Reading Ability: Cognitive and Psycholinguistic Perspectives

Reading is both simple and complex. It is, at the same time, both cognitively trivial and so difficult that failure at learning to read is common. Edmund Burke Huey (1908), who published the first comprehensive account of reading, could perceptively observe that a complete theory of reading would involve a description of "very many of the most intricate workings of the human mind" (p. 6). On the other hand, countless parents with no expertise in reading can boast of their preschool children's prodigious accomplishments in literacy. For example, Roger Schank (1982) begins his book on what artificial intelligence might tell us about reading by observing that he taught his daughter to read when she was four years old. Of course, reading achievements at an even younger age are possible. Just ask a parent.

However, not all children are so lucky. Many children do so poorly at reading that they are given a special category, "developmental dyslexia." Moreover, quite aside from specialized reading disabilities, there is continuing widespread concern about the ordinary failures of reading experienced by countless numbers of children who never earn the "dyslexic" label.

The issues of reading ability are not limited to children, however. Among adults, there are countless semiliterates. Moreover, even among college students, all of whom are literate, there is a wide range of talent. Some can read a textbook at 400 words per minute with good comprehension. Others plod through the same book at 100 words per minute and with no better comprehension than the faster students.

Thus, the range of reading talent is very broad and has several components. Huey was clearly correct about the "intricate workings of the human mind" being reflected in reading. It will not be possible to understand variations in reading talent without taking note of some of these

intricacies. In short, an understanding of reading ability requires an understanding of reading. This means that we must know something about the components of reading.

COGNITIVE COMPONENTS OF READING

When a sentence such as (1) below is read, some of the components of reading are seen:

(1) *Marvin asked his brother to lend him five dollars. He refused.*

The first obvious component is that the words be "recognized." That is, *Marvin, asked, his*, etc., must be associated with familiar concepts represented in the reader's memory. These representations include names of persons (Marvin), general concepts (*ask, brother, lend, dollar*), and referring devices, or anaphora *(he, his)*. In each case, they also include information about how the word is pronounced. Since these recognition processes involve access to mental representations of words, this general component of reading is referred to as *lexical access*.

The second general component is comprehension, which is not a single component at all, but a set of interrelated processes. In fact, it is reasonable to think of lexical access as one of these processes. However, the more salient comprehension components are those by which the reader builds a representation of text meaning. With a good representation of the text, the reader can answer such simple questions as: *(a)* What did Marvin do? *(b)* Whom did Marvin ask to lend him money? *(c)* How much money did Marvin get from his brother? Quite a few questions can be used to tap the representation of text meaning. Some, such as *(a)* and *(b)* tap a representation of text information explicitly in the text. Others, such as *(c)*, tap a representation that includes inferred information. Building the text representation, even for such a short text is as intricate in reality as it is simple in appearance. Think, for example, of the linguistic and practical knowledge that allows assignment of reference for *he* in the sentence *he refused*.

These intricate comprehension processes include *propositional encoding* and *propositional integration*, which are the relatively local text processes, and *text modeling*, which includes the processes of constructing the overall meaning of a text. The local comprehension processes are those that allow comprehension of even isolated sentences and sentence pairs. The text-modeling processes use the outcome of these local processes to build a larger representation of extended text.

Thus, the general account of reading processes includes components of lexical access and comprehension. The reader identifies words, taking

account of their meaning and pronunciation as context and task demands require. Complex comprehension processes build on these recognition processes and perhaps even influence them in a limited way. These are the reading processes that are to be understood if we are to understand reading ability.

LANGUAGE AND READING

The central processes of reading are essentially mental operations on linguistic structures that begin with visual input. Although visual processes and linguistic processes have to be taken into account, the linguistic processes may turn out to be especially important for reading ability.

This is not to say that the visual processing of letter and word forms, or Chinese characters for that matter, is not important. Indeed, a significant part of becoming skilled in reading is the increase, with experience, of recognition for print patterns. Gibson and Levin (1975) emphasized the role of this kind of perceptual learning. The reader learns to discriminate among letter forms, then letter patterns. We can think of the reader with years of experience as having countless useful patterns represented in memory. These patterns are abstract—they account for *TH* and *th* irrespective of the exact shape of the characters—and they potentially include a wide range of units—single letters, letter patterns *(th, ing)*, and whole words *(the)*. It is conceivable that even longer words, provided they have been encountered often enough, can be represented as patterns in memory. Thus, normal reading includes an obvious visual component and one to which learning can apply.

