DOCUMENT RESUME

ED 278 962 CS 008 696

AUTHOR Perfetti, Charles A.; McCutchen, Deborah
TITLE Schooled Language Competence: Linguistic Abilities in Reading and Writing.
INSTITUTION Pittsburgh Univ., Pa. Learning Research and Development Center.
SPONS AGENCY National Inst. of Education (ED), Washington, DC.
REPORT NO LRDC-1986/16
PUB DATE 86
NOTE 70p.; To appear in: S. Rosenberg, Ed., "Advances in Applied Psycholinguistics," Cambridge University Press.
PUB TYPE Viewpoints (120) -- Information Analyses (070)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Applied Linguistics; Cognitive Development; Communication Skills; *Language Processing; Language Proficiency; *Language Research; *Linguistic Competence; Psycholinguistics; *Reading Ability; *Reading Writing Relationship; *Writing Skills
IDENTIFIERS *Schooled Language Competence

ABSTRACT

The notion that a set of restricted-generalized abilities underlies both reading and writing is explored in this essay. Following a definition of schooled language competence (SLC), the first section asserts that knowledge and problem solving are insufficient and nonlinguistic approaches to language competence. The second section focuses on linguistic and nonlinguistic sources of reading skill and presents two related arguments for reading as a restricted-general ability. The first argument asserts that meaning comprehension and interpretation are not the same, while the second claims that comprehension processes representing "meaning comprehension" can become impenetrable by knowledge, beliefs, and expectations. The implications of these arguments for research on reading ability are also discussed. Emphasizing linguistic and nonlinguistic sources of writing skill, the third section suggests (1) that a general language competence underlies both reading and writing skills, and distinguishes this SLC from more basic communicative language skills, (2) that SLC, like basic competence, depends at its core on linguistic symbol manipulation, and (3) that, because reading and writing have more than shared features, some disassociation between reading and writing skills might be expected. The essay concludes by observing that recent research demonstrates a role for knowledge-free general abilities in both reading and writing. (JD)

LEARNING RESEARCH AND DEVELOPMENT CENTER

1986/16

SCHOOLED LANGUAGE COMPETENCE: LINGUISTIC ABILITIES IN READING AND WRITING

Charles A. Perfetti and Deborah McCutchen

University of Pittsburgh

SCHOOLED LANGUAGE COMPETENCE: LINGUISTIC ABILITIES IN READING AND WRITING

Charles A. Perfetti and Deborah McCutchen

Learning Research and Development Center
University of Pittsburgh

1986

To appear in S. Rosenberg (Ed.), *Advances in applied psycholinguistics.*

The research reported herein was conducted at the Learning Research and Development Center, funded in part by the National Institute of Education (NIE), U. S. Department of Education. The opinions expressed do not necessarily reflect the position or policy of NIE, and no official endorsement should be inferred.

Table of Contents

SCHOOLED LANGUAGE COMPETENCE: LINGUISTIC ABILITIES IN READING AND WRITING

Charles A. Perfetti
University of Pittsburgh

Deborah McCutchen
University of Colorado

In this essay, we pose a general question and develop an argument concerning the kind of answer that is required. The question is whether there are some general principles of language competence that can be applied to the development of both reading and writing skill.

The short answer to the question we pose will be "yes"--we will argue that there are some general principles of language competence that serve both reading and writing. At the same time, there will be some distinctive features of writing not shared by reading, and we will try to specify some of these distinctive features. The general form of our argument is that schooled language competence is a restricted set of abilities; i.e. it cannot be identified with the full range of cognitive skills. The essential activity of both reading and writing is linguistic symbol manipulation.

In what follows, we first define schooled language competence. Then we critically discuss other approaches to language competence, arguing that non-linguistic approaches are inadequate. We then demonstrate, first for reading and then writing, the arguments that language competencies play a central role.

Schooled Language Competence

By schooled language competence, we intend to suggest a set of language abilities that build on basic linguistic competence and are heavily modified by learning. By assumption, schooled language competence underlies performance on every language task. For the performance side, we will restrict discussion to the ordinary text reading and mundane writing activities of elementary school children, although we intend that the underlying competence serves other language performances as well.

