance may change during the course of the development of L2 reading skills (Brown & Haynes, 1985; Carlo & Royer, 1994; Haynes & Carr, 1990). Finally, the potential impact of differences between native and second-language scripts on reading performance has also shifted researchers' attention toward levels of the reading process (e.g., word identification) that were previously unexamined (Brown & Haynes, 1985; Haynes & Carr, 1990; Hornberger, 1989; Koda 1987, 1989).

The studies that will be considered in this review span several levels of the reading process, ranging from studies examining letter recognition processes to those focusing on higher level reading processes such as metacognitive strategy use. These studies also vary with respect to the theories from which they evolved. Many of them originated in the tradition of top-down models of reading such as those of Goodman (1970) and Smith (1971), which emphasize the role of background and linguistic knowledge in generating expectations about the text that in turn aid the process of decoding the text. Others are more in line with interactive reading theories (Carrell, Devine, & Eskey, 1988), which emphasize the role that prior knowledge plays in the interpretation of text.[1] Finally, other studies originated from bottom-up perspectives, which emphasize the importance of efficient low-level reading skills to support comprehension-oriented processes (Bernhardt, 1987; Favreau, Komoda, & Segalowitz, 1980; Favreau & Segalowitz, 1983; Haynes & Carr, 1990; Koda, 1992).

The present review considers research findings on adult L2 reading in the context of a componential theory of reading.[2] Clearly, other frameworks could be used to integrate these

research findings. However, throughout the next several pages, we discuss how such a framework might help us understand the relationships that exist between research findings of such diverse theoretical origins and then consider the possible extensions of this research suggested by a componential perspective.

It is our belief that a review of this nature could help researchers and practitioners move the field closer to finding ways that reading processes can interact with and support one another and move the field away from single factor explanations for variability in L2 reading performance. We hope that it will also raise questions about how the practitioners' involvement in the reading process should change over the course of the development of L2 reading skills.

Organizational Framework

As stated above, the research studies reviewed in this report will be considered in the context of a componential theory of reading. In particular, we will be using C. A. Perfetti's *Verbal Efficiency Theory* (VET) as a framework in which to organize and evaluate the studies' contributions to the field of L2 reading. We have chosen VET because it takes a comprehensive look at the spectrum of abilities that are involved in the process of reading and because it was developed from a well-established empirical base in the monolingual reading literature.

A Componential Reading Skills Perspective on Second-Language Reading

3

Verbal Efficiency Theory (VET)

Perfetti (1985, 1988) proposed Verbal Efficiency Theory as a framework for understanding the nature of individual differences in reading ability. Two major components characterize the theory: local text processes and text-modeling processes.

Under local text processes, Perfetti includes those cognitive processes that lead to lexical access (i.e., to the activation in memory of the meaning or meanings of a word) and to the integration of words into propositions. This would include all cognitive processing that precedes the recognition of a word such as feature extraction, pattern recognition, and letter identification (Sinatra & Royer, 1993), as well as those that involve accessing the meaning of the words and integrating these words into propositions (Perfetti, 1988).

Text-modeling processes are described as those that are applied to the product of the local text processes. These involve the application of knowledge structures based on our world knowledge and linguistic knowledge to the units of meaning derived from earlier local text processes. An assumption of the theory is that, as one reads, he or she continuously updates the text model by reconciling the result of local text processes with the knowledge structures involved in the text-modeling stage. In this stage, the schemata based on world knowledge, linguistic knowledge, discourse knowledge, and so on are reconciled with the products of local text processes in order to construct a model of the text (i.e., a meaning representation of the text as a whole).

Perfetti's theory incorporates concepts derived from information processing theory. In particular, he incorporates the notion that the cognitive system operates under limited capacity conditions. That is, our working memory—or short-term memory as others prefer to call it—can

activate in memory only a limited number of elements at any given point in time. The limited capacity of the cognitive system is problematic when several attention-demanding cognitive processes are operating simultaneously.

One manner in which the cognitive system is able to circumvent these limited capacity constraints is through overlearning. In reading, cognitive processes that have been overlearned (i.e., automated) typically require less attention. For the highly skilled reader, these may include letter recognition, word recognition, and lexical access, to name a few. Through repeated exposure to letters and words, the skilled reader is able to automate the operation of these cognitive processes to a level in which they make minimal attentional demands. Other processes—typically those higher in the hierarchy of reading skills—are attention demanding. These may include the application of prior knowledge in the generation of high-level inferences, critical reading skills, comprehension monitoring strategies, and so forth. The skilled reader is able to make efficient use of the limited attentional resources at his or her disposal because skills lower in the hierarchy of reading are performed automatically, thus allowing him or her to allocate the attention resources to higher level, comprehension-oriented reading processes.

At the heart of VET is the notion that the efficiency of a reading process can be understood in terms of the quality of its outcome relative to its cost in terms of processing resources (Perfetti, 1988). The most efficient processes are those that produce a quality product at the expense of few processing resources. One would argue that efficient word recognition processes would, for example, activate the meaning of a word in semantic memory at the cost of minimal attention. That is, the reader would not need to consciously attend to each of the individual letters to arrive at the sound and the meaning of the word. Activation of the letters, sounds, and consequently the meaning of the word would occur outside of conscious awareness (LaBerge & Samuels, 1974).

VET assumes that the ease with which a reader builds a text model is contingent upon the efficiency of operation of the local text processes. The more efficient the reader is at identifying a word and accessing its meaning, the better able he or she will be to integrate the meaning of words and the propositions that they form within and across sentences, to make inferences on the basis of this information, and to interpret and critically evaluate the content of a text.

In his description of VET, Perfetti has included the notion of modularized processes in reading (Perfetti, 1988; Sinatra & Royer, 1993; Stanovich, 1990). VET assumes that skilled readers do not rely on the product of higher level processes in order to carry out lower level processes. That is, processes like word identification do not depend on the output of higher level reading processes for their efficient operation. In fact, research on fluent readers has shown that lexical access proceeds independently of context even in the identification of polysemous words (Seidenberg, Tanenhaus, Leiman, & Beienkowski, 1982). When fluent readers encounter a word such as bank, both meanings are activated regardless of which meaning is favored by the sentence context. The appropriate meaning is selected at a later stage (within approximately 200 msec.).

This modularized processing is not characteristic of poor readers (Stanovich, 1980). Low proficiency readers have been found to exploit contextual clues in text to compensate for their inefficient (i.e., non-automated) word recognition skills (Stanovich, 1980). One could argue that modularized processing is not characteristic of readers who are in the process of developing efficient local text-processing skills. Although VET assumes modularized processing in the case of skilled reading, it also allows one to conceptualize different patterns of relationships among skills throughout the process of reading-skills development. Therefore, heavier reliance on contextual cues could be seen as a stage in L2 development and even as a useful strategy at early stages of L2 reading development.

With these ideas in mind, we can begin to consider the research on L2 reading. The studies have been organized according to the two general categories in VET (i.e., local text processes and text-modeling processes). Under the section on local text processes, the reader will find reviews of studies on letter recognition, word identification, and syntactic processing during reading. Under the text modeling section, the reader will find studies that have examined the role of prior knowledge, text structure, and reading strategies in L2 reading performance. The final section of the paper discusses the implications of the findings from these studies for L2 reading assessment and instruction.

Local Text Processes

Letter Recognition

For many L2 learners, learning to read in a second language also involves learning a new script. The literature on children learning to read in their native language has taught us that learning to discriminate among the letters in the alphabet is by no means a trivial task. Most children learn to differentiate these graphic symbols after many years of exposure to them, through language games, books, and print-rich environments (Adams, 1990). Research has shown that children's knowledge of the letters of the alphabet is a strong predictor of current and future reading achievement (Adams, 1990).

Despite the demonstrated importance of letter recognition skills to the development of reading ability in monolingual readers, little attention has been directed toward understanding the development of these skills in the context of L2 reading. Although several studies (which will be reviewed in the section on word recognition) have examined the consequences of script differences in learning to read a second language, to our knowledge, few studies have examined how knowledge of the individual symbols develops in a second language and how the development of this knowledge affects comprehension.

One study conducted with monolingual adults may help illustrate the difficulty of this process for an L2 learner. Brooks (1977) asked native English-speaking college students to learn the following six characters: "»" which corresponded to the letter A, ")(" which corresponded to the letter E, "«" which corresponded to the letter N, "( )" which corresponded to the letter P, "lll" which corresponded to the letter S, and finally "-" which corresponded to the letter T. After having learned the symbols and their respective sounds, the students were asked to name words that were spelled with these symbols. The students were also asked to learn an additional set of six English words that were spelled using a different set of novel symbols. In this case, the students were not given the sound for the individual symbols; rather, they were asked to learn to associate the whole symbol-string with the English word (i.e., paired-associate learning).

The purpose of the study was to compare the efficiency with which one learned to recognize words using either sound-symbol correspondence rules or paired-associate learning strategies. Brooks found that, although the college students were only required to learn six words through paired-associate training, they eventually became more efficient at recognizing words spelled in the sound-symbol system rather than the paired-associate training. An interesting aspect of his findings in the context of the present discussion is that fluency at recognizing the new alphabet developed over many trials. The students required approximately 200 trials before they were able to apply the sound-symbol correspondences efficiently enough to speed recognition time over what it took to recognize the words learned through paired-association.

The reader should keep in mind that these students were learning to relate only six unfamiliar symbols to six familiar sounds. Despite the small number of characters, this posed a

challenge to these subjects. As Brooks (1977) reports:

> . . .[the] comparisons between the paired-associate and orthographic conditions, however, do not quite get at the feeling of frustration so strongly expressed by many of our subjects. As they tell the story they often would have all the letters translated before they could put together a full word. (p. 167)

In a study investigating the relationship between lower level verbal-processing skills and reading proficiency development in a foreign language, Koda (1992) provided evidence that the ability to recognize the elements of a script is related to reading comprehension performance in the second language. Koda (1992) had college students who were learning Japanese in a U.S. university complete a cloze passage comprehension test, a paragraph comprehension test, and a sentence comprehension test. The cloze and paragraph comprehension tests were administered on two occasions at the end of the first and second quarters.

In addition to these measures, the students performed a word recognition task consisting of logographic (Kanji) characters and syllabary (Hiragana) characters. The students were required to provide a written translation of the word in English. Students had three minutes to complete the task for each set of 30 Kanji or Hiragana characters. The final task was a letter recognition task in which students were presented with nonsense syllabary strings each for a one second period. The students were asked to copy the letter-string that they saw using either syllabary characters or romanized Japanese.

The analyses examining the relationship between letter identification performance in Hiragana and the comprehension measures at Times 1 and 2 showed correlations ranging between .47 and .72. Regression analyses using each of the five comprehension measures obtained as the criterion variable and the three lower level reading tasks (i.e., Hiragana letter recognition and Hiragana and Kanji word recognition) as predictor variables were performed. Letter recognition was found to significantly predict performance on the cloze tests but not on the paragraph comprehension tests. This result was believed to be due to the fact that the cloze task primarily involves grammatical analysis. Since Hiragana characters are always used in Japanese to represent grammatical morphemes, efficiency in recognizing Hiragana nonsense letter-strings predicted performance on the cloze task. It should also be noted that the predictability of cloze task performance from the Hiragana letter identification performance decreased over the testing periods. Koda interpreted this finding as a result of the progress students had made in Hiragana recognition over the course of the semester.

Summary on Letter Recognition Processes

In the context of a component-processing approach to L2 reading, Brooks' and Koda's research points to a number of factors that may have an impact on L2 reading development and performance. The first issue concerns the rate of development of knowledge about the individual symbols and their corresponding sounds, as compared to the rate of development of knowledge that allows for the efficient application of the sounds to the symbols (i.e., procedural knowledge). Individuals might be able to accurately apply sound-symbol correspondence rules long before they can apply this knowledge in an efficient manner. This suggests that assessments of letter recognition performance should include measures of automaticity such as recognition speed, in addition to accuracy measures. To the extent that the simple differentiation of one symbol from another and the process of making associations between symbols and sounds constitute labor-intensive processes, they consume attentional resources that would otherwise be allocated to comprehension-oriented processing.

This research also raises the question of whether the time course for the development of efficient sound-symbol relationships might differ for a reader whose native language is based on a different script (e.g., Arabic-English) and one whose native language uses essentially the same

script (e.g., German-English). Different-script readers need to learn to associate a new symbol with a new sound, whereas same-script readers need to learn to associate a familiar script with a new sound. This difference might impact on the instructional emphases that each group would require during the initial stages of learning to read in a second language. For example, students who are learning an entirely new script might need more exposure to activities that foster the development of letter discrimination skills.

Word Recognition

The research on visual word recognition in adult L2 readers has, for the most part, concentrated on whether these readers apply the knowledge and/or procedures that they use to visually recognize words in their native language to the process of L2 reading. The issues that need to be examined in relation to this question differ depending on whether the second language and the native language share a writing system. For this reason, we have organized our discussion into sections based on similarities and differences in the script. Additionally, we have prefaced these sections with a discussion of the differences in the linguistic units represented by writing systems and differences in the visual recognition processes that are afforded by different writing systems.

Cognitive Processing Differences Across Writing Systems

Distinctions between writing systems are often made in terms of the unit of language that they represent (Rayner & Pollatsek, 1989). Logographic writing systems such as Chinese often use morphemes and words as their representational units. Logographic systems rely on visual systems (i.e., pictures) to represent units of meaning. This is not to say that logographic systems do not have a way of representing the sound of written characters. Chinese, for example, contains phonetic markers. However, there is disagreement concerning the extent to which these phonetic markers are used to access Chinese words. As Coltheart (1984) explains, not all words contain the phonetic markers and these markers sometimes function as semantic elements. Moreover, pronunciation of the word and of the marker have changed over time. The marker may only approximate pronunciation of the word given that the tone of the sound is not represented (Coltheart, 1984).

In syllabaries such as the Japanese Kana, the written characters represent or map onto speech syllables. In Japanese, for example, the syllables are in some cases represented by arbitrary characters. In others, the syllable is represented by a pictorial symbol (Rayner & Pollatsek, 1989). It is interesting that the pictorial symbol is not necessarily related to the meaning of the word as a whole. It is as if the English word *dogmatic* were represented by combining a pictographic representation of *dog*, an arbitrary symbol for the middle syllable, and a pictographic symbol for a *tick* (the insect).

The characters in phonemic or alphabetic writing systems generally represent phonemes. Within the same alphabetic writing system, languages may vary to the extent that they have a shallow or a deep orthography (Coltheart, 1984). Shallow orthographies exhibit regular grapheme-phoneme correspondence in that a phoneme is generally represented by a single letter. Deep orthographies, on the other hand, may have one letter representing more than one phoneme.

The differences surrounding the units of speech represented in each writing system have prompted questions about possible distinctions in the processing mechanisms that support visual word recognition across these systems. In particular, researchers have questioned whether readers of logographic writing systems, such as Chinese, rely more on visual (as opposed to sound-based) routes to meaning than readers of an alphabetic language such as English. Researchers have questioned whether the logographic character is translated into the speech unit it represents prior to accessing the meaning of the character (as is believed to be the case in

alphabetic systems),[3] or whether meaning is derived without the involvement of sound. One reason that researchers have investigated the manner in which words are visually recognized across writing systems is the idea that these studies may help identify universal aspects of the reading process (Henderson, 1984).

A number of studies have investigated these processing differences across writing systems.[4] Biederman and Tsao (1979), for example, used the Stroop task to examine differences in visual word recognition processing between English and Chinese readers. The typical Stroop task involves presenting skilled readers with a color name (e.g., blue) printed in a different ink color. The reader is asked to name the ink color and to ignore the meaning of the word (Stroop, 1935). As it happens, participants take longer to name the ink color under this condition than when the ink color appears on a color patch. This has been interpreted as evidence that skilled readers are unable to refrain from processing the meaning of a word, presumably because their word-processing skills have become automated. One characteristic of automated cognitive processes is that they are outside of volitional control (LaBerge & Samuels, 1974). Therefore, one cannot help but recognize the letter pattern and process its meaning.