The linguistic part of reading is emphasized for two reasons. The main reason is that reading includes both recognition of words and comprehension. Linguistic processes are heavily involved in both of these. Comprehension processes are essentially manipulations of linguistic objects rather than visual ones. Word recognition processes are essentially translations of visual objects into linguistic symbols used in these manipulations. A secondary reason for the linguistic emphasis follows from the first: A theory of reading ability must take account of the linguistic aspects of reading because differences in reading ability turn out to depend on its linguistic components.

Language, Speech, and Print

The linguistic nature of reading implies there should be something shared between print and speech processes. Indeed, there is a good deal in common between written and oral language. This assumption of commonality can be sloganized into such claims as "Print is speech writ down" or

"Reading is listening plus decoding."

On the other hand, it is possible to be impressed by differences between spoken and written language. Consider the following list of differences:

1. In speech, prosodic (e.g, intonation) and paralinguistic (e.g., gesture) features help signal meaning. Such features are absent in print.
2. In print, memory demands are reduced because the text can be reinspected. Speech makes higher memory demands because its signal is transient.
3. Print conventions mark word boundaries with spaces. In speech, word boundaries are not always marked by silence.
4. Speech is typically part of a social interaction. Reading ordinarily is an individual activity.
5. The content of speech is seldom arbitrary because of its social component. There is a shared message context between speaker and hearer. The content of print is often arbitrary from the perspective of a child reading in a classroom.
6. The content of speech is modulated by the participants. The content of print is fixed by the writer.
7. In learning to read, a learner must master a conventional coding system which maps a writing system onto a language system (a phonemic system in the case of alphabetic and syllabary writing systems, a semantic system in the case of ideographic systems). Speech is a natural coding system easily mastered by any child within a speech community.

This list can be extended to include some other features. For example, there typically are syntactic differences between speech and print. Written language uses more nominalizations (Chafe, 1982) and more subordinate clauses (O'Donnell, 1974). However, such differences may derive from one of the seven differences listed above or from some other source. For example, syntactic differences may derive from the memory feature (2) in conjunction with social context features (5 & 6) that emerge in typical purposes of writing compared with speech. However, whether derivative or fundamental, the fact that syntactic patterns of print diverge from syntactic patterns in speech has serious implications for reading. This is especially true for children in the early stages of reading, who may encounter unfamiliar syntactic patterns.

A generalization may be possible concerning these features that distinguish print from speech. There seem to be two fundamental features, design features of print and speech, from which others seem to derive:

The physical design of the signal. The spatial-visual design of print contrasts with the temporal-auditory design of speech. Such differences as 1, 2, 3, and probably 7 derive from this feature.

The social design of the message context. There is a fundamental contrast between the socially interactive and pragmatically functional context of speech and the asocial, one-way communication of print. Differences 4, 5, and 6 are derived from this feature.

Thus there are both commonalities and differences between spoken and written language. The central commonality is their dependence on linguistic structures and processes. Semantic, syntactic, and phonological structures are the linguistic core of language that is used in both print and speech. In addition, pragmatic, real-world knowledge is necessary in both speech and print. Differences concern the relative importance of particular structures and kinds of knowledge that derive from physical and social design features.

Implications for reading ability

If we consider the child learning to read, there are two obvious obstacles deriving from differences between speech and print: the *decoding* obstacle and the *decontextualization* obstacle.

The fact that print requires the learning of a code is fundamental, especially for orthographic writing systems. There are strong opinions about the implications of this fact—how and even whether decoding should be taught, for example. Some have argued that because reading is ultimately about comprehension, children should read only when comprehension is possible. Kenneth Goodman (1967) and Frank Smith (1973) are prominent proponents of this view.

By this view, the code, i.e., the decoding rules mapping letters to phonemes, is not to be taught. Reading is to occur only with texts, and the child's linguistic talents are supposed to allow him or her to use context to handle any problem of word recognition. This issue is too complex to be discussed here (see Chapters 10 and 11). However, one thing can be made clear: The child somehow has to discover the coding principles of his writing system. It is either impossible or difficult to become a skilled reader without mastering the code system. Young children with difficulty in reading almost invariably have imperfect knowledge of the coding system that maps written symbols to speech.