One problematic component of the concept of schooled language competence is its relation to basic language competence. We can make the relatively weak assumption that a child entering school at age six has basic language competence in the sense of knowing the grammar of his or her language. Furthermore, the child has a high degree of pragmatic competence, implicitly understanding conditions on communication, turn taking, etc. Effects of schooling on language competence appear, at least by informal observation, to lie in two areas--(1) an increase in vocabulary size and, concomitantly, an increase in semantic precision of words and (2) an increase in syntactic options. It is the syntactic growth that is clearly connected to initial language competence, although vocabulary growth is also, to the extent that word morphology is used generatively, e.g. adding unable to the vocabulary based on appreciation of the negative prefix. In general, increased competence in syntax is the part of schooled competence that builds on basic language competence.

What is problematic is how to understand this "building on" relationship. One possibility is that new structures are learned. Another possibility is that the number of syntactic options merely increases from basic knowledge of syntactic forms. The

difference between these two alternatives is whether, for example, the increased use with schooling of subordinate clauses (Loban, 1976) reflects the acquisition of subordination structures (or rules) or merely the productive control of structures that have been part of basic competence for some time. There has been a profound neglect of the mechanisms by which language growth occurs beyond early childhood and, accordingly, there is little reason to choose one syntactic growth hypothesis over the other. A weak assumption seems appropriate and sufficient: The growth of language competence with schooling reflects a basic language competence developed at an early age that, with appropriate experience and linguistic dispositions, drives subsequent grammatical development. Extended grammatical competence is especially important in writing, as we will argue.

Schooled language competence develops in the context of the acquisition of literacy. There are two parts to this general claim. One is that the development of schooled language competence serves the acquisition of both reading and writing. The second is that the development of schooled language competence occurs primarily through the influence of literacy. The relationship between writing and reading, on the one hand, and schooled language competence on the other, is reciprocal. Although both claims have interesting entailments, we will focus here on the first one, that reading and writing are served by schooled language competence. That such competence arises through reading and writing rather than through spoken language is an interesting hypothesis, but largely beyond our purpose here. (See, however, Perfetti 1985; in press.)

Knowledge and Problem Solving Are Insufficient

In contrast to the approach we develop here, there are some approaches to skilled performance that include virtually no roles for a generalized language competence. There are two which we will discuss briefly to show that they are inadequate.

Knowledge

The first approach emphasizes the critical role of knowledge in skilled performance. The basic thrust of this approach is that cognitive task performance in general, including reading comprehension, is driven by conceptual knowledge of the task domain. The methodology behind this approach has been the comparison of experts with nonexperts in a domain, e.g. physics (Larkin, et al., 1980; Chi, Glaser & Rees, 1982), chess (Chase & Simon, 1973) social science (Voss, Greene, Post & Penner, 1983), and baseball (Spilich, Vesonder, Chiesi & Voss, 1979). The conclusion that seems to cut across the different domains is that performance on a task qualitatively depends upon the individual's expertise in the domain. When an individual is knowledgeable in a domain, his or her problem solving is qualitatively different from that of the nonexpert in its reliance on the conceptual structures of the domain. Performance is, in short, more driven by the deep conceptual structure of the domain than by more general principles of skilled performance.

In the case of reading and writing, such an approach can be characterized as schematic or, more generally, semantic. It suggests that understanding a text and producing one are activities largely driven by the application of knowledge structures or schemata that are specifically appropriate for the text domain. To a considerable extent, this knowledge approach seems to be on target. It not only allies with common sense, it is supported by empirical demonstrations that domain knowledge is important in text comprehension. Thus, to cite just a few examples, there is Bransford and Johnson's (1973) classic demonstration that comprehension of a vaguely worded passage is virtually

impossible in the absence of a topically-relevant title given in advance of the text. Dooling and Lachman (1971) provide a similar demonstration. There is also the demonstration of Anderson, Reynolds, Schallert and Goetz (1976) that the interpretation of ambiguously worded passages can depend upon the background knowledge of the reader. Anderson, et al. found that physical education students interpreted an ambiguous text in terms of a wrestling match and other students interpreted the same text in terms of a prison break. Finally, there is the demonstration of Spilich, Vesonder, Chiesi and Voss (1979) that individual differences in topic knowledge produce corresponding differences in comprehension of texts about the topic.

Despite the demonstrated importance of topic knowledge in text comprehension, the strong knowledge approach to comprehension is limited. Indeed, it is impossible to simultaneously hold both to a strong knowledge approach to reading comprehension and to a concept of reading ability. At minimum, reading ability is what remains after specific knowledge effects are accounted for. Now, it may turn out that reading ability is an illusion that masks innumerable topic-specific comprehension procedures. If so, tests of reading comprehension skill would essentially be tests of knowledge differences in which students vary in the extent of their knowledge of the mundane topics covered by such tests. To see that such a view is not completely far-fetched, one might think of the long standing controversy about the knowledge-dependent nature of IQ tests. If it is possible to believe that IQ tests reflect specific knowledge, it is possible to believe the same of reading comprehension tests.