Biederman and Tsao (1979) reasoned that, if meaning were, in fact, more directly related to the configural appearance of the stimulus in the logographic characters, then Stroop interference for Chinese readers should be greater than the interference for the English readers, since they associate the graphic stimulus to meaning by application of sound-spelling rules. Moreover, the authors speculated that, because access both to meaning from a configural pattern and access to color information show a right-hemisphere processing advantage, processes involved in completing these tasks may compete for perceptual capacities, thus, showing more interference. The findings of Biederman and Tsao (1979) were consistent with their hypothesis. They found that Chinese readers experienced more interference than English readers when completing the Stroop task.

Tzeng and Wang (1983) also report data on this issue. They conducted a study using a modified version of the Stroop task. Tzeng and Wang (1983) asked English-speaking subjects to look at two numbers on a screen and select the one of higher value. When the number of smaller value was printed in a larger font, a Stroop-like interference occurred. However, when the same numbers were printed in English as words, the interference disappeared. When the study was conducted with Chinese speakers, the interference that was present using the number symbols did not disappear when the numbers were printed as Chinese characters.

Perfetti and Zhang (1991) have also presented evidence supporting the claim that logographic characters are processed differently than alphabetic scripts. These authors used a backward-masking procedure to determine whether there was evidence of prelexical (prior to accessing meaning) phonemic effects. In the backward-masking task, the participant is briefly (30–70 msec.) shown a target word. This target word is later replaced by a mask that is graphically similar to the target word but phonemically different; graphically dissimilar but phonemically similar; semantically related but graphically and phonemically dissimilar. The participant is also shown a neutral mask that is neither graphically, phonemically, nor semantically similar to the target word. The participants are asked to report the target word after each trial, and their responses are scored in terms of accuracy. The logic behind the task is that, once early processing of the target word is interrupted by the mask, the mask can help reinstate either the graphic or phonological processing (depending on the similarity between the target and the mask) that had already taken place (Perfetti & Bell, 1991). A previous study by Perfetti and Bell (1991) conducted with English speakers had shown prelexical phonemic effects. That is, phonemic similarity facilitated processing of the target word, indicating that there had been very early processing of sound (the target word was presented for only 30 msec.) prior to accessing the meaning of the word. When this task was used with native Chinese speakers, there was no evidence that sound was processed prior to meaning. Rather, the evidence was consistent with the claim that sound and meaning are accessed simultaneously in reading logographic characters.

Other researchers have obtained different results when examining questions about differences in processing across writing systems. Smith and Kirsner (1982), for example, replicated the Biederman and Tsao study and obtained different results. Their study found no differences in the amount of interference produced by processing Chinese logographs and the amount produced by processing English words, suggesting that both types of words were processed in similar ways. Similarly, Seidenberg (1985) provided evidence that access to meaning in English and Chinese high-frequency words followed a direct route to meaning in both languages, while low-frequency words in both languages showed phonological mediation.

The evidence that different writing systems afford different cognitive-processing mechanisms has raised some interesting questions for L2 researchers. In particular, it has raised the issue of whether the visual word-processing mechanisms employed in the native language are transferred to the L2 reading situation.[5] We will now examine the evidence that has accumulated on this issue.

Cognitive Processing Across Different Writing Systems

Earlier we described a study by Biederman and Tsao (1979) that examined differences in the amount of interference experienced by logographic and alphabetic readers while performing a Stroop task. The study found that readers of Chinese experienced more Stroop interference than did readers of English. The following study investigated whether Chinese-English, Japanese-English, and Spanish-English bilingual readers experienced a reduction in the amount of Stroop interference under same language (intralingual) conditions and different language (interlingual) conditions. In the interlingual condition, participants name the ink color in one language while the color name appears in the alternate language. Fang, Tzeng, and Alva (1981) reasoned that, in the same manner that "a reader of alphabetic writing cannot refrain from applying an abstract rule system to the word ... a reader of Chinese may not be able to refrain from configurational processing of the logograph" (p. 610). They further argued that, because Spanish and English require the same obligatory processing and Chinese and English require different obligatory processing, then Chinese-English bilinguals should experience more reduction in Stroop interference from the intralingual condition to the interlingual condition than the Spanish-English bilinguals. The results were consistent with the hypothesis, leading Fang et al. (1981) to suggest that, as the orthographic structure of the two languages becomes more similar, the processing becomes more similar as well.

Tzeng and Wang (1983) also investigated whether there was evidence for transfer of word-processing strategies from a logographic to an alphabetic script. They report on a study in which participants were asked to select the larger of two numbers appearing on a screen. As the reader may recall, the number of smaller value appeared in a larger font, a manipulation which produced interference on the decision time. The reader may also recall that the interference disappeared when the numbers were printed as English words but not when they were printed as Chinese characters. In the present study, the authors asked Chinese-English bilinguals to perform this task and found that these individuals also experienced interference when the numbers were printed as English words. The same was not true for Spanish-English bilinguals performing the task. These participants experienced interference in the Arabic number condition only, not in the Spanish or English word condition. These results led the authors to conclude that the Chinese speakers were transferring the processing strategies used for logographs to the processing of the alphabetic system.

A study by Brown and Haynes (1985) qualifies the findings of Tzeng and Wang by examining the relationship between the application of the native script-processing strategies with proficiency in the second language. Brown and Haynes (1985) were interested in the effects of literacy background and, in particular, of writing-system background on L2 learning. These researchers conducted two studies that examined visual processing differences in English that might exist among Japanese, Arabic, and Spanish readers who were studying ESL in an

English language program at a U.S. university. The participants performed several tasks designed to reveal potential differences in visual word recognition processing. Among the tasks was one measuring visual discrimination efficiency (using both accuracy and speed information) with a same-different matching task of words, pseudowords, and nonsense strings. That is, students were asked to decide if pairs of words, pseudowords, or nonsense strings were the same or different. On this task, the experimenters predicted that, due to their greater familiarity with the Roman alphabet, the Spanish speakers would be the fastest performers. However, they found that the Japanese speakers were the fastest and that Spanish speakers were faster than Arabic speakers. The same was true when students were required to match same or different abstract figures. Here Japanese speakers were also superior, but the Spanish and Arabic speakers performed at the same level. The investigators hypothesized that the advantage in visual processing demonstrated by the Japanese students was not specific to the processing of linguistic symbols.

The findings from other tasks in the experiment also supported the authors' conclusions concerning the above task. When the students performed a word naming task using short and long words, there was no difference in the performance of the three groups on the short words. However, Japanese speakers were significantly slower than speakers from the other two groups on the long words. Thus, as the stimulus became more complex, the Japanese students lost their processing advantage. The Japanese students also showed a greater familiarity effect in that they were better able to efficiently name real English words than English-sounding pseudowords. This finding suggests that the Japanese readers were not able to exploit the spelling-to-sound rules that the other two groups of readers were accustomed to using. The Japanese readers were more dependent on their sight-word knowledge.

The results of this study prompted the researchers to conduct a second study with the purpose of examining what was to them "the intriguing possibility that the Japanese students were treating the letter-strings of the matching task more like the abstract figures of the visual discrimination tasks" (Brown & Haynes, 1985, p. 28). In this study, the Japanese students still outperformed the Spanish and Arabic speakers in their speed on the matching tasks. However, the effect due to stimulus length, which was present for the previous sample of Japanese learners, was not replicated. In addition, the Japanese speakers showed smaller differences between their word, pseudoword, and nonsense string matching than the other groups of readers. This finding suggested to the authors that these readers were not using orthographic regularity as a basis for their matching decisions.

Although the findings discussed so far may suggest that readers of a different writing system are able to employ these strategies in the second language, Brown and Haynes present some further evidence suggesting that, while they may use this strategy initially, they do not necessarily stick to it as their language proficiency develops. The second study by Brown and Haynes showed that, when each of the language groups was divided according to high or low proficiency, the more advanced readers (including the Japanese readers) were faster on all types of words. However, they were also more adversely affected by the loss of orthographic regularity that the nonsense strings imposed. As the authors argue, "while Japanese students may show smaller effects of orthographic regularity overall, their progress in reading English is nevertheless associated with increasing sensitivity to orthographic regularity—just as it is for the other L2 [second language] groups and for other beginning L1 [native language] readers" (Brown & Haynes, 1985, p. 29).

A study by Haynes and Carr (1990) also found this relationship between language proficiency and reading for Taiwanese readers learning to read in English. Higher proficiency in reading English was related to developing sensitivity about the orthographic structure of English as is the case with native speakers of English (Haynes & Carr, 1990). "Linguistic knowledge, as well as world knowledge, is necessary for all forms of language comprehension, but orthographic knowledge is indispensable for reading. Comprehension of text simply cannot

take place without knowledge of the written code, no matter how skilled a person may be as a speaker or listener. This is a fundamental fact that is sometimes forgotten or ignored by ESL researchers" (Haynes & Carr, 1990, p. 377).

Haynes and Carr (1990) examined visual processing efficiency of English by more and less proficient Chinese readers and native English readers. They also examined the relationship that exists between performance on visual orthographic processing by the native Chinese speakers and reading outcomes such as comprehension, reading time for texts, and vocabulary learning in context. The participants in the study were senior and freshmen college students at a Taiwanese university. The seniors in this study had more years of exposure and instruction in English. A group of monolingual English speakers from a U.S. university also participated in the study. The students were tested on a set of visual efficiency measures that included a same-different visual matching task. Students were asked to decide if two letters were the same or different, if a pair of three-digit numbers was the same or different (this was used as a covariate to control for differences in processing efficiency that were not the result of processing English stimuli), if a pair of four-letter words was the same or different, if pseudowords were same or different, and if four-letter-strings were the same or different (these did not conform to English orthographic rules). Performance measures were based on the speed and accuracy of subjects in completing the task.

This study (Haynes & Carr, 1990) also included a language proficiency measure involving a lexical-semantic synonym/antonym matching task. On this task, students were instructed to respond same if the two words meant the same thing or *different* if a pair of words meant the opposite. The experimenters also had the students perform a native language reading comprehension test, an English listening comprehension test, and two English cloze tasks, one measuring knowledge of syntax and the other measuring knowledge of vocabulary. They also measured the following outcome variables: reading comprehension in English, reading time, and vocabulary learning from text.

The experimenters compared performance on the word and pseudoword matching tasks to performance on the letter-strings for both the Taiwanese and native English speaking group. The results of this analysis showed that the Taiwanese students did not seem to benefit from the presence of orthographic regularity in the words and pseudowords over the letter-strings as much as the native English speakers did.

Additionally, regression analyses examining the relationship between component processing variables and the outcome measures showed that L2 reading comprehension was significantly predicted by (a) the ESL students' ability to read and comprehend Chinese, (b) by their ability to use the orthographic patterns of the English language during visual matching, and (c) by their listening comprehension ability in English. They also found that performance on the vocabulary learning measure was predicted by the (a) general components of number matching and Chinese reading comprehension, (b) visual matching of words, (c) ability to use the orthographic regularity of the English language, and (d) language proficiency measures in English (particularly vocabulary knowledge and listening comprehension). The authors concluded that "writing-system knowledge continues to exert an impact on reading outcomes beyond the early stages of language learning in general and beyond the early stages of exposure to any given text, particularly in situations like that of new word learning in which effective discrimination among potentially confusing word forms is essential" (Haynes & Carr, 1990, p. 413).

Koda's (1992) study (described in the section on letter recognition) has also demonstrated a positive relationship between the development of efficient low-level reading skills and comprehension. In her study of native English speakers learning to read Japanese, she obtained evidence that efficiency in recognizing Hiragana nonsense letter-strings, Hiragana words, and Kanji words significantly predicted Japanese reading comprehension on two separate test occasions.

Schoels (1991) examined a somewhat different issue related to the effects of native

language background on L2 word-processing performance. This study used a phoneme deletion task to determine whether native language background affected phoneme manipulation performance in English when the subject's native language was an alphabetic language and when it was not. The subjects included a group of native Spanish speakers, a group of native Chinese speakers, a group of native English speakers, and a group of English language learners from heterogeneous language backgrounds.

The phoneme deletion task included three types of items. In the first item type, the phoneme that was to be deleted corresponded to a letter in the word (e.g., raft /f/ would form rat). In a somewhat more difficult item, the relationship of the phoneme to the grapheme was less clear (e.g., quick /w/ kick). The most difficult items were those in which the phoneme was not exclusively represented by a letter in the word (e.g., taxed /s/ tacked). The task could be completed using two different strategies: internal visual processing or auditory processing. In the aural processing strategy, words like *thought* would be pronounced as *thaw* once the /t/ sound was deleted, and *liked* would be pronounced as *light* once the /k/ sound was deleted. In the internal visual processing strategy, *liked* would be pronounced as *lied* once the /k/ sound was deleted, and *thought* would be *though* once the /t/ was deleted. The participants were instructed to follow an auditory processing strategy.

The results of Schoel's study showed that nonnative speakers were more accurate on the most difficult items than the native speakers. Moreover, there were differences between the groups in the type of processing in which they engaged. The majority of native English speakers engaged in visual processing strategies, whereas the majority of Chinese speakers engaged in the aural processing strategy. The Spanish and heterogeneous language groups seemed to divide somewhat equally between the two processing strategies. The explanation offered for this difference was "that Chinese speakers were more attuned to sound and less to spelling than users of alphabetic orthographies" (Schoel, 1990, p. 139). Unfortunately, little information is provided regarding the subjects' English proficiency levels. However, one could speculate that use of an internal visual strategy is correlated with level of reading proficiency. It is possible that as these native Chinese readers become more attuned to the orthographic patterns of the English language, they would be more likely to engage in an internal visual strategy to perform such tasks. Other studies have shown that reading affects aural processing (Henderson, 1984). This being the case, one could further speculate that the Chinese readers' tendency to rely on sound does not represent an invariable processing strategy but rather reflects a strategy characteristic of a particular point in the development of reading skills for Chinese readers of English.

The last two studies reviewed in this section have examined the transfer of word-processing strategies across writing systems at a different moment in the processing of words: after lexical access (Koda, 1987; 1989). In particular, these studies have examined whether the inability to phonologically recode a word affects English reading comprehension in native readers of logographic scripts as much as it does native readers of English. Phonological recoding (to access the sound of a word) is believed to aid comprehension by allowing the reader to register information in short-term memory as input for the operation of comprehension-oriented processes (e.g., propositional integration). Research with native English speakers has shown that inability to pronounce a word affects comprehension (see Koda, 1989 for a review of this research).

Koda (1987) examined whether phonological inaccessibility affected the Japanese speakers' reading of English as much as it did native English speakers. In Koda's study, Japanese students in a summer-long, intensive English language program read English passages containing either unpronounceable or pronounceable nonsense words that were used to refer to different types of fish. While this manipulation was shown to adversely affect the English readers, it did not seem to have the same impact on Japanese speakers/readers. The study with native English readers showed that they were adversely affected by the presence of the unpronounceable words in English text, while the study with Japanese readers showed they

were not. Koda's study has been criticized on the grounds that it tested the null hypothesis (the lack of a significant difference was interpreted as supporting the prediction that Japanese readers would not be affected by phonological inaccessibility; Grabe, 1987). However, the findings from her 1989 study provide stronger evidence on this issue.

Spanish-, Arabic-, Japanese-, and English-speaking university students with a college-level education in the native country and with a minimum of six years of English instruction participated in Koda's (1989) study. The task was based on an ordered-recall paradigm. These students were shown five letter-strings on index cards, and then a probe was administered. After the probe, the students were to indicate what letter-string had followed the probe word in the five letter-strings sequence. Prior to this, the students received a display card that contained eight stimuli from a stimulus set. The stimulus sets were either phonologically similar pronounceable letter-strings, graphically similar/phonologically dissimilar pronounceable letter-strings, graphically and phonologically distinct, pronounceable letter-strings, or unpronounceable letter-strings. These sets were constructed for English, Japanese, and Sanskrit.

As in her 1987 study, Koda (1989) reasoned that phonological inaccessibility in English would not have as adverse an effect on the performance of the Japanese readers as it would on the alphabetic readers. She hypothesized that this difference across groups would result because Japanese readers must often employ other coding strategies when phonological information is not contained in the character. The analyses comparing the performance of phonographic (Spanish, English, and Arabic) readers and logographic (Japanese) readers showed that the latter group had better performance on the unpronounceable letter-string set in English than on the phonologically similar letter-string set. The results for the phonographic readers were just the reverse; performance was better on the phonologically similar sets than on the unpronounceable sets. Thus, Japanese readers' performance on the English sets was not impaired by the lack of phonological information in the stimuli.