The second major obstacle is that the reader has to learn to deal with the decontextualized nature of print. He comes to school with a fairly rich knowledge of language and considerable experience in using it. However, this experience has been with contextualized language, speech that occurs in social context. He has seldom had to deal with meanings

that are solely "in sentences." Meaning has been a joint venture, with context providing as much information concerning message interpretations as speech itself. More often than not, the things referred to in a conversation are physically present in the environment. When they are not, they are present in the world shared mentally by the participants in the conversation. Even speech the child hears on television is embedded in rich social and narrative contexts. It is quite possible that such contexts, since they overdetermine the interpretations of spoken messages, allow syntactic processing to be relatively unused and underdeveloped.

The child's encounters with print change all that. The meanings are less determined by context and more dependent upon sentences. The written sentence, unlike the spoken sentence, carries the meaning intrinsically. Syntactic processes must be used and they may not be sufficient. Also, inferences which might be supported by context in speech will be less available in print.

All of this is, of course, quite a simplification. But there is a central point concerning learning to read. Because of differences between print and speech, the child learning to read faces at least two obstacles: mastering a conventionalized coding system and adapting, eventually, to decontextualized language. In the course of these adjustments, reading will become increasingly a generalized linguistic activity. Differences between print and speech will be reduced. It is even likely that mastering reading leads to some changes in the way speech gets used.

Reading Ability: A Psycholinguistic Perspective

With the assumption that reading includes important linguistic processes comes the implication that reading ability can be understood in terms of linguistic processes. This implication constitutes a psycholinguistic perspective on reading and reading ability.

"Psycholinguistic" must be understood in a very careful sense. To call reading a psycholinguistic process is to assume that linguistic structures are important in the structure of written language and that language processes are important in the processing of print. It does not mean that reading is a "psycholinguistic guessing game," the description of reading suggested by Goodman (1967).

In fact, the metaphor of the "psycholinguistic guessing game" is an obstacle to understanding reading. The basic idea of the guessing game is that there are many cues that a reader uses to get at the meaning of text. Indeed there are syntactic cues, semantic cues, and graphemic cues. All these can be used, and are used, in reading. However, these "cues" depend on the reader's knowledge of linguistic structures and of concepts in intricate interaction with his knowledge of word structure—not just the arrangement of letters in the spelling of a word but also phonology

and morphology. The reader can know, for example, that *nation* and *national* have different phonetic shapes (pronunciation) that are related to morphophonemic rules.

The intricacies of these linguistic systems, and especially how they are used in processes of reading, require investigation. The processes are complex and insufficiently understood. However, the psycholinguistic processes add up to something more than a guessing game. The skilled reader has quite a bit of certain knowledge at his disposal. The orthographic system provides a constrained set of possibilities for any given string of letters. And the coding principles provide very narrow choices for any orthographic string. Of course, *lead* may map onto "led" or "leed" out of context. But it can't map onto "window" or "deer." The skilled reader has adequate knowledge to identify most words without context and adequate knowledge to identify almost all words with very minimal context. For the skilled reader, reading is psycholinguistic but it is no guessing game.

Reading Ability: A Cognitive-Developmental Perspective

The psycholinguistic perspective of reading is appropriate because of the importance of language processes in reading. Another perspective overlaps with it. Reading is a process that includes many general cognitive components, especially with respect to comprehension. The knowledge that a reader has plays a large role in the understanding of a text. This knowledge is both specific to certain content (e.g., cooking and politics) and general to forms of thought. Both kinds of knowledge undergo development. The child reading at age 7 and the child reading at age 12 differ in the knowledge they bring to the reading task. Assuming each has adequate abilities at lexical access (word recognition) and given the same text, their comprehension of the text may be different.

Nevertheless, it is too ambitious to try to understand all of cognitive development. We will be concerned primarily with those aspects of reading that are most naturally associated with reading and language. If general cognitive development sets limits on reading ability, so be it. We want to understand reading ability within these limits. This means we want to understand especially how processes of lexical access, knowledge, and comprehension interact.

Reading Ability and Verbal Efficiency

Consideration of reading as cognitive and linguistic processes in interaction leads to the formulation of verbal efficiency. At least some of the processes in reading are executed within limitations of processing resources. Thus one key to the development of reading skill is the extent

to which the limited-resources problem can be overcome.