Although it is possible that this view could be mainly correct in the long run, there is no reason to accept it in the absence of strong supporting evidence. The strong knowledge position indeed contains a knowledge paradox. If comprehension is strongly

dependent on knowledge, how is new knowledge acquired through comprehension? The strong semantic approach would need to claim that, given some metric of knowledge-relatedness, learning new material is possible only within some "distance" of the learner's present knowledge.

The concept of general language ability provides part of the answer to the knowledge paradox. New knowledge can be acquired through language because of general mechanisms that are part of language competence. Syntactic abilities, coupled with broader-scope discourse abilities, allow comprehension to proceed by linking together word concepts in such a way as to establish a text base, i.e. a representation of what the text "says", even if this is short of a deep representation of the referent world described by the text. This distinction between the text base (the propositions of the text) and the situational base (the relations in the referent world described by the text) has proved to be a useful one (van Dijk & Kintsch, 1983). It is possible for a reader to understand a text, to a limited but useful extent--e.g. to be able to summarize its contents--without being able to learn from it. For example, students who lack LISP programming knowledge can read and summarize a LISP programming text even when they are not learning much about programming from the text (Kintsch, 1986). Certainly such superficial comprehension is short of deep understanding, and learning ultimately seems to depend on deep understanding. Building (permanent) new knowledge structures depends on a base of related knowledge for the foundation. But these learning processes themselves depend on a logically prior more elementary sort of comprehension that does not build permanent knowledge structures but rather builds temporary representations of texts. Of course, the sooner these text representations can be integrated with knowledge building processes the better for the learner. Temporary representations not integrated into knowledge structures are at risk.

This learning-comprehending distinction may help mark out the boundaries of knowledge effects in text performance, and it allows a role for language ability in comprehension, on which learning depends. However it does not seem to explain the results of Bransford and Johnson (1973) and Dooling and Lachman (1971), nor Anderson, et al. (1976). Was the knowledge contribution in these demonstrations on learning rather than comprehension? No, instead the effects were on comprehension but they were indeed on the situational model rather than the text model. Once subjects were informed that the vague text of Bransford and Johnson (1973) was about "washing clothes" then they knew the situation referred to by the text. Once Dooling and Lachman's subjects were told that a certain story was titled "Christopher Columbus," then they could interpret such phrases as "an egg not a table correctly typifies this unexplored planet ..." in terms of a situation. Thus, when most of the words and phrases are referentially vague (Bransford & Johnson; Dooling & Lachman) or referentially ambiguous (Anderson, et al.), knowledge of the situation is important for selecting a situational model for comprehension. This demonstrates the limits of comprehension based only on an impoverished text model. However, where mundane texts are involved the referential value of many words and phrases will be clear and the reader or listener will be able to simultaneously construct a text model and a situational model. The key to the construction of a situational model is that the reader have an interpreted representation of the text, i.e. one that is referentially and inferentially rich. This process depends both on knowledge and on a basic meaning representation, a point we will return to later.

Strategies

A second non-linguistic approach to skilled performance emphasizes strategies. The thrust of this approach is that the individual applies either general or task-specific strategies in the course of cognitive task performance. In the case of reading, such strategies as self-questioning and summarizing are applicable to text learning (Palinscar & Brown, 1984). In the case of writing, planning and goal setting are especially prominent (Hayes & Flower, 1980) although these strategies apply to reading as well. There are complicating features in concepts of strategy use. Normally, strategies may be conscious or unconscious; they may support learning or memorizing; they may have, in principle, wide applicability or they may be task specific. However, since only relatively weak claims have been made for strategies, we will not be concerned with the many useful distinctions that can be made. That is, whereas it is in principle possible to imagine a knowledge approach to comprehension that ignores all but the most basic general language ability, it is not possible to imagine a stand-alone strategy approach to comprehension. Nor are we aware of any claims that reduce comprehension to strategy application. Thus it is sufficient to simply note that reading and writing cannot be understood as the acquisition and use of general cognitive strategies.