Analyses focusing on the performance of Japanese students on the Japanese stimulus sets demonstrated that their best performance was on the graphically similar/phonologically dissimilar sets followed by performance on the unpronounceable sets. The poorest performance was on the phonologically similar set. Finally, analyses of performance on the Sanskrit set showed no differences across groups.

The results suggest that lack of information about the pronunciation of a character or alphabetic letter-string does not affect Japanese readers' recall of the character or letter-string. The results are consistent with the notion that these readers apply the cognitive processes that underlie word-level processing in their native language to the second-language reading situation.

The studies provided in this section suggest that individuals who read languages that employ logographic coding systems initially transfer these strategies to reading in alphabetic-based systems. However, some of the studies reviewed in this section also suggest that there is a positive relationship between the readers' knowledge of the orthographic redundancies of the second language and their proficiency in that language. In addition, the evidence suggests that efficiency in L2 word identification is positively related to L2 comprehension regardless of the writing system of the target language.

Cognitive Processing Across Similar Writing Systems

Researchers are also interested in the impact of native language on the processing of a second language that uses the same writing system. Besides the study by Brown and Haynes, which included Arabic speakers, we have not found studies that examine the impact of the native language when the two languages employ the same writing system but are based on *different* scripts. The reader may recall that the Brown and Haynes study, which compared students who were readers of Spanish to students who were readers of Arabic, concluded that

the Spanish readers were more efficient at the same-different matching task when the stimuli were words, pseudowords, or nonsense strings, but that these groups were no different when the stimuli were abstract figures. This result suggests that even when the underlying processes are presumed to be the same, familiarity with the script seems to prove beneficial (with regard to determining if two stimuli are the same or different).

The next set of studies explores how knowledge of one language influences visual processing in another language when both are based on the same script. In particular, these studies attempt to determine whether knowledge of the orthographic redundancies of one language influence the recognition of words in an alternate language. This body of research supports the conclusion that fluent bilinguals do not switch off knowledge of their alternate language during language processing.

A common paradigm used to examine this question involves the Lexical Decision Task (LDT). The LDT requires that subjects decide if a letter-string is a real word. Typically, experimenters measure the time subjects require to mark *yes* if the stimulus is a real word, and *no* if it is not a real word. The nonword stimuli may be any of several types. They can be pseudowords (e.g., *sorbid*), which follow the orthographic conventions of the language in question; they can be unpronounceable letter-strings (e.g., *tprle*); or they can be a neutral stimulus (e.g., a string of X's).

Altenberg and Smith-Cairns (1983) used the LDT in a study examining the influence of knowledge of German orthographic regularities on the English word recognition among fluent English-German bilinguals. They had subjects make lexical decisions about a set of English words and about a set of nonwords that fell into one of the following four categories: (a) orthographically legal (i.e., following the spelling conventions of the language) letter-strings in German but not in English, (b) orthographically legal letter-strings in English but not German, (c) orthographically legal letter-strings in both English and German, and (d) orthographically illegal (i.e., contradicting the spelling conventions of the language) letter-strings in both English and German. The authors were interested in determining whether the subjects would apply the phonotactic constraints of both languages (English and German) when performing a lexical decision task in English. They were particularly interested in whether the legality of the letter-string in German influenced the manner in which subjects responded to the English words.

The results of the study were consistent with the interpretation that the subjects were applying their knowledge of German phonotactic constraints, even when processing English words. It took the subjects the same amount of time to reject nonwords that were legal in German but not in English as it did to reject nonwords that were legal in English but not German. Nonwords that were illegal in both languages took less time to reject than nonwords that were legal in both languages. These results suggest that the subjects were not able to ignore knowledge of the orthographic patterns of their second language (German) when making decisions about the lexical status of words from their first language (English). As the authors point out, these results provide evidence that the subjects' knowledge about German spelling patterns was being activated even while processing in English.

Another study examining this question (Nas, 1983) had Dutch-English bilinguals make lexical decisions in English (the second language) about lists that included: (a) English words, (b) Dutch words that were orthographically legal in English (but not actual English words) and had different pronunciations in each language, and (c) English-derived nonwords. The results showed that the subjects took longer to reject the Dutch words than to reject the English-derived nonwords. Thus, subjects were not able to suspend their knowledge of Dutch during completion of this task.

In a second experiment, Nas (1983) had subjects make lexical decisions about lists that contained English words, English pseudowords that when pronounced according to English

rules actually sounded like Dutch words, and English-derived nonwords. The results showed that the Dutch-sounding nonwords took longer to reject than the English-derived nonwords. This suggests that the phonological overlap with Dutch words activated the entries or representations for these words in the Dutch lexicon. The results of the study are consistent with the idea that the subjects' knowledge of Dutch was not rendered inaccessible by virtue of having to perform the task in English, and that their knowledge of Dutch influenced how quickly they were able to judge whether or not a stimulus constituted an English word.

Lukatela, Savic, Gligorijevic, Ognjenovic, and Turvey's (1978) study of Serbo-Croatian speakers also provides evidence consistent with the above findings concerning activation of orthographic and phonological knowledge among bilinguals. Although the participants were not bilingual, Serbo-Croatian can be written using two different writing systems, Roman and Cyrillic, which have characters in common. The researchers showed that when these two writing systems for Serbo-Croatian map different sounds to the same characters, these characters are assigned two different phonological interpretations during processing as well.

Some of these characters receive the same sound when read using each of the two writing systems. For example, the characters *A, E, O, J, K, M,* and *T* have the same grapheme-phoneme correspondence in the two writing systems. However, the characters *H, P, C,* and *B* are pronounced differently, depending on whether they appear in Cyrillic or Roman. Thus, when subjects in the study were confronted with letter-strings that could be assigned two distinct readings depending on which writing system was used, they simultaneously assigned two different phonological interpretations to those strings.

The studies reviewed in this section suggest that knowledge of the orthographic patterns of one language remain active even when bilinguals are performing a task in another language. The studies also suggest that both sets of knowledge can be applied simultaneously towards the processing of a stimulus. However, most of the evidence comes from examinations of how knowledge of the alternate language influences the manner in which nonwords are processed. There is no real indication from these studies that the findings can be extended to the visual recognition of real words. The next set of studies discussed here should help clarify this issue.

The following studies have dealt with the way in which bilinguals (whose two languages share a script) decide what lexicon to search when they are presented with a visual stimulus. Two arguments have been offered. One states that bilinguals use language context (as defined by the language in which the task will be performed) to constrain lexical search (Gerard & Scarborough, 1989; Scarborough, Gerard, & Cortese, 1984). The other position states that the appropriate lexicon is selected via data-driven processing. The stimulus itself automatically activates the representation in the appropriate lexicon. That is, the properties of the stimulus guide the search into the lexicon. The following studies have examined how orthographic knowledge may help guide access to the appropriate lexicon.

Grainger and Beauvillain (1987, Experiment 2) obtained results that are consistent with the notion that the appropriate lexical choices are data-driven for bilinguals. Grainger and Beauvillain had English-French bilinguals make lexical decisions about words in pure-language lists and mixed-language lists. In the mixed-language lists, the sequence of items were varied so that some items were preceded by either a same-language word, a different-language word, or a nonword. They hypothesized that if the appropriate lexicon were preselected on the basis of language mode, then response times to words in the pure-list condition would be shorter than in the mixed-list condition. This difference is due to the fact that, in the latter condition, subjects will (on some trials) search the wrong lexicon. On the other hand, if the lexicon is selected via data-driven processing, then there should be no difference in the response times to words in the pure- and mixed-list conditions.

The words in both types of lists also varied with respect to whether or not they followed a

language-specific orthography. Words with language-specific orthographic structures had spelling patterns that occurred in only one of the two languages of the bilingual subjects. For example, words containing *wh* were considered to have a language-specific orthographic structure since *wh* is not a legal spelling pattern in French. Nonspecific words were orthographically legal and pronounceable in the other language. An example of such a word is the French word *vide*. The results of the experiment showed that response times to words with language-specific orthographic structures were the same regardless of whether or not they were in pure- or mixed-language lists. Words with nonspecific orthographic structures produced a pure-list/mixed-list effect only when they were preceded by a word in the alternate language. The authors argued that the results were not consistent with a preselective mechanism since such a mechanism would have predicted better performance overall on the pure lists than on the mixed lists. The results are consistent with the notion that stimulus-driven mechanisms guide access to the appropriate lexicon. The results also suggest that when word recognition takes place in isolation, fluent bilinguals can exploit their knowledge of the orthographic redundancies of their two languages to aid word identification.

Grainger and Djikstra (1992) demonstrated that lexical decisions made by English-French bilinguals concerning English target words were affected by the number of French neighbors of particular English target words. The neighbors were defined, in accordance with Coltheart, Davelaar, Jonasson, and Besner 's (1977) criterion, as words that could be formed by changing a single character while preserving the position of all other characters. By this definition, the word *late* has neighbors such as *mate*, *lute*, and *lace*.

The target words in Grainger and Djikstra's (1992) study were of three types. *Patriot* words were those with more English language neighbors than French neighbors. *Traitors* were words with more French neighbors than English neighbors. Finally, *neutrals* were words with roughly equivalent neighborhood sizes in both languages. The results showed that lexical decisions on patriot words were faster than those on neutral words. The slowest lexical decisions were on words in the traitor group. These results were interpreted as supporting a Bilingual Interactive Activation (BIA) model of bilingual word recognition. In this model, there are three hierarchically organized levels of representation. The lowest level consists of letter nodes, the next level is made up of word nodes, and the highest level contains language nodes. Levels that are adjacent to one another are connected, and there are interconnections among nodes within a level. Moreover, the language nodes can inhibit one another. Within this framework, response to English traitor words is believed to be slower because of the French language node. Activation of the French language node will inhibit the English language node, which will in turn make recognition of the English target word more difficult. With respect to performance on neutral words, it is believed that each of the language nodes will receive approximately equal levels of activation and the inhibition of two language nodes will cancel each other out. Finally, patriot words will give the English language node more activation than the French language node; consequently, recognition of these words will be facilitated relative to neutral or traitor words, which will produce a degree of inhibition for the English language node.

Beauvillain's (1992) study also suggests that cross-language orthographic similarities affect the manner in which bilinguals process words in their two languages. She argues that, when a word contains an orthographic pattern that is common to both languages, the word activates a subset of possible lexical candidates from both languages. However, when a word has a language-specific orthographic pattern, the subset of lexical candidates that is activated belongs only to that language. According to Beauvillain, this difference in the size of the candidate set for language-specific words versus nonspecific words translates into differences in the speed of recognition of these words. In another experiment, she found that bilinguals responded faster to words that contained language-specific orthographic patterns than to words that contained nonspecific patterns that were matched in frequency. Response times by monolinguals did not show differences in performance between these two types of words.

Thus, the findings presented in the paper to this point suggest that fluent bilingual readers can—and do—exploit their knowledge of the orthographic patterns found in their two languages when identifying words. The evidence we have reviewed is consistent with the argument that an ability to exploit this information may even accelerate processing of words during reading in either language. However, the above evidence is limited with respect to how much it can be generalized to real reading situations. All of these studies have examined how words are processed in isolation. Further investigations are needed to discover how these sources of knowledge are used during the reading of connected text.

Development of Efficiency in Second-Language Word Recognition

Favreau, Komoda, and Segalowitz (1980) conducted two studies with English-French bilingual subjects who could read each language with equal comprehension but read their second language at a slower rate. The study used a letter recognition task to examine the degree to which L2 readers showed sensitivity to the orthographic redundancies of the second language (Favreau, Komoda, & Segalowitz, 1980). The experimenters asked the participants to report the letter that appeared in a target position in English words, word anagrams, or single letters surrounded by ampersand characters. The main finding of this study was that a word *superiority effect* (i.e., individual letters are more accurately recognized when they appear in real words than in random letter-strings) emerged for both languages, but the effect only emerged in the second language if additional processing time was provided. The authors concluded that the subjects did have knowledge of orthographic redundancies in both languages, but they differed in how efficiently they used this knowledge.

Another study conducted by two of the above cited authors, Favreau and Segalowitz (1984), asked subjects to perform a first- and a second-language version of a primed lexical decision task similar to the one used by Neely (1977, cited in Favreau & Segalowitz, 1984). In the Favreau and Segalowitz study (as in Neely's), the expectations about the semantic relationship between a prime (i.e., a word presented prior to the target word) and a target word (i.e., the word on which a lexical decision will be made) was manipulated. In one condition, subjects were told to expect two semantically related words. In another condition, they were told to expect two semantically unrelated words. Within each of these conditions, subjects were presented with related and unrelated pairs of words that they did not expect. The experimenters were interested in testing the hypothesis that slower L2 reading was due to less automaticity in terms of lexical access. The results showed that the subjects who read their first and second language *at the same rate* showed facilitation for semantically associated words in both languages. That is, the presentation of a semantically related prime accelerated lexical decisions on the target word. However, subjects who read their second language *at a slower rate* showed no facilitation for the semantic associates under conditions in which automatic semantic priming was purportedly operating. The authors concluded that the slower L2 reading of the unequal reading-rate group was related to their inability to automatically process words in the second language.

Meara (1984) has also conducted research investigating possible reasons for the difference in native and second-language word recognition efficiency. His research examined the effects of word length, word frequency, and morphological complexity on the accuracy of recognizing words presented during brief exposures (200 msec.). In terms of word length and word frequency, he has found the same main effects that are found with native English speakers: Accurate recognition of low frequency words and long words is more difficult. However, these effects are exaggerated in the second language.

Meara (1984) also reports on some evidence obtained using a letter cancellation task with Chinese speakers. He has found that Chinese speakers make fewer errors than native English speakers on the letter cancellation task. However, the patterns of error are similar to those demonstrated by native English speakers. Accuracy decreases as the target letter appears later

in the word. He concludes that "if we accept that error level is an indication of how much detailed processing is going on, then it seems that these non-native speakers are working much harder and more painstakingly than their native speaker counterparts" (p. 103).

It is unfortunate that Meara (1984) presents so little information about the proficiency level of the study's participants. Even so, within the componential perspective, one could speculate that greater accuracy of letter cancellation could be the result of more conscious attention to the individual characters. This conscious attention could be due to a lack of automaticity in word recognition. One would speculate that as reading proficiency increased, letter cancellation performance would approximate that of native English speakers.

Studies of Second-Language Learners' Eye Movements

Oller and Tullius (1973) conducted the first of a small number of studies investigating the patterns of eye movement produced by L2 readers. They had ESL college students (who spoke 21 different languages) read a college-level text for an eye-movement photography experiment. In this study, the ESL learners were compared to native English speakers in terms of the number of fixations (the number of times the eyes fixate on words), the fixation duration, number of regressions (defined as the number of times the eyes returned to a previously fixated word on the same line), the average word span (the average number of words recognized during a fixation), and the number of words read per minute. The main results showed that ESL subjects who read the college-level text with 70% comprehension or more were no different than native speakers, in terms of the average number of regressions. The main results also showed that the average fixation duration for the ESL learners was significantly longer than that for the native speakers. The measure that showed the most marked difference was the average fixation duration.

Another eye-movement study, conducted by Bernhardt (1987), found that, as level of language proficiency in German increased, the fixation durations approximated those of native German readers. However, the average fixation duration of the more proficient German (L2) readers was still 34 msec. longer than that of native readers. What is interesting about this piece of data is that the subjects in the experienced group were highly fluent German speakers. All of them had graduate degrees in German language studies. This raises the question of whether or not reading in a second language can be carried out as efficiently as in the first language.

Finally, a study by Osaka (1989) with four bilingual readers of English and Japanese (Kanji) recorded participants' eye movements as they read texts in each language. As in the previous two studies, the results showed that the fixation durations for these readers were longer for the English (L2) texts than they were for the Japanese texts.