With respect to learning how to read, mastery of the code is essential. As development of skill increases and as text demands increase, these coding processes do not become less important. They merely change in the nature of their impact. These coding processes must be executed fluently, with little effort. The increased textual demands mean the reader must take more and more use of higher level comprehension processes. This can be done only without expenditures of resources at low-level coding skills. This is the central claim of verbal efficiency theory (Chapters 6 and 7). Readers of low ability have inefficient—slow and effortful—coding as the major obstacle to reading achievement.

Reading Ability: Individual Differences

The range of individual differences in reading ability is enormous. Consider for a moment speed of reading as an index of ability. The average college reader reads at about 250 words per minute with some comprehension. However, some people read at 400 words per minute, while many others plod along at 150 words per minute. Of course, reading rates depend on reading materials and reading purposes, but these factors can be disregarded for now. The fact is that even among such a select population as college students, reading rates differ widely among individuals. One defining trait of a skilled reader is a reading rate that is at least average for the comparison population. A college student who reads at more than 250 words per minute over a wide range of texts is a skilled reader.

Of course speed is not enough. Some level of comprehension must be included. Our intuitive concept of reading skill includes reading fast and reading with good comprehension. One way to combine these two characteristics is to follow the lead of Jackson and McClelland (1975), who defined "effective reading speed" as the product of comprehension $\times$ words per minute. Thus two people could be equivalent in effective reading speed, the first twice as fast as the second and the second twice as good at answering comprehension questions.

Eventually, a theory of reading skill may be able to account for speed and comprehension separately. It is likely, for example, that the reader who puts speed as a priority is not only comprehending less but is engaged in slightly different processes (Just, Carpenter, & Masson, 1982). For now, both comprehension and speed must be considered part of reading skill. To an extent, reading rate may be traded off against comprehension. An individual can slow down or speed up by altering his criterion for comprehension. To this extent, then, it is quite sensible to define reading skill as including either high comprehension or high rate,

with the other of these components above some minimum. Here we will seldom be able to refer to specific measures of speed and comprehension. It will, in fact, be common to have only measures of comprehension. In such cases we need only assume that a reader was not particularly slow, a condition often assured by time-limited standard assessments.

There is another issue of definition. Obviously a college-age reader who is highly skilled need not have just the same skills as a 10-year-old reader of high skill. There are qualitative differences in skilled reading that depend on the development of reading ability. Thus, a college reader may not simply do the same things that a 10-year-old does except faster. He may do them differently. There is no simple solution to this problem, because the solution depends on a deeper understanding of the very qualitative differences that might be involved. Instead, we must resort to a normative concept: Reading skill is relative to the age group of the reader.

Thus we have a definition of reading skill. A skilled reader is one who, relative to a given age group, shows comprehension and reading rates that are at least average. The less skilled reader, accordingly, is one who is below average in comprehension and/or reading rate. Although it is sometimes difficult to be sure whether the subjects in any particular study fit this definition, or whether they are fully comparable to the subjects in some other study, the definition is at least the ideal for any theoretical claims. It identifies the groups we refer to by the terms "skilled" and "less skilled" readers or the equivalents "high-ability" and "low-ability" readers.

SUMMARY

This introductory chapter has set forth the issues of reading and reading ability that are treated more fully in subsequent chapters. Reading ability is to be understood in terms of the cognitive processes of reading. Lexical access (word recognition) processes are those that identify words, and comprehension processes are those that build meaning representations of the text. Individual differences in reading ability can be understood only in reference to these processes.

Another important perspective on reading ability is that it reflects essential language processes. Linguistic processes, defined as the manipulation and representation of linguistic structures, are central to reading and therefore to our understanding of reading ability. In that sense the approach to reading developed in this book is a psycholinguistic approach. However, the linguistic components of reading are intricate. For example, there are both important similarities and differences between written and spoken language that derive from their basic design features. The beginning reader has to master a conventionalized coding system and

learn to deal with decontextualized language, two prominent departures of print from speech.

Another possible perspective on reading ability is in terms of cognitive development. Cognitive capabilities set some limits on reading achievement. The main objective, however, is to understand the linguistic and cognitive components of reading processes that occur within these general constraints. An important assumption is that these processes take place partly within a limited-resource processing system. This leads to the verbal efficiency theory of reading ability.

Finally, the definition of reading ability comes from considering both speed and comprehension. Generally, a skilled reader is one who is above average in comprehension with at least average reading speed relative to a given age group. As a practical matter, measures of comprehension are sufficient.

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