Nevertheless, it is clear that there are strategies for reading and learning from text. They begin, perhaps, with the reader setting some purpose for his or her reading. Once set, this purpose can control the percentage of words fixated and the fixation duration per word. This speed control then influences the degree of detailed comprehension achieved. In addition, there are direct comprehension strategies that may be applied. The reader who asks him- or herself the main point of each paragraph is applying such a strategy. Self testing and summarization are further examples of explicit comprehension monitoring strategies.

In our view the interesting thing about all strategies--except for general purpose setting, which affects comprehension because it controls the density and duration of lexical processes--is that skilled reading can get by without them. The skilled reader may be doing the functional equivalent of summarizing or self-questioning when he or she derives a higher order representation of text sentences. But there does not seem to be any meaningful sense in which such processing amounts to a strategy. It does indeed depend on the timely activation of relevant knowledge and the concomitant rapid construction of necessary inferences. (Texts are never fully explicit.) However such knowledge activation and inference making may be more appropriately thought of as tied to basic text processes than as detachable strategies. They are, in ordinary circumstances, triggered by comprehended text elements.

It is only the appearance of reading failure that allows notice of the potential for strategies. It is possible, although as far as we know not yet established, that text-based processes that readily apply to spoken language only unreliably apply to print for some readers. For such persons, instruction in strategy application sometimes may be worthwhile and such instruction has been strongly advocated (Ryan, 1982). As one example of the strategy approach, Palinscar and Brown (1984) showed that teaching comprehension monitoring strategies was successful only when the strategies were learned through a socially interactive reciprocal teaching procedure. The strategies themselves may be less important than whatever learning potentials are allowed by reciprocal teaching. Even if this is not the case generally, the importance of strategies would be limited. They are procedures to apply to texts for individuals who have trouble in reading. Their trouble in reading, it is worth noting, is not necessarily their lack of monitoring skills. Indeed, many, perhaps most, individuals who have

comprehension problems, we predict, will turn out to lack monitoring skills only as a secondary derivative problem. They also will lack more fundamental language competence skills that serve reading.

In the case of writing, the strategies approach emphasizes planning, especially establishing goals and subgoals in connection with audience, tone, and writing purpose. It is clear that skilled writers attend to such goal-setting and that children and writers of low skill often do not (Scardamalia & Bereiter, 1982). The school setting, in fact, often makes such goal setting difficult, and the appearance of arbitrary writing goals has been one of the noted shortcomings of writing instruction (Applebee, 1982). Learning to write with a purpose and audience in mind is certainly part of what it means to learn how to write. Similarly, learning to plan beginnings and endings and in-between expositions is part of the acquisition of writing.

On the other hand, the contribution of such planning and goal setting to writing competence should not be overemphasized. (See McCutchen (1984) for a related discussion of the limitations of planning models as complete accounts of writing.) Just as strategy deficiencies are seldom the only problem faced by a reader of low skill, planning deficiencies are seldom the only problem faced by the writer of low skill. Writing competence is the productive control over the grammatical devices of language in the service of some communicative intent. It is our impression that the communicative intent, in a general way, comes easier to writers than the productive control. Nevertheless, we do not wish to argue against planning and strategy applications. We do, however, want to assert that writing is primarily a process of productive control of linguistic symbols. We think acquiring this control in the context of communicative intentions that are often arbitrary or inadequately specified is what makes writing

acquisition nontrivial. However it is linguistic manipulation that lies at the heart of writing and thus makes it a cognitive skill that must be understood as one based on schooled language competence.

In summary, we have argued for a concept of schooled language competence that serves both reading and writing as well as other language performances. We have further argued that alternative approaches to cognitive skills that, respectively, emphasize knowledge and strategies provide insufficient accounts of reading and writing skill despite their value in explaining some aspects of cognitive performance. In what follows, we illustrate the schooled language competence analysis of reading and writing.

Linguistic and Nonlinguistic Sources of Reading Skill

There is a substantial body of reading research that informs us about word identification and comprehension, and, to a lesser extent, learning how to read. We can extract general principles of language-based competence from this research and also from a rational analysis of reading. We will argue that certain basic linguistic abilities drive skilled reading and that these abilities are both highly generalized, i.e. independent of domain, and restricted, i.e. especially suited for language processing. The argument extends to both word identification and comprehension.

Reading and Knowledge

We have already argued that reading ability cannot be identified with knowledge. Here we will try to be more specific as to why this is the case. There are two general principles that are critical to our argument. First, we claim a distinction between meaning and interpretation. Second, we note the possibility that certain language

processes are relatively impenetrable. The consequence of accepting these two principles is that important parts of reading cannot be influenced by knowledge.