All three of these eye-movement studies have converged on the finding that L2 readers appear to spend more time processing individual words in the second language. This finding is supported by comparing the word fixation duration times of the readers both to monolingual word fixation durations and to their own native language word-fixation durations. What is not known from these studies is the source of these differences. The studies reviewed above, which point to differences in lexical access time and to differences in the efficiency of using orthographic knowledge, do, however, offer some suggestions for future investigations of this issue. That is, the longer fixation durations may reflect the additional time needed to access the meaning of a word, or they may reflect additional processing that results from the overlap in the orthographic structure of the two languages. Research that distinguishes between these and other possible explanations could help clarify some of the differences and similarities between reading processes in bilinguals and monolinguals and between more and less proficient L2 learners.

Summary on Word-Level Processes

The studies reviewed in this section focused on the consequences of having an L1 writing

system that is different from, or similar to, the L2 for the visual processing of words during L2 reading. Research on readers of logographic scripts learning to read alphabetic scripts suggests that the processes that support word identification in logographic scripts are used for word identification when reading alphabetic scripts. However, reliance on this strategy appears to be characteristic of beginning L2 readers and not of fluent L2 readers. It seems to be the case that progress in L2 reading is accompanied by the use of visual word-processing strategies similar to those used by native readers of alphabetic scripts.

The research reviewed here on the visual word-processing strategies of L2 learners when L1 and L2 share the same script suggests that fluent L2 readers are highly sensitive to the orthographic patterns of their two languages and that they depend on this knowledge to guide access into the appropriate lexicon. The findings from this research suggest that these readers rely on highly efficient bottom-up processing for word recognition.

Finally, the research examining eye movements suggests that even highly proficient L2 speakers take longer to process words in the L2 than native speakers. What remains unclear from this research, however, is whether or not these differences reflect less efficient processing on the part of the L2 readers or simply different processing strategies altogether.

Lexical Access

Lexical Access and Bilingual Memory Organization

So far, we have been concerned with descriptions of reading processes that, for the most part, have not involved examinations of how L2 readers access the meaning of words. The manner in which bilinguals arrive at the meaning of words presents an interesting issue that has not been systematically studied in the context of L2 reading. Cognitive psychologists have long debated whether bilinguals access word meaning in the second language by referring to the native language or instead use separate, independent lexical systems in each language to accomplish this task. The literature on this subject is quite extensive, and discussion of the intricacies of this debate would add little to our understanding of the implications of these models for L2 reading. However, a discussion of the consensus model that has emerged from this literature is worthwhile in the context of our review of research on L2 reading.

Over the years, a consensus model of bilingual memory organization has emerged that presents interesting problems for the understanding and/or development of a model of L2 reading. This model, known as the Concept Mediation Model, characterizes fluent bilinguals as having separate lexicons in each language with links to a shared and amodal semantic memory store (Kroll & Stewart, 1992; Potter, So, Von Eckardt, & Feldman, 1984). The lexical representations are not believed to code information about meaning; rather, they code surface-level information such as orthographic and phonological information. Additionally, there are no links across lexical representations in the two languages. Thus, the process of translation occurs through mediation of the semantic or conceptual representations and not through mediation of lexical representations. The opposing model is based on the Word Association Hypothesis which argues that there are direct links across lexical representations in bilingual memory.

Early evidence for the Concept Mediation Model came from a study conducted by Potter, So, Von Eckardt, and Feldman (1984). Their study tested predictions derived from the Concept Mediation Model and the Word Association Model using word-naming, translation, and picture-naming tasks with fluent Chinese-English bilinguals and less fluent English-French bilinguals. According to the Word Association Hypothesis, the amount of time it takes to name a picture in the second language (L2) should be longer than the time required to translate from the first language (L1) into the second. Presumably, picture-naming, in terms of this model, requires recognition of an image, retrieval of the concept, retrieval of the L1 word, retrieval of the L2 word, and finally, naming of the L2 word. Translating, on the other hand, only requires

recognition of the L1 word, and retrieval of the L2 word in order to name the L2 word. In this model, translation does not require access to the underlying concept. The Concept Mediation Hypothesis does not predict differences in the time needed for picture naming in L2 compared to time needed for translating from L1 to L2. Both tasks require recognition of the surface form (the image or the L1 word), retrieval of the underlying concept, retrieval of the L2 word, and finally naming the L2 word. In Experiment 1, the fluent Chinese-English bilinguals named, translated, and categorized pictures and words. In Experiment 2, less fluent English-French bilinguals named or translated pictures and words. The results were consistent with the predictions of the Concept Mediation Hypothesis. There was no difference in the relative difficulty of producing an L2 word under conditions of picture naming and L1 word translation. According to the authors, the results are inconsistent with models that propose direct links between lexical representations (e.g., Kirsner, Smith, Lockart, & King, 1984; Paivio & Desrochers, 1980).

Although this Concept Mediation Model seemed to accurately describe the relationship between the two languages of fluent bilinguals, Kroll and Curley (1988) questioned the accuracy of the model with respect to less fluent L2 learners. These researchers replicated the study of Potter et al. (1984), using subjects that were more varied with respect to their L2 proficiency. Kroll and Curley (1988) hypothesized that at a very early stage in the acquisition of a second language, the processing of words in the new language is mediated lexically, not conceptually, through the first language. That is, L2 learners arrive at the meaning of words in the second language through associations with lexical representations in the native language. Access to the conceptual memory store proceeds through mediation of the native language lexicon. In essence, they argued that the Word Association Model would be a more accurate characterization of how L2 learners access the meaning of words in the second language. The findings from Kroll and Curley's studies were as follows: The pattern of results of the less fluent German speakers (those who had studied German for less than two years) was in agreement with the Word Association Model in that translating from L1 to L2 took less time than picture naming in the L2. The pattern of results from the more fluent subjects was consistent with the Concept Mediation Model in that the time necessary to translate words or to name pictures in German was essentially equivalent.

Chen and Leung (1989) also replicated the study by Potter et al. (1984). In a study that involved adult native speakers of Cantonese who were either proficient English speakers or beginners, these authors obtained similar results to those of Kroll and Curley (1988).

The evidence reviewed above suggests that both the Word Association Model and the Concept Mediation Model may each provide an accurate description of bilinguals at different levels of proficiency. Kroll and Sholl (1992) present a revised hierarchical model of bilingual memory representation that can accommodate the seemingly conflicting evidence described above into a developmental framework. The model contains two lexical stores and one conceptual store. Words in the native language are connected to the conceptual store via direct conceptual links. Words in the second language are initially connected to the conceptual store via lexical links with the native language. Frequent exposure to the L2 words eventually results in the creation of conceptual links between the L2 word and the underlying concept. The conceptual links from the native language to the conceptual store are stronger than those from second language. The model also allows for stronger lexical links from the second language to the native language to reflect the fact that translation usually takes place from the second language into the native language.

As mentioned earlier, we believe that the notion of developmental differences in bilingual memory organization may have important implications for our understanding of L2 reading and its development. This model points to an additional source of variation in reading performance as a function of proficiency levels. In essence, during the initial stages of L2 learning, an additional step needs to occur before access to the meaning of a word takes place. The word

must be translated into the native language. Although the evidence from these studies suggests that this translation process is automatic (i.e., it is not a conscious process), the fact that it differs from what occurs in native language reading and, presumably, in fluent L2 reading, presents interesting questions about the impact it might have on differing stages in the development of L2 reading proficiency. Here, we are thinking in particular about the possibility that this additional translation step may further tax attentional resources and thus affect the operation of other reading processes during the initial stages of L2 learning in general.

Lexical Access and the Use of Context

As mentioned in the introduction, Goodman's (1970) psycholinguistic model of the reading process has had a significant impact on the study of L2 reading issues. Goodman has described reading as a psycholinguistic guessing game and argued that readers use their world knowledge and general linguistic knowledge to generate predictions about upcoming words in text, thereby accelerating their processing of the text. Additionally, good readers are thought to be particularly efficient at this prediction process, even in circumstances in which they are encountering unfamiliar words. Presumably, good readers use these general knowledge sources to guess the meanings of unfamiliar words.

Despite the prevalence of this argument in instructional textbooks on L2 teaching, few studies have been conducted to determine if this characterization actually reflects the reading behavior of good L2 readers, and, if it does, how this process takes place. As we will soon see, the evidence from the small number of studies investigating this issue does not necessarily support the above description of the reading process.

Haynes (1984) conducted a study to examine ESL learners as they guessed the meanings of unfamiliar words in a text. The subjects were ESL college students who were either Spanish speakers, Arabic speakers, or Japanese speakers. These students were asked to read two passages that were each two paragraphs in length. The passages were constructed so that they had parallel story and syntactic structures. Two nonsense words (e.g., bimidor) were contained in each of the passages. The meaning for one of the words could be derived from the context of the immediate sentence, whereas the other word's meaning required integration of information across sentences in the passage. The students were asked to (a) read the story, (b) retell the story, (c) point to words in the sentence that had made the story difficult to understand, and (d) guess the meaning of the nonsense word.

The results showed that these ESL readers were better able to guess the meanings of words that were locally defined than globally defined nonsense words. However, success at guessing words was affected by lack of knowledge about the meaning of other words in the immediate sentence context. Analyses of guessing patterns indicated that the guesses were successful only when there were immediate contextual clues.

The results demonstrated that learners often relied on non-contextual clues to aid their guesses, such as using cross-language homographs (which did not always have the same meaning in the alternate language). The results also showed that, on occasion, the readers would guess unfamiliar words on the basis of the degree of visual match to words in their memory (e.g., *swan* was guessed as *swam*). At times, these guesses were in conflict with the syntactic context.

Bensoussan and Laufer (1984) also conducted a study that examined lexical guessing on the part of L2 learners. The participants were first-year university students enrolled in an English-as-a-foreign-language course. The first task required that students translate a list of 70 words into their native language. One week later, they were asked to read a text that contained all 70 of the words from the original list. They were also asked to translate the target words when they appeared in the context of the passage and to answer comprehension questions about

the passage. A control group, who had not seen the original list, also read this same text. The performance of this group was found to be no different than that of the experimental group in terms of their translations for the words in context.

The target words were divided into those that had clear contextual clues for guessing (41 of 70 words) and those that did not. The first research question examined the "guessability" of words from context. The authors reported that students were able to generate correct guesses (correct guesses from context were calculated in terms of words that had not been translated correctly in isolation and that were translated correctly in context) for slightly less than half of the words that had clear contextual clues. Thus, context generally did not facilitate lexical guessing for these students. There are two possible explanations for the failure of context to facilitate guessing. Either there were no contextual clues that could be used, or the students did not fully exploit the clues that were available.

Analyses of the strategies used by the students when dealing with the target words in context indicated that the most frequent strategy was to ignore the word. The next most common strategy—which actually resulted in errors—was to guess the context-inappropriate meaning of a polysemous word (e.g., *bank* and *bat*). This strategy was followed by one in which the students applied partial knowledge of a morpheme or an idiom in the word, often resulting in wrong deductions about the meaning of the word unit. Another problematic strategy was to associate the word with the meaning of a similar sounding word or to apply the native language meaning of non-cognate homophones (e.g., *mantel*, which means tablecloth in Spanish). The strategies that were used the least included wild guesses, use of context to guess the word, approximations, and translations of the opposite meaning.

The reader should keep in mind that the infrequent use of contextual strategies may be related to the fact that the text itself may not have been particularly suited for this type of strategy. Nevertheless, the study raises questions about the appropriateness of teaching students to rely solely on contextual guessing strategies, considering that not all texts render such strategies useful.

Bensoussan and Laufer's (1984) next research question asked whether higher proficiency students were better guessers than lower proficiency students. They found that the higher proficiency students were no better at guessing the meanings of unfamiliar words from context than were the lower proficiency students.

Adams (1982) used groups of college students reading in either French or English to study the effects of script activation on vocabulary learning during reading. The students performing the task in French were enrolled in a Foreign Language French course at the university level; those reading in English were enrolled in a psychology course. The task required subjects to read six passages (each containing five sections) that were presented on an overhead projector for 30 seconds. A target word was selected for each passage. In each section, the target word was replaced by a nonsense word (either English legal or French legal) that was related to the activity described in the passage (e.g., playing tennis, grocery shopping, doing laundry, washing dishes, a wedding). Half of the groups in each language received a script activator—a statement reflecting the main point of the passage. Unfortunately, the article contained no information describing how the measure of vocabulary learning was obtained.

Adams hypothesized that, on measures of unfamiliar vocabulary, students who received the script activator would score higher than those who did not receive the script activator. Adams also hypothesized a language effect. That is, in the native language, vocabulary-learning performance was predicted to be superior to L2 performance. Furthermore, Adams hypothesized a script by language interaction in that subjects reading in the second-language were expected to benefit more from the script activator than those reading in the native language.

The results demonstrated both a language effect and a script effect. Those students who read either the native or second language passages with the support of a script activator outperformed those students who read without script support. As Adams hypothesized, the group who read in English (the native language) outperformed the group who read the passages in French. Adams did not find evidence for an interaction between language and script.

In another study, Perkins and Brutten (1983) examined the effects of word frequency and contextual richness on the word identification skills of L2 readers. The task they used to examine this issue was one in which the participants were asked to guess a word that would fit the context of a sentence (i.e., fill-in the blank). If they did not succeed in the first trial, they were given one letter of the word as a clue. The students continued to guess until they provided the correct word. The authors hypothesized that higher proficiency learners would be able to identify the target word using fewer letter cues than lower proficiency learners. They also hypothesized that high-frequency words would be identified using a smaller portion of a word than low-frequency words. Additionally, they hypothesized that words which appeared in rich contexts would require fewer letter cues than words in poor contexts.

The learners were ESL students from two different proficiency levels in a university language center. The experimenter read each sentence aloud and provided the letter cues as needed. The results of the study were consistent with the authors' predictions. Fewer letter clues were required for high-frequency words and for words in context-rich environments. Additionally, high-proficiency students required fewer letter clues than low-proficiency students.

The evidence from these studies suggests that, when L2 readers are provided with cues as to the general topic of a text, they are better able to learn the meaning of unfamiliar words in the text than students who do not have this information. Thus, the evidence suggests that when L2 readers encounter unfamiliar words, they are able to use their prior knowledge to deduce the meaning of these words. However, the results also suggest that the ease and accuracy with which learners are able to deduce the meaning of unfamiliar words also depends on characteristics of the text, namely the presence of immediate contextual clues. One must also be cautious about using evidence obtained from observations of L2 readers dealing with unfamiliar words (be it nonwords or unknown words). The fact that L2 readers can use context to arrive at the meanings of unfamiliar words does not necessarily imply that context is used to recognize familiar words. Investigations in the native language reading literature have shown that context is used for the purposes of word identification under only rather special circumstances, specifically when the configural properties of the word are degraded (as in the Perkins & Brutten 1983 study), or when the word is unfamiliar (Rayner & Pollatsek, 1989; Stanovich, 1980).

Summary on Lexical Access

The research reviewed in the section on lexical access dealt with two issues. The first issue concerned whether bilinguals have separate or shared lexical representations and whether or not they gain access to the meanings of words in the second language through translation into the L1. The research suggests that bilinguals do have separate lexical representations for each language but that these lexical representations are linked to a semantic memory store that is shared by both languages. The research also suggests that the route to the meaning of L2 words differs for fluent and less fluent L2 speakers and readers. It appears that, during the early stages of L2 learning, access to the meaning of L2 words is mediated by the first language. That is, before accessing the meaning of an L2 word, the learner must translate the word into the L1 and then gain access to semantic memory. However, with time, links between the L2 word and its representation in semantic memory are created, thus allowing direct access to meaning.

The second issue discussed in this section asked whether access to the meaning of unfamiliar L2 words can be influenced by the operation of higher level reading processes. The

studies suggested that L2 readers' ability to access the meaning of unfamiliar words from context is confined to situations in which the contextual clues are rich and in proximity to the target word. This suggests that students need to be provided with additional strategies for word recognition that will allow them to deal with context-poor texts.

Syntax and Second-Language Reading

In an attempt to understand the process of reading in a second language, researchers have also investigated the role of syntax in that process. One area of investigation has focused on the syntactic knowledge that L2 readers bring to the reading process and on how it influences comprehension. To investigate readers' syntactic knowledge, researchers have (a) compared the respective roles of syntactic and lexical/semantic information in processing L2 texts (Barnett, 1986), (b) isolated a particular syntactic feature of English to assess reader knowledge and awareness of that feature in the reading process (Guarino & Perkins, 1986), and (c) explored the interaction between first- and second-language syntax in the reading process (Koda, in press). In investigating the syntactic knowledge that readers bring to the second-language reading process, researchers have also explored the relationships between verbal processing, reading, and syntax (Hatch, Polin, & Part, 1974; Zhang, 1988). Other research has focused more on texts than on readers, exploring the relationship between the readability of a text and its syntactic complexity (Blau, 1982).

Syntactic Knowledge and Reading Comprehension

In Barnett's (1986) study, he attempted to answer questions about the extent to which L2 readers rely on syntax to understand texts. In addition, this study aimed to determine the relative importance of syntactic or lexical/semantic knowledge in the process of reading in a second language. Barnett hypothesized that, when reading French texts, the native English speakers in the study would rely more on lexical and semantic analysis than on syntactic analysis. This study employed three methods of data collection: (a) a multiple-choice cloze test, (b) two original reading passages, and (c) student recalls of the French texts in English. For each reading passage, 50 deletions were made, half of lexical/semantic information and half of syntactic information to develop the cloze test.

Scores on the cloze test were used as indicators of vocabulary and syntactic proficiency levels. The findings indicated that recall differed according to level of vocabulary proficiency and according to level of syntactic proficiency. For students with either medium or high scores in syntax or vocabulary, as scores in one domain increased, so did scores in the other. However, for students with low vocabulary scores or low syntax scores, recall did not increase if the score in the other domain increased.

In his conclusion, Barnett calls for further research on the role of syntactic and lexical/semantic information in the L2 reading process. He suggests that further research is necessary to determine both whether there is a hierarchy of reading strategies and whether one type of strategy is more important in the process of reading in a second language. The study indicates that both syntactic and lexical/semantic knowledge contribute to the L2 reading process, but it is not able to answer questions concerning their relative importance in that process. It should be noted, however, that the interaction of semantic and syntactic factors is not well understood in monolingual reading either.[6]

Guarino and Perkins (1986) investigated the role of *form class knowledge* in the L2 reading process. They defined form class as "awareness of a word's morphemes or structure units" (p. 77). They explained that, although some research has been done on the manner in which beginning readers attend to form class and how it should be taught and tested, few studies have focused on the ESL reader's awareness of form class and the influence it may have on reading comprehension in a second language. Thirty-five ESL students from an intensive

English program (10 intermediate; 25 advanced) were involved in the study. To test knowledge of form class, nonsense words with common English suffixes were given as options to fill in missing parts of sentences. Nonsense words were selected so that form classes had to be recognized using structural cues rather than the meaning of words in order to make selections. As a separate criterion measure, they also had subjects take a multiple-choice reading comprehension test, which used 8 passages and contained 48 test items.

In comparing correlations between the two measures for those who tested above and below the mean, Guarino and Perkins (1986) found that awareness of form class correlates with reading proficiency. However, these results should be interpreted with caution as they are founded on correlations based on attenuation correction formulas. The researchers suggest that further research is needed to determine whether form class knowledge is more data driven (bottom-up) or more concept driven (top-down). This question seems to concern whether form class knowledge relates more to syntactic structures or more to lexical/semantic knowledge (of suffixes and prefixes).

Koda (in press) investigates the interaction between knowledge of L1 and L2 syntactic structures (particularly the case-signaling system) during the process of reading in a second language. Previously, researchers have explored both the effects of L1 syntax on L2 reading and the effects of L2 structure on acquisition of the L2, but they have never looked at the interaction between these two phenomena. The case-marking systems in the four languages under investigation have syntactic similarities and differences. Both Japanese (the L2 in this study) and Korean are highly marked for case, using both postpositional morphemes and word order; in contrast, both English and Chinese rely mainly on word order to signal case. The subjects in this study were native speakers of Chinese, English, and Korean enrolled for nine months in a Japanese program at an American university. Four different assessments were used: (a) a sentence comprehension with sentences varying in terms of case-marking particles (with or without postpositional morphemes) and word order (canonical or non-canonical); (b) a particle test to determine variance in students' levels of knowledge; (c) a reading comprehension test, including both a cloze task and comprehension questions; and (d) a questionnaire asking students to discuss self-perceptions of strategies.

Koda found that, regardless of language background, all subjects performed better on the comprehension tasks when case-marking particles were available. She also found that L1 case-signaling does seem to have an impact on the way L2 learners read in a second language. As hypothesized, the native speakers of English and Chinese were very influenced by word order changes and scored highest when both types of syntactic cues were available. However, the performance of native speakers of Korean did not vary significantly with changes in word order. Because some findings held across language backgrounds and others varied across language backgrounds, this data supports the notion that both native and second-language syntactic structures influence the process of reading in a second language. In addition, unlike the Japanese children in the L1 acquisition studies, the adults in this study were able to use both types of case-signaling cues independently.

Verbal Processing, Syntactic Knowledge, and Reading Comprehension

Hatch, Polin, and Part (1974) investigated the connections between acoustic scanning and syntactic processes in reading a second language. The *acoustic scanning hypothesis* suggests that knowledge about word pronunciation aids in comprehension. By asking subjects to cross out letters as they read, the researchers hoped to investigate two main questions: Are there differences in how L2 readers process texts when difficulty is based on syntax rather than vocabulary? and If L2 readers depend more on function words as syntactic cues than L1 readers, do they also pay more attention to these function words? This study had three parts. In the first, subjects were nonnative speakers of English with very high levels of proficiency (i.e., they had tested out of university English classes for international students). They used four

reading passages that varied in terms of complexity of syntax and vocabulary. In the second part of the study, nonnative speakers of English with lower proficiencies (at beginning and intermediate levels) were selected. Although the same four passages were used, these students were also asked to cross out two-letter graphemes (i.e., *ch*). The researchers hypothesized that L2 readers would mark them as single letters. In the third part of the study, they investigated the influence of sentence and word stress, hypothesizing that stressed words would be marked more often and that L2 readers would not mark word stress as consistently as native speakers.

This study found that both native and nonnative English speakers mark more letters in content than in function words. In addition, syntactic complexity did not increase the marking of function words. L2 readers marked fewer letters when the difficulty of vocabulary and the complexity of syntax increased.

The relationship between the acoustic scanning hypothesis and the use of syntactic cues in the reading process is somewhat unclear. The researchers themselves suggest that some of their data point to differing explanations. The fact that native speakers seem to pay more attention to content words than function words conflicts with this hypothesis. However, the fact that L2 readers pay more attention to function words may be due to their paying equal attention to each word, rather than paying special attention to function words. In addition, the L2 readers who marked many function words had difficulty with comprehension questions. The researchers suggest that both of these findings support acoustic scanning.

In another study that looks at the connection between oral production and the reading process, Zhang (1988) investigated reading miscues as "positive indicators of language development" in L2 readers. One of Zhang's findings was that these Chinese readers of English often dropped suffixes or neglected form shifts during reading. These readers had particular difficulty with words that use internal variation to show changes in case or tense. In addition, they were often confused by complex sentences in which the main clauses were separated by other clauses. In the latter case, they typically separated the English sentences into shorter simpler sentences, often losing the relational meaning shown through the clauses. Zhang hypothesizes that these two tendencies could be due to interference from Chinese syntactic structure in which function words perform most of the grammatical functions in a sentence and where complex sentence structure is rare. While reading, the less proficient readers generally made the English syntax similar to the Chinese syntax. Chinese syntax was even more likely to appear when those readers retold the story in English. Although the subjects made many miscues while reading, Zhang states that 70% were syntactically acceptable in English. She hypothesizes that this may be due to similarities in the syntactic structure of the two languages.

Although the tendencies reported in this study are of genuine interest in understanding the relationship between syntax and reading in a second language, many of the findings are quite tentative. Although the goals of identifying typical miscues, assessing positive and negative transfer in L2 reading, and understanding the relationship between language development and reading comprehension are all of importance in understanding the process of reading in a second language, Zhang's data does not fully address these concerns. The topic that has perhaps been most fully explored is the identification of typical miscues among Chinese readers of English. The lack of conclusive evidence for the other two areas of investigation may be related to the methodology chosen and the small size of the subject pool. In addition to questions concerning the measure of comprehension in this study, the relationship between oral miscues and reading comprehension is somewhat unclear. For L2 readers, who may produce miscues not only because of difficulty with reading processes but also because of their developing knowledge of the second language, the relationship is particularly unclear. Zhang's concluding remarks indicate that intralingual interference and lack of language proficiency seemed to be the main causes of comprehension problems for the subjects in her study. More research is needed to investigate the role of transfer and language development in the L2 reading process before such tendencies could be stated with assurance.

Syntactic Complexity and Readability

Blau's (1982) study used a measurement of readability based on "degree of sentence combining." This method was chosen to investigate whether traditional readability formulas based on sentence length and word frequency are the most useful way to determine the difficulty of a particular passage. In addition, it is an attempt to understand whether syntactic structures influence text difficulty. Although some research has shown that shorter sentences are easier for children reading in their native language, this study questions whether this is also true for adults reading in a second language. In developing the instrument, three versions of an 18-paragraph reading passage were created. They differed in terms of syntactic complexity but not in terms of content or vocabulary. The first version was primarily composed of simple sentences; the second version used complex sentences, but surface cues to underlying relationships were maintained; the third version included mainly complex sentences, but there was more "chunking" than in the second version. Regardless of which version students were given, they were asked to answer the same 2 or 3 questions (24 in all) after each paragraph.

This instrument was used with two different subject pools to see whether traditional readability formulas are more accurate for younger students. One group included college students from the University of Puerto Rico and the other consisted of eighth graders. The two groups' comprehension scores were compared using an analysis of covariance. The college students' scores on the ESLAT were used as the covariate and the eighth graders were compared using a 3x3 randomized block design (formed by three homogeneously grouped eighth-grade classes). Students who had lived in the mainland United States or who were from bilingual homes were not included.

Blau found that the data did not support an assumption that the simple sentences (Version 1) would be easiest for the college student group. Surprisingly, the college students with the lowest proficiency levels seemed to do slightly better on Version 3. Among the eighth graders, the differences in mean scores were not significant across the three versions. However, Version 1 yielded the lowest comprehension scores, and Version 2 yielded the highest. There were interesting findings across proficiency levels among the eighth graders. For the lowest group, sentence combining made no significant difference, although scores on Version 1 were slightly higher in this group. For more advanced students, the degree of sentence combining seemed to enhance reading comprehension. Although the relationship between syntax and readability was not shown to be as strong as suggested and many of the findings did not prove to be statistically significant, this study does suggest that short, choppy sentences may actually interfere with comprehension and that the relationships found in more complex sentences may actually aid in comprehension.

Summary on Syntax Processing

The bulk of the studies reviewed in this section have shown that syntactic knowledge and complexity is related to L2 reading comprehension. Additionally, the study by Koda (in press) suggests that there may be a transfer of syntactic knowledge from the native language to the second-language reading situation. These studies fail to tell us, however, whether we have understood something about syntactic processing in reading or whether we have understood something about syntactic influences on language processing more generally. Research that attempts to understand the interaction of the specific demands of the reading situation with syntactic knowledge in reading comprehension is necessary.

How Might Research on Local-Text Processes Inform Assessment and Instruction?

The studies reviewed in the section on local-text processes point to a number of sources of information about reading performance that may be useful in the instruction and the assessment of reading competence among L2 learners. A discussion of these sources follows.

Research on Letter Processes

The research reviewed earlier in this paper on the topic of letter recognition is consistent with several conclusions. First, the research suggests that L2 readers who are learning a new script are able to accurately identify the symbols in this script before they are able to efficiently process them. As is the case in L1 reading development, efficient processing of the elements in a script develops only with considerable practice. Secondly, the research suggests that efficiency in letter recognition is correlated to reading comprehension performance. That is, individuals who are able to efficiently process the symbols in a new script tend to have better reading comprehension skills than those who have yet to develop efficiency in letter processing.

That this research points to efficiency in letter processing as a factor related to the development of comprehension of L2 texts suggests the need for assessments that evaluate not only the accuracy of letter recognition but also the speed with which an L2 reader can identify the symbols in the new script. Assessments of this type are already used in component process approaches to L1 reading assessment (e.g., Carr, 1990; Sinatra & Royer, 1993). Sinatra and Royer (1993), for example, have used the Computer-based Assessment of Academic Skills (CAAS) to measure speed and accuracy of performance on tasks such as letter naming, word and pseudoword naming, and syntactic and semantic analysis of sentences. Efforts are currently underway at the National Center on Adult Literacy (NCAL) to test the validity of this type of assessment for use with adult L2 learners (Carlo & Skilton Sylvester, 1994).

The research also supports the notion that instruction that develops familiarity with the new script may need more emphasis than is called for in texts describing L2 reading instruction methods. In a review of the literature on L2 reading instruction methodology, the first author of this report found that very little emphasis was placed on the way in which teachers ought to develop students' ability to recognize and manipulate the symbols in the new script. Notably, a common view expressed in many methodology textbooks is that the source of students' difficulties in reading stem from their attention to such features of the language. For example, Schulz (1983) states:

> While it seems paradoxical, less careful reading—i.e., not insisting on word-for-word decoding—leads to more efficient and better comprehension than does present practice. Our task is, then, to teach students to use strategies that involve guessing, and tolerance of uncertainty. (p. 28)

To view this behavior as a cause of poor reading, we believe, deprives students of the very experiences that might be necessary for early progress in L2 reading. Given the findings reviewed here and those obtained in the context of native language reading research, we are more inclined to believe that attention to the graphemic symbols of the language is more likely to reflect the need to develop greater familiarity with the script, than to reflect an inadequate reading strategy.

Research on Word Processes

One of the most consistent findings in the research on L2 visual word processing is that skilled reading in the second language is related both to knowledge and to the efficient use of the orthographic patterns and symbols employed by the language. The research reviewed earlier suggests several ways in which information about learners' familiarity with this feature of the second language may help diagnose reading problems or monitor the reading acquisition progress of L2 learners. As mentioned earlier, there is evidence that L2 learners whose native language is based on logographic scripts transfer the processing strategies used in the L1 to the L2 reading situation. However, progress in L2 reading appears to depend on the ability of these learners to abandon the L1 strategies and use orthographic information to access sound, as do the native readers of alphabetic scripts. Thus, information about learners' ability to use grapheme-phoneme

correspondence rules may allow the practitioner to determine the likelihood that a learner has been able to make the shift from L1 to L2 visual word-processing strategies that would allow them to decode words. This information would also suggests the need to provide the students with instruction that allows them to develop the knowledge of the sound-symbol relationships of the language and to develop efficiency in the use of this knowledge.

Additionally, the research suggests that, when two languages share the same script, knowledge about the orthographic patterns of the languages help guide the search for an appropriate lexicon. Instructionally, these findings suggest (for L2 learners of alphabetic scripts such as English) that there is a need to develop students' decoding skills to the point where these orthographic patterns are more efficiently recognized.

Many of the instructional approaches that are suggested in the literature on L2 reading instruction fail to recognize the importance of providing direct instruction on sound-symbol relationships. As Bernhardt (1991) has argued, the emphasis on top-down models of reading has led educators and researchers virtually to ignore the role of lower level processes in L2 reading. It is encouraging, however, to note that recently some L2 educators have been working to find ways of integrating top-down and bottom-up approaches to L2 reading instruction. For example, Long and Gillespie and Dean (published in Wrigley & Guth, 1992) have developed curriculum models that suggest ways to integrate skills-based and meaning-based approaches to literacy instruction.

As discussed earlier in the section on letter processes, the research on word-level processes suggests that assessments geared to measuring efficiency of visual word processing could also be useful in the assessment of L2 reading skills. One task that has been frequently used by L1 reading researchers includes measures of accuracy and speed of word and pseudoword naming. To perform this task, the participant is asked to name, as quickly as possible, a word or pseudoword that appears in the center of a computer screen. The computer keeps track of the time that has elapsed between the moment the word or pseudoword appears and the moment it is named.