First, there is a matter of definition. It is natural to suppose that the validity of theoretical claims about reading hinge critically on the definition of reading. One can define reading in such a way that it is similar to thinking, or at least so that it includes a wide range of inference, interpretation, and construction. On the other hand reading can be defined more narrowly as the translation of written elements into language. The latter is essentially the decoding definition of reading and there are some reasons to prefer it, although it is probably the nonpreferred definition among reading researchers (See also, Perfetti, 1984). However, we take the position that the definition of reading will not matter much for our argument, provided that an extremely broad thinking definition is rejected. We argue that reading is a generalized language ability; however, there is no reason to make this argument about thinking. Indeed, we want to make a distinction between unconstrained higher level mental processes that take full advantage of all information sources and relatively constrained lower level processes that cannot take full advantage of all information sources. We will accept a definition of reading that includes comprehension or one that stops at print-language translation, but not one that suggests that reading is thinking guided by print. Or, to put it another way, if one insists on the broadest definition our argument will apply to only part of reading. In any case, we do intend it to apply to reading comprehension.

Meaning and Interpretation

Reading comprehension, like comprehension generally, is the construction of veridical mental representations of situations described in written text. The text itself

can be said to have a range of possible representations, because texts are ambiguous. To the extent that there is overlap between one of these potential text representations and a mental representation constructed by a reader, then to that extent we can speak of the reader achieving a reading of the text, or comprehending the text. Ordinarily, we speak of comprehending the text as if there were one idealized text representation rather than a range of possible interpretations. No harm comes from this fiction. The important point is that comprehension is the overlap between the reader's obtained (or constructed) representation and a text representation. This is a reasonable understanding of comprehension, perhaps without contention, except for such tricky details as assessing what the possible readings of a text are (let alone what the reading is).

On the other hand, we know there is both more (and less) to comprehension than this concept of overlap between representations. Consider a perhaps classic sentence from an experiment described by Bransford and Johnson (1973):

(1) The haystack was important because the cloth ripped.

In the experiment, such a sentence was relatively difficult to recall in a cued recall situation when the subject noun (haystack) was a cue. However when the sentence was accompanied by a context cue, the word parachute, its recall was dramatically improved. The usual interpretation of this result is that parachute provides a context that allows comprehension of the sentence and that things, including sentences, that are comprehended are better remembered than things that are not comprehended. Comprehension, by this conclusion, is a matter of relating a sentence to knowledge of the world. In this case, relevant knowledge about parachutes and parachuting gets activated and linked to the sentence.

The parachute example represents a well known approach to comprehension in general. It assumes that language comprehension strongly depends on knowledge. We agree with this assumption, but only if we appreciate some distinction between interpretation and meaning. "Comprehension" is an equivocation between two possibilities: achieving a meaning for a text and achieving an interpretation for a text. Identifying comprehension only with interpretation leads to the claim that comprehension depends on knowledge. Identifying comprehension with meaning leads to a different perspective--comprehension depends on meaning, a symbol-based process, whereas interpretation depends on meaning plus knowledge.

To return to the parachute example, it is not that the sentence The haystack was important because the cloth ripped is not comprehensible. Indeed its meaning is fully represented by a set of elementary propositions. In effect, the propositions of this sentence presuppose the existence of two objects, assert a predication for each concept (important) and (ripping) and, centrally, assert a predication (because) linking these two predications. The meaning of a sentence is embodied in the combination of its propositions and its symbol values or word meanings. Propositional analysis, although not without problems, e.g. there is no algorithm for it, is a widely accepted text research tool thanks to the research of Kintsch and van Dijk (1978; Kintsch, 1974).

However, word meanings present a deep problem of long standing. The tradition represented by Wittgenstein (1892) holds that there are no necessary and sufficient conditions on word meaning and that meaning is a matter of language use. The tradition represented by Katz and Fodor (1963; Katz, 1966), among others, holds that there are systematic components that comprise word meaning. It is beyond our purpose to join the historical controversy in the philosophy of language concerning meaning.

However, it is useful to examine some of the implications for comprehension of what we call the symbol approach compared with context approach.

The context approach is represented by the work of Bransford, already cited, and by a number of other important psychological studies of comprehension. For the issue of word meaning, a study of Anderson and Ortony (1975) is a good representative of the contextualist approach. Anderson and Ortony report a cued recall experiment for sentences such as the following:

(2) The accountant pounded the stake.

(3) The accountant pounded the desk.