Research on Lexical Access

In the section on lexical access, we reviewed research that suggested there were two steps in the development of the cognitive processes supporting lexical access in a second language. The research suggests that, in order to build direct links from the L2 lexical representation into semantic memory, learners must first rely on a translation strategy to access information from semantic memory. As this process of translation takes place through repeated encounters with L2 words, direct links into semantic memory are formed. As a result, lexical access processes are accelerated. Since differences between these two stages can be detected through differences in speed of performance on lexical decision tasks, one possibility with regard to the assessment of L2 reading would be to use these tasks to monitor gains in the efficiency of lexical access. This research also suggests the need to reevaluate the practice of discouraging students from using translation. Translation might be a necessary process in the development of fluent word recognition and access to meaning.

The research on vocabulary learning from context suggested that L2 readers' ability to gain access to the meaning of unfamiliar words from context is limited to situations in which the contextual clues are rich and in close proximity to the target word. As mentioned earlier, this suggests that students need to be provided with additional strategies for dealing with unfamiliar words in context-poor texts.

Research on Syntactic Processes

The research on syntactic processes in L2 reading raises issues relevant to the assessment and diagnosis of syntactic-processing problems in L2 reading. The research points to the need

to distinguish between two potential sources of difficulty in syntactic processing. One source is simply the lack of knowledge of the grammar, and the other is the negative transfer from the native language grammar (i.e., the inappropriate application of syntactic knowledge from the L1 to the L2 reading situation).

Though more research is needed that investigates the effects of simplified texts on L2 reading comprehension, the research presented here questions the assumption that simplified syntactic constructions are easier for L2 readers to understand. This finding raises questions about the practice of altering texts for use with L2 learners, and these questions should be taken into account both in the creation of instructional materials and in the development of tests for use with this population. It also suggests that the use of authentic reading materials may be more appropriate.

Text-Modeling Processes

In the following sections, we will consider research that has focused on higher level reading processes. We have grouped them under the heading of text-modeling processes because they have dealt with reading processes that involve the integration of information over large portions of a text or with the integration of prior information with that contained in the text.

Effect of Differences in Prior Knowledge

L2 reading research has been heavily influenced by interactive theories of reading (Carrell, 1984a, 1988; Carrell & Eisterhold, 1988).[7] These theories have centered on the transaction between a reader and a text and on that transaction's relationship to reading comprehension. They are different from the interactive theories proposed by researchers such as Stanovich (1980) that focus on the interaction between levels of the reading process. Research on native-language readers has shown that prior knowledge has a considerable impact on the extent to which information is understood and remembered. For example, factors such as content area knowledge (Royer, Marchant, Sinatra, & Lovejoy, 1990), schemata or scripts (Anderson & Pearson, 1984), and cultural knowledge (Reynolds, Taylor, Steffensen, Shirey, & Anderson, 1989) have all been shown to affect one's ability to read and comprehend text.

Several of the studies reviewed below have focused on whether L2 readers' comprehension is affected by the prior-knowledge factors that have been shown to influence native language readers' comprehension. Other studies have focused on how the sources of knowledge (e.g., cultural and content knowledge) that the L2 reader brings to the task of reading affect comprehension. In the following section, we will review research that investigates the effect of schema activation on L2 reading and the effects of cultural knowledge and content area knowledge on L2 reading comprehension.

Schema Activation and Comprehension

Carrell (1983) conducted a study that evaluated the interaction between different components related to prior knowledge during L2 reading and how this interaction affects comprehension. In her study with a group of native English speakers and groups of advanced and intermediate ESL learners (enrolled in a U.S. university) of various native language backgrounds, Carrell manipulated three components of prior knowledge. The first component, *context*, involved the presence or absence of cues (i.e., picture-page and title) that alerted the readers to the content areas in which they would be reading. In this study, context was manipulated as a between-subjects variable. A second component, *transparency*, involved the presence or absence of words that cued the readers about the content of the text. This variable was also manipulated between subjects. Finally, text *familiarity* was manipulated (within-subjects) by including both a passage on a topic of which the reader had some knowledge and

one of which the reader had no knowledge. The passages were based on the *Washing Clothes* and *Balloon Serenade* texts used in previous studies by Bransford and Johnson (1973, cited in Carrell, 1983).

After reading the passages, the participants were asked to rate (on a seven point Likert scale) the comprehensibility of the passages and to write, in English, *recalls* of what they had read. The recalls were scored on the basis of the percentage of idea units contained in the text that were recalled by the readers. The written recalls were used as an index of reading comprehension.

Carrell (1983) analyzed the recall and rating data separately for each group.[8] We will concentrate our review on the results of the performance measure (i.e., recall). Those results indicated significant main effects for each of the three independent variables (context, transparency, familiarity) only for the group of native English speakers. The other significant result in the analyses was on the familiarity variable for the advanced ESL group. For both groups, the analyses of the familiarity variable were the opposite of what one would have predicted from a schema theory perspective. Recall was better for the novel passage than for the familiar one. The context and transparency effects for the native English speakers were in the predicted direction; the presence of context facilitated the recall of idea units in the text, and the presence of lexical items related to the text content also facilitated recall.

Carrell (1983) interpreted the above findings as indicating that native speakers process text differently than ESL learners. She argued that ESL readers are "not efficient top-down processors, making appropriate predictions based on context, nor are they efficient bottom-up processors, building up a mental representation of the text based on the lexical information in the text" (p. 199). Given Carrell's own acknowledgment of the problems of interpreting null findings and given that *group* was not a factor in the analysis, we are surprised at her interpretation of these findings as indicating differences in the reading processes of native and second-language readers. Several methodological issues in the study might have affected L2 readers' ability to use background knowledge sources. One likely candidate is the fact that the ESL learners were required to produce the recalls in the second language (Lee, 1986). Writing in a second language might have placed demands on these readers that overrode any effects resulting from the background knowledge variables manipulated in the study. We would also like to note that, in a slightly different study by Carrell and Wallace (1983), a context by familiarity interaction was obtained. Their study with a similar population of learners found that, for ESL advanced learners, the context and familiarity (familiar, somewhat familiar, and novel texts) variables interacted; recall of a somewhat familiar text was facilitated by the availability of context.

Lee's (1986) study sought to challenge Carrell's (1983) findings that nonnative readers show no effects of background knowledge. The experimenter had third-year native English-speaking students of Spanish read two passages in Spanish. The passages were Spanish translations of those used by Bransford and Johnson. Each student read both a familiar and an unfamiliar passage. Context (i.e., presence or absence of a title and a picture) and transparency (i.e., presence or absence of concrete lexical items that provide textual clues as to the topic of the text) were manipulated between subjects. Subjects read the passages and then wrote in the native language what they remembered. (Carrel had subjects write their recall protocols in the second language.) The results were analyzed with an ANOVA framework. They showed a significant main effect only for the context variable. The interaction between context and familiarity was significant, as was the three-way interaction of context, transparency, and familiarity. Tests of simple effects indicated that recall of the familiar passages, but not the novel passage, was facilitated by the presence of context and that the effect of context on the familiar passage depended on the presence of lexical item cues (transparent condition). Thus, once the L2 writing demands were removed, the positive effects of the background variables were evident. The results also suggest that the effects of background knowledge on comprehension

are evident and that these effects are perhaps most beneficial when several subcomponents of background knowledge converge in a text and in a reader.

Cultural Knowledge

Previous studies examining the effect of culture on reading comprehension in the native language have found that texts based on culturally familiar topics are read faster and are better remembered. In addition, this research shows that readers are more likely to make culturally appropriate elaborations and distortions of the text (Steffensen, Joag-dev, & Anderson, 1979; Reynolds et al., 1989)

Nelson (1987) examined the role of cultural knowledge on foreign language reading comprehension performance. The participants in this study were English-as-a-Foreign-Language students (of low to intermediate proficiency) at a university in Cairo. The students read two passages on each of the following topics: the changing roles of women in Egypt and the United States; pollution in Egypt and the United States; humorous Egyptian and U.S. folk heroes; and finally stories of an Egyptian boy buying beans for breakfast and a U.S. boy on his first day of school.

The results indicated that comprehension was superior on those passages that depicted a culturally familiar situation or event. The experimenter also asked the readers to indicate which of a pair of readings they found more enjoyable. An examination of the relationship between preference scores and performance scores indicated that the two were not correlated. Thus, the interpretation that better performance was due to greater interest in the Egyptian passages may be ruled out.

In another study, Malik (1990) used miscue analysis to examine how the presence of culturally familiar topics in a text written in the foreign language affected the recall, reading rate, and reading comprehension strategies of foreign language readers. Malik had Iranian college students in a U.S. university read aloud encyclopedic descriptions of an Iranian or Japanese myth and later retell what they read.

The results indicated that the students had better comprehension of the familiar text and that they were more sensitive to differences in the level of importance of the idea units in the familiar text condition than in the unfamiliar text condition.[9] However, the analyses on reading rate showed no significant differences as a function of topic familiarity.

The analyses of miscues also revealed differences as a function of familiarity. Students were more likely to disregard punctuation marks, to omit words, and to insert words that were not in the text when they were reading in the familiar passage condition. Additionally, word substitutions were less frequent in the familiar passage condition. However, no differences in the syntactic and semantic acceptability of the miscues were obtained in relation to text familiarity.

In terms of strategies, the author found that, whereas the use of predicting strategies did not vary as a function of text familiarity, confirming/correcting and integrating strategies did vary. There were more confirming/correcting miscues present for the nonfamiliar text and more integrating strategies (miscues) present in the familiar text condition.

Thus, familiarity with the topic of a text written in a second language appears to help readers prioritize and better remember the more important ideas in the text. On the other hand, the ability to prioritize information on unfamiliar topics seems to diminish, as demonstrated by the lack of differences in the proportion of idea units recalled as a function of level of importance. If, in light of the criticisms raised earlier, one is to regard analyses of miscues as rather faithful indicators of text processing, then these results suggest that there is more evidence of conceptually driven processing when texts are on a familiar topic. We have

reservations, however, about whether oral miscues reflect speech or memory processes more than they reflect text encoding processes.

Content Knowledge

Hammadou (1991) conducted two studies, one with native English-speaking college students who were learners of French-as-a-Foreign-Language and the other with students who were learners of Italian. The purpose of the studies was to examine the effect of topic familiarity and foreign-language proficiency on comprehension. The students were grouped according to language proficiency using more and less advanced distinctions. Proficiency level was determined on the basis of the level of the class sequence in which they were enrolled. These subjects were asked to read three passages excerpted from authentic newspaper and magazine articles that had been published in each of the foreign languages. After reading them, they were asked to recall and write, in English, what they had read in the passage. They were also asked to rank, from most to least familiar, each of the passages they had read.

The written recalls were scored on the basis of the number of possible propositions that were contained in the text. The researcher also scored the recalls in terms of the number of propositions that did not match the contents of the text. These propositions were divided into those that were logical inferences from the text and those that were illogical inferences.

The results were analyzed using proficiency and topic familiarity as between and within subject factors respectively and using course grade as a covariate. The percentage of propositions recalled from the text was used as the dependent variable. The main results showed that familiarity with the topic of the passage did not result in better recall of these passages. The results also showed that, as expected, the more proficient groups outperformed the less proficient ones. A more interesting finding was that less proficient readers generated more inferences than the more proficient readers. However, the tendency to produce illogical inferences declined as language proficiency increased. Additionally, the more proficient readers tended to produce less illogical inferences for the more familiar passages, though this trend was only significant for the Italian readers.

One possible explanation for the lack of a familiarity effect may have been that the distinctions the students were asked to make regarding the familiarity of the passages did not represent drastic familiarity differences. The reader might recall that the texts were news articles published for French and Italian audiences. It is likely that the news articles were on topics that were unfamiliar to U.S. audiences. Thus, the students might have had to make fine-grained distinctions on passages that were generally unfamiliar. However, as Hammadou points out, the effects of familiarity emerged in the inferencing behaviors of the more proficient students.

Summary of Work on Prior Knowledge

This section reviews evidence that supports the conclusion that prior knowledge can affect adult readers' ability to comprehend texts written in a second language. This finding has important implications for the assessment of L2 reading skills in that it suggests the need to be sensitive to the possibility that an individual's lack of prior knowledge about a topic contained in a text may bias the results of reading assessments that are based on those texts.

Use of Text Structure in L2 Reading

Another aspect of the L2 reading process to which researchers have devoted attention is the influence of text structure on L2 reading performance. The manner in which ideas are structured in a text has been shown to influence how native language readers learn the information contained in the text, what they remember from a text, and how they summarize

the information in the text (see Connor, 1984 for a review of this evidence). Thus, L2 researchers have been interested in understanding how these factors might differentially impact on the reading performance of native and second-language readers and how they might differentially impact on the reading of more and less proficient L2 learners.

The first study that we will consider in this section was conducted by Connor (1984). Connor had native English speakers, Japanese-speaking ESL learners, and Spanish-speaking ESL learners read a passage and produce written recalls in English. The passage had been analyzed using Meyer's content-structure analysis. Connor wanted to know whether L2 readers were able to exploit the structure of a text to aid comprehension. She argued that "it is reasonable to expect that ESL students who have had relatively little practice in reading expository texts in English might not be aware of the structure of the texts that they read and therefore would have difficulties in recognizing, retaining, and recalling superordinate ideas and their related subordinate ideas" (p. 245). The number of propositions in the text were calculated and categorized according to their level of importance in the passage. The results showed that native English speakers recalled a greater number of propositions than both groups of ESL learners (ESL learners were no different from each other).

We would like to point out an issue that complicates the interpretation of these results. Given all the other factors that might have been affecting the performance of the ESL learners as compared to the native English speakers, one cannot be certain that the differences in performance are due exclusively to differences in their ability to use text structure to aid comprehension. Other unexamined factors such as vocabulary knowledge or syntactic knowledge could also be responsible for the differences in performance. Thus, the interpretation that the differences in performance between the groups result from a lack of knowledge of English expository text structure is not entirely supported by the findings. The present study reflects Meara's (1984) criticism of L2 reading research, which argues that, often in this research, the "theoretical assumption [is made] that it is possible to manipulate higher order variables without worrying too much about more basic processes" (p. 98).

A study by Carrell (1984b) offers a closer look at the effect of text structure on L2 reading comprehension. Carrell (1984) conducted a study to investigate the effects of rhetorical organization on the recall of texts read in a second language. She was interested in three questions. The first question concerned the effect of the rhetorical organization of an expository text on the ability to recall the content of the text. This was studied by constructing four versions of a text that contained the same content information. The first version was based on a collection of *descriptions* structure. This combines the *collection* structure, described by Carrell as " ... the loosest organizational type, being merely a grouping or listing of concepts or ideas by association" (p. 442) and the *description* structure, which "is a specific kind of grouping by association in which one element of the association is subordinate to another, namely to the topic" (p. 442). A second version used a *causation* structure, which groups casually related ideas. A third *problem/solution* structure is described as containing "all the features of cause-effect, with the additional feature of overlapping content between propositions in the problem and solution" (p. 441). A final structure, *comparison*, uses opposing viewpoints as the organizational framework.

The participants in this study were enrolled in the final three levels of an intensive English class for foreign students in a U.S. university. The learners were of Spanish, Arabic, and Asian language (Korean and Chinese) background. There was also a group that consisted of learners from diverse language backgrounds. The learners were randomly assigned to each of the four text versions. The learners were asked to write what they recalled from their reading of the text both immediately after reading it and 48 hours later. The recall protocols were scored on the basis of the total idea units contained in the text. The recall protocols were also coded in terms of whether they fit the rhetorical structures described above (collection and descriptions were also coded separately). The learners were also asked to answer fill-in-the-blank questions that tested their recall of the idea units in the text.

The recall data were analyzed using language group and text condition as between-subjects factors and time of recall as a within-subjects factor. As expected, performance on the immediate recall task was superior to that on the delayed recall task. The author reports that only the three main effects were statistically significant. Post-hoc tests of the means across texts revealed that recall performance on the collection of descriptions structure was significantly below the performance level for all of the three other structures. This was interpreted as an indication that the high level of organization in the discourse structure facilitates recall. As Carrell herself points out, these data should be interpreted cautiously since the number of idea units recalled tended to be far below the total idea units contained in the text.

A final question focused on whether the use, by participants, of the same rhetorical structure as the text facilitated recall. Analyses of the data on the protocol organization indicated that learners who employed the same rhetorical structure in writing the protocols recalled a greater number of idea units than those who used a different structure. This finding raises an issue about the use of recall as a measure of comprehension that has been the source of much controversy in the native language reading literature. This issue concerns whether recall performance reflects processing at the point of encoding or at the point of information retrieval (Kardash, Royer, & Greene, 1988). This, in turn, raises the question of whether or not the variables that affect recall performance (how information is remembered) also affect how information is understood. The fact that students' use of same or different rhetorical structure in their written recalls was related to recall performance suggests that text structure might be playing a role in how information is remembered. Whether it plays a role in how information is understood (i.e., encoded) is, from our perspective, an open question.

The previous study suggested that text structure can play a role in how well L2 readers recall information that they have read. The next study investigated how text structure and content familiarity interact during comprehension of texts read in a second language. This study (Carrell, 1987) investigated the interaction between content schemata (knowledge about the topic of a text) and formal schemata (knowledge of the rhetorical organizational structure of texts) in L2 reading. The participants in the study were high-intermediate ESL learners enrolled in an intensive English program at a U.S. university. One of the groups consisted of learners with a Muslim background, while the other group consisted of learners from a Spanish Catholic background. The groups read historical biographies of religious characters; one was entitled *Ali Affani* and the other *Saint Catherine*. In the original version of these texts, the rhetorical structure was that of an historical narrative, following a straight temporal order. In an altered version of the texts, the rhetorical structure was one in which the events were presented in an interleaved order. The author hypothesized that the interleaved temporal order would increase the difficulty of the reading because readers lacked a formal schema for this type of text. The author, however, did not explain why the readers would lack this type of formal schema.

The group of Muslim background learners and Catholic background learners read each of the passages on separate days. (The Ali Affani passage was read before the Saint Catherine passage.) Half of the learners in each group read the temporal narrative version while the other half read the interleaved version. Comprehension of the passages was measured both by means of a multiple-choice comprehension-inference test and through written recalls. The recalls were evaluated in terms of the quantity of idea units as well as the quality of the recalls. Recall quality was defined in terms of top (main idea), high-level, midlevel, or low-level ideas. The author also examined the elaborations or distortions of the ideas in the text as reflected in the written recalls.

Significant differences were obtained on both the multiple-choice and recall scores as a function of content familiarity. Learners performed better on the familiar content passages than on the unfamiliar content passages. Performance on these measures did not significantly vary as a function of rhetorical form. Moreover, rhetorical form and content did not interact. Carrell

performed statistical analyses comparing the number of idea units recalled for each type of idea unit (i.e., top, high, medium, and low) as a function of content familiarity and rhetorical structure familiarity.[10] The results of these analyses indicated that more top-idea units were recalled in the temporal structure condition than in the interleaved structure condition. Additionally, more high-idea units were recalled in the familiar content condition than in the unfamiliar content condition. Finally, analyses examining the elaborations and distortions made by learners in their recalls indicated that more elaborations were made on familiar content texts than on unfamiliar content texts and that more distortions were made on unfamiliar content texts than familiar content texts. Rhetorical form did not significantly affect the number of elaborations or distortions, and the number of these was not affected by the interaction of the rhetorical form and content familiarity variables.

Training Text-Structure Use

The final study reviewed in this section investigated whether there were positive effects of training L2 readers to use text structure in order to facilitate comprehension. Carrell (1985) conducted this study with a sample of ESL learners from diverse language backgrounds who were in an upper level ESL course in a U.S. university. The training for the experimental group occurred over the course of one week and emphasized the use of the top-level organization of the text to improve comprehension. The control group worked on the same texts as the experimental group, but the emphasis was on linguistic operations such as grammar exercises, sentence combining, discourse connectors, cohesion, and vocabulary.

The students performed a pretest and a posttest, which involved reading a text and writing a free recall. The test also involved identifying the overall organization of the text in response to an open-ended question. As in previous studies, Carrell scored the recall protocols on the basis of the total idea units contained in the text. She also scored the recall protocols on the basis of the quality of the ideas recalled. This was done by classifying the recalled ideas in terms of whether they represented introduction, top, high, medium, or low level ideas in the text. The protocols were also categorized in terms of whether or not they used the type of rhetorical organization of the text in composing the protocol. Finally, students' accuracy in identifying the structure of the tests was determined.

The results demonstrated that students in the experimental group were more likely to use (in composing their recalls) and recognize the organizational structure of the texts after instruction than the control group students. Analyses of variance examining pretest and posttest differences in the number of idea units recalled indicated that, although the groups did not differ in terms of their performance on the pretest scores, their performance did differ on the posttest. Thus, the results suggest that training on text-structure use strategies can help students improve comprehension.

Summary on Text Structure

The studies reviewed in this section suggest that text structure can affect the comprehensibility of texts on the part of L2 readers. The studies suggest that some text structures are more easily understood than others. Additionally, these studies also suggest that differences in patterns of recall across groups of different language background may facilitate comprehension of a familiar text structure over another less familiar text structure. The studies on training also suggest that knowledge of text structures can help learners improve comprehension of L2 texts.

Strategy Use in Second-Language Reading

Another area that has received attention from researchers interested in L2 reading has been the use of reading strategies. In particular, researchers have been interested in understanding what Paris and Parecki (1993) have described as "knowledge that people bring to

various literacy activities . . . knowledge about parameters of the task that influence performance, and knowledge about appropriate strategies to use in different contexts" (p. 2). The following studies examined these issues for L2 readers.

Anderson's (1991) study investigated the reading strategies used by L2 readers in two different reading situations: test taking and academic reading. He examined differences in the strategies used by L2 readers in the context of reading for the purpose of answering a standardized multiple-choice reading comprehension test versus reading content matter text (i.e., text from an academic content area). He was also interested in identifying individual differences in strategy use in each context, and in differences between good and poor L2 readers in their use of strategies in each context.

The participants were Spanish-speaking students enrolled in an intensive ESL class in a U.S. university. The levels of L2 proficiency in this group ranged from beginning to advanced levels. Anderson examined the students' strategies by asking them to "think out loud" after having read and answered multiple-choice comprehension questions on the Descriptive Test of Language Skills (a standardized reading comprehension test) and on the Textbook Reading Profile (which consisted of items developed by the author based on test passages from freshman level academic courses in science, business, American history and government, and sociology). The students were allowed to choose between using Spanish or English while thinking aloud.

The author categorized the strategies that the students reported to have used through their think-out-loud protocols into reader supervising strategies (e.g., recognizing loss of concentration, testing inferences, adjusting reading rate), reader support strategies (e.g., skipping unknown words, skimming, use of dictionary), paraphrase strategies (e.g., use of cognates, translating, paraphrasing, extrapolating from text), text coherence-establishing strategies (e.g., rereading, use of context, use of background knowledge), and test-taking strategies (e.g., time allocation, guessing, looks for response in text).

The results[11] of a regression analysis that looked at the effects of language proficiency and strategy use on reading comprehension performance on each of the two tests indicated that level of language proficiency accounted for more variance on the reading measures than use of any one of the strategies. The author also conducted regression analyses to examine the relationship between performance on the reading measures and (a) the total number of times strategies were used and (b) the total number of unique strategies that were used. Performance on the reading comprehension measures was related only to the total number of times strategies were used and not to the number of unique strategies used.

The author's conclusion was that "there is no single set of processing strategies that significantly contributes to success on these two reading measures" (Anderson, 1981, p. 468). Anderson also concluded that there was great similarity between the strategies used for both types of reading situations. Although not discussed by Anderson, it is possible that the similarities in the strategies used in both reading contexts are the result of the fact that, despite differences across the texts, both contexts required reading for the purpose of answering multiple-choice tests. Thus, the similarities may be more related to the task that followed the reading of the passages than to the reading of the passages themselves.

Kozminsky and Graetz (1986) conducted a study examining the differences between native and second-language reading strategies employed in situations that required learning from text. The participants in the study were Hebrew speakers enrolled in the last required English-as-a-Foreign-Language course in an Israeli university. The participants were asked to read and summarize (in the native language) either an English or a Hebrew translation of a sociology text. English materials consisted of an English text in sociology and its translation into Hebrew. The students were asked to perform any of the activities (marking text, underlining, etc.) that they would normally conduct when they summarized. The experimenters analyzed the

underlying behavior, the note-taking behavior, and the marking behavior of the students and found that the students that read the Hebrew passage tended to mark larger text portions than those that read the English language passage. The latter group tended to only underline words. There was also a tendency for students who read the English passage to make more margin notes (made in Hebrew) than those who read the Hebrew passage. It is difficult to interpret what the differences in underlining behavior may reflect since it is possible that the students were using underlining for different purposes in each language. It is also difficult to interpret why the students tended to make more margin notes when the text was read in English. One might speculate that the translated notes might help them recall the information.

The summaries were analyzed in terms of (a) verbatim or paraphrased information, (b) abstractions, (c) generalizations and combinations of the information in the text, (d) cohesion and coordination, (e) additions of information, and (f) opinions. These analyses indicated that students composed longer Hebrew summaries than English passages and engaged in more of the verbatim reports, paraphrasing, abstractions, and so forth than the students who read in English. However, it is possible that, with unlimited time, the summaries of the English texts would have been more elaborate. The authors also found that students produced more verbatim summaries when they read in Hebrew than in English. However, it is difficult to judge whether this was affected by the translation process into Hebrew.

Carrell (1989) examined the relationship between readers' judgments of their reading strategies and skills in the native and second language and their ability to read and comprehend the second language. The participants in this study were native Spanish speakers (college students) who were learning English as a second language and who were in the intermediate and advanced levels of an English language program for nonnative English speakers. The second group was made up of native English speakers who were learning Spanish as a foreign language. They ranged from first- to third-year Spanish proficiency.

These students were asked to read two passages and answer multiple-choice comprehension questions for each passage in each language. The two languages were tested during separate sessions. In addition to completing the reading comprehension test, the students completed a metacognitive strategies questionnaire for each of the languages. The questionnaire asked them to indicate on a Likert scale how much they agreed or disagreed with statements about their confidence as readers, asked them about the repair strategies that they employ during reading, about strategies for effective reading, and about what makes reading difficult for them in that language.

The data were analyzed using regression procedures[12] to examine whether the strategy measures predicted reading comprehension performance in each language. The results of the analyses on the native language data showed the following: (a) a negative relationship for the Spanish group between use of strategies that emphasized sound-letter correspondences, sentence syntax, word meaning, and content details with Spanish reading comprehension; and (b) a negative relationship for the English group between use of sound-letter strategies and English reading comprehension. Thus, the less readers reported that they used each of these strategies in the native language, the better their comprehension.

The analyses on the L2 data showed that Spanish speakers who reported distinguishing between the main idea and the supportive details were better able to read and comprehend in English. Spanish-speaking students who tended not to give up when they experienced reading problems in English and who tended not to attend to details in the text were also among the better comprehenders. Finally, Spanish-speaking students who were less likely to respond that relating text to prior knowledge is difficult were among the better readers.

The English speakers who tended to disagree that attention to sound-letter relationships was a good strategy had the higher comprehension scores. Additionally, the more the English

speakers agreed that attention to word meaning and to sentence syntax was a good strategy, the higher the L2 comprehension scores. Finally, the more these students disagreed that sentence syntax was a source of difficulty, the higher the comprehension scores.[13]

Carrell (1989) interpreted the findings of these studies as follows:

> In other words, the ESL group, of more advanced proficiency levels, tended to be more global or top-down in their perceptions of effective and difficulty-causing reading strategies. The Spanish-as-a-foreign-language group, at lower-proficiency levels, tended to be more "local" or bottom-up in their perceptions of effective and difficulty causing reading strategies. Because of their lower proficiency in the foreign language, they may have been more dependent on bottom-up decoding skills; they may have needed—and may have been aware of their need—to "hold in their bottoms" as Eskey has argued. (p. 128)

The next study was conducted by Devine (1984), who was interested in understanding whether L2 readers have internalized models of the reading process and whether these models had an effect on their reading performance. The study involved interviewing and testing a group of intermediate and beginning level students from varied native language backgrounds.

Devine was interested in whether readers' conceptualizations of the reading process could be characterized as either sound centered, word centered, or meaning centered. The learners were interviewed about (a) the strategies they follow when they have trouble understanding what they are reading, (b) their beliefs as to what makes someone a good reader, (c) how they would help someone who was having trouble reading, and (d) what they would like to improve in their reading. The learners were also asked to read a text aloud. Their reading performance was analyzed using a miscue analysis. The students were also asked to summarize what they had read. Their summaries were scored using a six-point scale ranging from poor to excellent. The evaluation criteria employed to score the summaries were not described in the article.

Devine hypothesized that the internalized model of the reading process that the learners possess would affect the readers both in terms of the information that they chose to focus on while reading and in terms of their comprehension of text. Devine further believed that meaning-centered readers would comprehend texts better than sound-centered readers. The students were grouped as sound, word, or meaning centered based on their responses to the interview questions.

The first of these questions was analyzed by examining students' graphonic, syntactic, and semantic miscues as a function of their internalized reading model. She found significant differences in the proportion of semantic miscues between meaning-centered and sound-centered readers. The former produce more semantically appropriate miscues. She also found that sound-centered readers made more phonemic miscues than both word- and meaning-centered readers. Finally, sound-centered readers made more graphic miscues than word-centered readers.

Devine also examined the breakdown of summary scores as a function of the three reading model categories (sound, word, and meaning centered). This analysis indicated that all learners in the sound-centered category received summary evaluations that were poor or very poor. The summaries of readers who were placed in the word-centered category were mixed, ranging from very poor to very good. Finally, the learners in the meaning-centered group composed summaries that were all in the good to excellent scores. Devine interpreted the results of the study as an indication that having a meaning-centered model of the reading process improved comprehension and argued that students need to be encouraged to adopt a meaning-centered model of the reading process. However, we would like to note that we find Devine's implication that the readers' internalized model is the cause of his or her good or poor comprehension to be problematic. The data do not support a causal relationship between these

two factors. As we suggested above, the differences in readers' models and strategies might simply reflect, rather than cause, the students' level of reading proficiency.

Horiba (1990) was interested in determining if L2 readers were more attentive to their mental states during reading. The participants were a group of native Japanese speakers and a group of native English speakers learning Japanese (advanced level in college). Half of the students in each language group read a 10-sentence story using a Think-out-loud (TOL) technique and half did not use of the TOL technique. The L2 readers were asked to read the story and then write what they recalled in their native language. (This procedure was followed twice for each learner.) With the TOL technique, subjects were asked to report their thoughts after every two sentences in the passage.

Of the categories that were generated through the TOL procedure, the ones that seemed to discriminate between native and second-language readers on the first reading and recall of the text were (a) the (relative) frequency of comments on their own behavior, (b) inferences, and (c) general knowledge and associations. The L2 readers were more likely to comment on their own behavior, less likely to make inferences, and less likely to make comments related to their general knowledge of the topic. These two groups did not differ in terms of the frequency of predictions, questions, comments on text structure, confirmation of predictions, and references to antecedent information.

Qualitative analyses of the TOLs revealed the following behaviors on the part of the L2 readers. Although both groups were similar in terms of the frequency of content questions, the L2 readers were, as one might anticipate, the only ones to formulate questions on vocabulary and sentence meaning. The L2 readers' comments on their own behaviors were mostly focused on language mechanics with conscious monitoring of word recognition and understanding. Finally, the L2 readers generally made similar inferences to those of the native readers.

Horiba (1990) attributed the differences in the amount of attention paid to language mechanics by the two groups of readers to the L2 groups' lack of automaticity in processing linguistic information in text. Further research is needed that directly examines the relationship between the use and reporting of sound- and word-centered strategies and the level of automaticity of low-level reading skills. Another avenue for research would be to examine how adult L2 readers might use reading strategies developed through native language reading in the context of reading in a second language. As we mentioned earlier, it is possible that these native language literate readers might initially be able to use these reading strategies to compensate for their as yet inefficient word-level processing skills. Research supporting this hypothesis may speak to the potential advantages of developing native language reading skills prior to the delivery of L2 reading instruction.

Training in Reading Strategy Use

Two studies have examined the effects of training students in the use of reading strategies on their L2 reading performance. The first of these studies examined the link between strategy use and comprehension (Barnett, 1988). The subjects were college students with four semesters of French instruction who were satisfying their college foreign language requirements. One group of these students received direct instruction on reading strategy, while the other followed a traditional curriculum. Barnett asked the subjects to perform three different tasks. First, the subjects read a French passage and, after having read the passage, wrote down everything they recalled about the passage in English. A second task had subjects respond to questions that assessed their prior knowledge of train stations. After answering these questions, the subjects read a story that took place in a train station. The third task (which purported to measure strategy use) asked them to answer multiple-choice questions that presented them with alternative phrases, sentences, and paragraphs with which to continue the story. The purpose of this task was to measure their ability to use context to aid

comprehension. A fourth task measured perceived strategy use. This task required that participants answer a questionnaire about the strategies they used during their reading. These were scored as correct or incorrect based on their use of strategies that are considered effective for reading.

The first analysis involved an examination of the effects of strategy use and perceived strategy use on comprehension. This question was analyzed within an ANOVA framework by dividing scores on both independent variables into low, medium, and high categories, and analyzing their effects on recall performance. The results showed that comprehension scores tended to increase as strategy use scores increased and as perceived strategy use increased. However, no evidence was obtained of an interaction between these two factors.

Barnett (1988) also compared the performance of students who had been instructed on strategy use to that of students who followed a traditional approach. The results showed that the two groups differed only with respect to their strategy-use scores (trained students had higher performance on the multiple-choice questions) but not in terms of their perceived-use scores.

Carrell, Pharis, and Liberto (1989) examined the effects of metacognitive strategy training on improvements in L2 reading comprehension. The participants were ESL students from varied language backgrounds in the fourth level (the authors do not state whether this is the last level of the program) of an intensive ESL course at a U.S. university. A group of these students were assigned to a course that included metacognitive strategy training, while others were assigned to the standard ESL course.

The training consisted of four days of instruction on the use of semantic mapping tasks that use "a variety of strategies designed to graphically display information within categories related to a central concept" (Johnson, 1986, p. 651, cited in Carrell et al., 1989). The training also involved the Experience-Text-Relationship (ETR) method, which "uses discussion to link what the reader already knows to what will be encountered in the text" (p. 654). The goal of the training was to model the use of metacognitive strategies so that the students will later use them.

The authors had students complete a reading comprehension pretest and a posttest within a nine-day period. The test was based on multiple-choice and open-ended questions. The students were provided with a cloze test semantic map for each of two passages tested. The authors also constructed a map from scratch for the last passage and administered an Inventory of Learning Processes in order to examine interactions between individual differences in learning style and strategy use.

The main analyses evaluating the results of the instructional intervention showed that the control group made no gains on the multiple-choice test, open-ended questions, cloze semantic map, and open-ended semantic map. The semantic training group improved on the open-ended questions and on the open-ended semantic map. The ETR group improved on the open-ended question and the cloze semantic map.

Summary on Reading Strategy Use

The studies reviewed in this section suggest that there are differences in the strategies used by more and less proficient L2 readers and in those used by native and second-language readers. The studies suggest that less proficient readers tend to engage in strategies that concentrate on low-level text processing, while more proficient readers tend to engage in meaning-building strategies. Different interpretations have been provided about whether these strategy differences are the cause or the result of low reading proficiency. We have argued that the evidence does not support a causal interpretation for the relationship between strategy use and reading proficiency.

How Might Research on Text-Modeling Processes Inform Assessment and Instruction?

Prior Knowledge Research

The findings from the studies examining the relationship between prior knowledge and L2 reading comprehension have important implications for the assessment of reading comprehension in a second language. One of these implications relates to the diagnosis of L2 reading problems. Given that prior knowledge affects L2 readers' ability to comprehend texts, the assessments of reading proficiency in this population of readers need to distinguish between reading difficulties that arise from lack of prior knowledge and those that arise from problems in the execution of lower level cognitive skills that support fluent reading (Royer & Cunningham, 1981). The problem, of course, lies in measuring prior knowledge independently from reading ability. Royer (1990) proposed the assessment of listening comprehension skills in addition to reading comprehension skills as one way to distinguish between these two factors. Royer (1990) has argued that, when listening and reading comprehension tests are based on texts dealing with the same topic (thus making similar demands on prior knowledge), comparison of listening and reading comprehension performance scores can be used to distinguish between poor reading comprehension performance that results from reading problems and poor performance that arises from prior-knowledge problems. Presumably, if an examinee performs poorly on the reading comprehension test but performs well on the listening comprehension test, then one might consider the possibility that the low reading comprehension performance is due to a reading problem and not a prior-knowledge problem. If, however, performance on both the listening and reading comprehension tests is poor, then it is possible that the text makes prior-knowledge demands on the reader that he or she cannot meet. Failure to consider the impact of prior-knowledge differences on reading comprehension performance can lead to erroneous conclusions about students' reading competence. One might infer a general inability to read with comprehension when one is in fact witnessing lack of knowledge about a particular topic.

The role of prior knowledge in the reading process also has implications for classroom practices. First, this research would suggest the need for teachers to inquire about students' prior knowledge both in terms of content-matter knowledge as well as cultural knowledge (Carrell, 1988). The studies would also have implications for the selection of reading materials that build on students' prior knowledge (Carrell, 1988). One way in which this can be achieved is by using texts that describe aspects of students' native countries and culture.

Text Structure Research

If there are differences in text structure preferences across language groups, then test developers and teachers may need to consider how particular text structures might differentially impact on the reading performance of learners with different native language backgrounds. Additionally, the research suggests that there might be benefits to the practice of providing direct instruction on the use of text structure knowledge in order to facilitate comprehension.

Reading Strategy Research

In the native language reading literature, a distinction has been made between knowledge of strategies, experiences using those strategies, and application of the strategies (Garner, 1987). The studies reviewed here suggest that instruction promoting awareness and experience with reading strategies may facilitate the application of strategies in L2 reading.

In terms of assessment, this research suggests that adult L2 learners are able to articulate the strategies that they believe they use as they read. This research further suggests a

relationship between the strategies that learners report to use and their stage of development of L2 reading proficiency. Consequently, teachers might be able to use students descriptions of their strategies as a means of understanding their instructional needs. Future research should further investigate the complexity of the relationship between students' self-reported strategies and actual strategy use.

The connection between native language strategy use and second-language strategy use has not yet been investigated, but the research cited above raises questions about whether knowledge of this relationship might be beneficial to L2 reading. If such a connection were supported, this would allow teachers to address issues that concern the positive or negative transfer of reading strategies from the native language to the L2 reading situation.

Implications for Assessment and Practice: A Summary

Throughout this paper, we have reviewed research that attempts to understand aspects of the L2 reading processes of adult learners, and we have discussed how research on L2 reading processes might inform instructional practices and the assessment of L2 reading skills. While the focus of the review has been on adult research, many of its implications for evaluation and practice are not necessarily specific to adults. In particular, the recommendations made here for the assessment of L2 reading progress may be useful in the evaluation of both children and adults. The following section highlights some of the more important points regarding instruction and evaluation that have been discussed so far.

- **Use of measures of efficiency in reading component processing**

  The research reviewed here on lower level components processing strongly suggests that measures of efficiency in low-level reading component processing can aid in the evaluation of student progress in L2 reading and in the diagnosis of reading problems. For example, measures of processing efficiency allow practitioners to assess gains in reading competence before they translate into gains in reading comprehension. Given that it takes time for gains in reading comprehension to manifest themselves in evaluations of reading competence, measures of low-level processing efficiency may provide the practitioner with information concerning the continued progress of students as a function of reading instruction. For example, a student's increased efficiency in word decoding can be identified before any gains in reading comprehension performance are visible. Moreover, measures of reading efficiency may help identify students who have not developed automaticity in low-level reading component processing, thus suggesting the need to provide them with the additional practice that will eventually develop this automaticity.

- **Attention to decoding instruction**

  The research discussed here indicates that L2 readers of alphabetic scripts need to develop fast and accurate decoding skills. Fluent reading in the second language was associated with efficient decoding strategies and with sensitivity to, and knowledge of, the orthographic patterns and redundancies of the target language. This suggests the need to provide students with instruction that develops knowledge of sound-symbol relationships and that provides enough practice to develop automatic decoding skills. As discussed earlier in this paper, new teaching methods are currently being developed that integrate phonics instruction into meaning-based reading curricula.

- **Attention to changes in visual word-processing strategies as measures of reading progress**

  The research reviewed in the section on word-level processing provided evidence of two changes in word-processing strategies that could be used as indicators of reading acquisition progress. One of these changes had to do with transitions from the use of native language word-processing strategies to the development of strategies specific to the second language. These changes appeared to occur for readers of logographic writing systems who were learning to read languages based on alphabetic systems. As mentioned earlier, these readers initially appear to process L2 words as whole units through paired associate learning. However, with increased experience in L2 reading, they begin to rely on the application of sound-symbol correspondence rules. Consequently, attention to this shift in processing strategies may serve as a measure of reading progress during the initial stages of L2 reading development of native readers of logographic scripts.

  A second change in word-processing strategies that may also be useful in the early assessment of L2 learners concerns the shift from L1 mediated lexical access to the creation of direct links into the L2 lexicon. As discussed in the section on lexical access in L2 reading, access to concepts initially occurs through a process of translation that links the L2 lexical entry to the L1 lexical entry which, in turn, guides access to conceptual memory. As this process repeats itself through repeated encounters with a word, direct links from the L2 lexicon to conceptual memory are formed. Attention to the transition from L1 mediated lexical access to direct access may also signal early gains in L2 reading proficiency. The computer-based experimental procedures described in the section on lexical access (such as the Lexical Decision Task), may also have value as procedures for language assessment in that they may help in the identification of such transitions in L2 processing.

- **Reconsideration of the benefits of translation in L2 learning**

  The research on lexical access in the second languages also raises questions about the practice of discouraging the use of translation for L2 learning. As the research suggests, the urge to translate may be more a reflection of a stage in L2 reading development.

- **Attention to the development of flexible strategies for dealing with unfamiliar vocabulary**

  Students who are learning to read in a second language are often instructed to either skip unfamiliar words or to figure out their meaning from the surrounding text. This practice is intended to encourage students to read for the whole meaning of a text (not just word for word reading) and to make the experience of reading more enjoyable and less laborious. The research that we reviewed in this paper lends support to this practice but also points to the need to help students develop a wider variety of strategies for dealing with unfamiliar words in text. As the research demonstrated, students needed to develop other strategies (such as dictionary use) in order to process words that cannot be deciphered from the context of the reading.

- **Use of authentic materials**

  Although more research is needed to understand the relationship between syntactic processing and L2 reading, the research reviewed here suggests that it may be counterproductive to alter the syntactic complexity of texts to simplify them for L2 learners. The research indicated that altering texts in this manner negatively affected the comprehensibility of texts for L2 learners.

- **Attention to students' use of reading strategies**

  The research on strategies is of relevance to the assessment and instruction of L2 reading because it suggests that processes beyond the level of decoding and syntax are key for L2

reading. As the research suggested, the use of strategies both for remembering information that has been read and for dealing with unfamiliar vocabulary in text are part of the repertoire of the more fluent L2 readers. These findings suggest the importance of developing such strategies in L2 readers and also of assessing whether students have successfully developed such strategies. Since a lack of such strategies may also be a source of L2 reading problems, their assessment may be useful for diagnosis.

- **Attention to effects of prior-knowledge differences on reading comprehension performance**

  A reader's prior knowledge of a topic influences his or her ability to read a text on that topic with comprehension and affects the amount of information that can be retained from reading such a text. The research on the effects of prior knowledge on L2 reading comprehension indicates the importance of sensitivity to the prior-knowledge demands of texts. Failure to consider these effects in the development of L2 reading tests may lead to erroneous conclusions regarding learners' competence in L2 reading since examinees may perform poorly because they lack either the background knowledge or cultural knowledge that is assumed by the text rather than because they are unable to read in the second language.

Many of the current debates concerning the teaching of reading in both a first and second language include differing opinions about which aspects of the reading process should be the primary focus. Historically, particular research orientations have been linked to specific teaching methodologies and these philosophical and methodological differences have often been seen in clear opposition to one another. More recent theorizing about reading research and instruction has attempted to bring together these traditionally conflicting orientations. This trend can be seen in the birth of componential theories of reading, which include the contributions of multiple levels of cognitive processing. It can also be seen in instructional methodologies that incorporate a focus on both lower level and higher level considerations.

This review emphasizes the importance of viewing particular aspects of the reading process within a comprehensive framework. The question is not which aspect of the L2 reading process is most important but rather how these processes occur and change over the course of L2 reading development. The role of native language background in the second-language reading process also has instructional implications. Although more research is needed to understand the intricacies of this factor, the research reviewed shows that language background influences both lower level processes, such as letter recognition, and higher level processes, such as prior knowledge about text structure. Our understanding of this relationship has important implications for the teaching of L2 reading.

We believe that the framework used to organize this review may be useful in delineating what is currently known and what still needs to be investigated about the full range of processes involved in reading in a second language. It is clear, however, that knowledge about the strategies employed by L2 readers can influence the teaching and evaluation methods used by L2 teachers.

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Endnotes

[1] This perspective is distinguished from interactive perspectives that emphasize the interactions among reading processes (e.g., Rummelhart & McClelland, 1982; Stanovich, 1980).

[2] The research literature that we reviewed was selected through computer searches of the Psychological Abstracts and of the ERIC databases using the following descriptors: adult second and foreign language reading. We specifically sought studies that had been conducted with the purpose of understanding some aspect of the reading process in a second language. Another source used to identify studies on second language reading with adults was E. B. Bernhardt's (1991) book entitled *Reading Development in a Second Language: Theoretical, Empirical, & Classroom Perspectives*. To this corpus of studies, we added literature from cognitive psychology that focused on issues of bilingual memory representation. Although these studies were not conducted as investigations into second-language reading processes, their findings have much to offer to our understanding of the cognitive processes that support visual word recognition in bilinguals.

[3] Whether sound is involved in word processing prior to lexical access is debated even for alphabetic writing systems. Dual-route theories, for example, propose that frequently encountered words are accessed by a direct visual route whereas infrequent words are accessed through a sound-based route (Rayner & Pollatsek, 1989).

[4] Our review of studies in this section is selective rather that exhaustive, given that these studies do not deal directly with second-language reading.

[5] The argument that second-language learners transfer native language visual word processing mechanisms to second-language word identification needs to be distinguished from the argument that reading skills developed in the native language transfer to or facilitate the learning of second-language reading. As far as we know, no studies have been conducted to test whether applying the perceptual processes that support word recognition in one writing system to a different writing system also facilitates second-language reading acquisition.

[6] This point was made by an anonymous reviewer of this paper.

[7] As mentioned earlier, these authors' use of the term *interactive* is distinguished from that of Stanovich (1980). Stanovich uses the term to refer to interactions among cognitive processes whereas these authors use it to refer to the interaction taking place between the reader and the text.

[8] The results could have been analyzed by including *group* as an additional between-subjects variable in the Analysis of Variance, but—for reasons not described in the article—the author chose not to follow this procedure. The use of separate analyses raises the probability of Type I errors since the likelihood of these increase as do the number of statistical comparisons.

[9] The authors do not indicate if the statistical analyses controlled for Type I error. The reader is cautioned that some differences might not have been significant if stricter significance criteria were used.

[10] The author does not indicate whether the probability of Type I errors were controlled for in judging the statistical significance of these comparisons.

[11] The actual results of the regression analyses are not provided in the document.

[12] The actual results of the regression analyses are not provided in the document.

[13] Additional analyses were performed in which students were categorized as *global strategizers* and *local strategizers* on the basis of their responses to the items on strategy effectiveness and difficulty. These results will not be discussed here since the groupings sometimes resulted in cells that contained a single participant.

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