There were two different recall cues for these sentences, hammer and fist. The idea was that hammer would be a better recall cue for (2) and fist would be a better cue for (3). The reasoning was that sentences are comprehended and remembered as contextually particularized mental representations. If so, then a cue's effectiveness will depend on whether it is consistent with the particularized representation. The results of the experiment confirmed this expectation: hammer was a better recall cue for (2) and fist was a better recall cue for (3).

The question is what to make from such a result. We agree with Anderson and Ortony and Bransford and Johnson (1973) that "sentence comprehension and memory involve constructing particularized and elaborated mental representations" (Anderson & Ortony 1975, p. 167). Thus a reader, or a listener for that matter, is apt to understand "pounded the stake" as a particular action that is different from "pounded the desk." The mental representations that result are probably not identical in the two cases, although experiments on recall do not demonstrate anything about the representation

formed during comprehension. Indeed, the question of when and what kinds of inferences and elaborations are made remains an open question.

What we reject is the stronger position that the words only loosely constrain the mental representation. Indeed the words strongly constrain the representation to elaborations consistent with propositions that contain (the) word. Thus how pounding will be understood will be consistent with the semantic constraints of pound: pound (AGENT, OBJECT, INSTRUMENT). The difference between sentences (2) and (3) is how the reader is apt to fill in the instrument case, which is not explicit in either sentence. Presumably the reader would have no trouble understanding (4).

(4) The accountant pounded the stake with his fist.

The explicit mention of an instrument fills in the variables allowed by the verb frame, and, no matter how pragmatically unconventional, forces an interpretation of (4) that is, at the action level, more similar to (3) than (2).

What is not possible, in general, is to use The accountant pounded the stake to mean that the accountant pounded the desk. Nor can it be used to mean that the accountant pulled up the stake nor that the bartender pounded the desk. The fact is that mental representations, i.e. interpretations, are constrained by meanings. One cannot use any sentence to carry any interpretation. There is a range of possible likely interpretations and there even seems to be a default interpretation when meanings are underspecified, but there are constraints imposed by both symbol meaning and syntax.

At this point, the counter argument is usually that anything can "mean" anything in the right context. On the contrary, it seems correct only to say that words can be used to "refer to" anything and any sentence can be given such and such

"interpretation". There is nothing gained by this claim. Interpretation is indeed a matter of context, and reference can be assigned by convention or whim. However, the distinction between meaning and interpretation makes context-stretching an idle exercise. Comprehension is the link between meaning and interpretation, and there is no reason to identify it only with interpretation.

Finally, it is important to note that nothing in our argument requires a "fixed-meaning" view of language. It is perfectly possible to accept the Wittgenstein analysis of meaning as family resemblance and simultaneously to hold a distinction between meaning and interpretation. We can understand concepts, particularly natural categories, as organized around prototypical instances (Rosch, 1973), rather than as sets of necessary and sufficient features. Indeed, we need make no strong assumptions about the mental representation of word meaning. The only assumption needed is that word meanings are represented rather than merely constructed de novo on each token occurrence. The represented word meaning, which may have probabilistic family-resemblance characteristics, places significant constraints on comprehension.

If the meaning-interpretation distinction is maintained, then we take interpretation to be determined by meaning plus context. The role of knowledge is clarified by this distinction. In general, knowledge has a limited effect on comprehension; it has a profound effect on interpretation. The many studies that have shown knowledge effects in text processing, by this view, have demonstrated such effects in how the reader interprets a passage. In some cases the passage is so vague in its wording that interpretation is very poorly constrained. This is the case with the Bransford and Johnson (1973) washing machine and balloon experiments. When subjects were given pictorial cues, it enabled a uniform interpretation of the text. In the case of

Anderson, et al. (1976), who presented subjects with an ambiguous text, subjects' interpretation of the text was influenced by their specific background. An ambiguous passage that refers to "Rocky" getting up from a mat was more likely to be interpreted as being about a wrestler by students from a weight lifting class than by education students, who were more likely to construct a prison-escape interpretation. It is probably significant that such experiments have used very odd texts. Even a cursory examination of the Bransford and Johnson texts and the Anderson et al. texts shows their vagueness of reference. The words seem to float in the air above the referential ground. Presumably, readers either fail to construct an interpretation or they construct one based on their individual experiences. It's far from clear that ordinary texts, written to communicate rather than obfuscate, would show such a strong effect of knowledge. However, this is a minor point, for knowledge surely affects interpretation. In ordinary texts, interpretation and meaning (comprehension) are usually highly overlapping. In these experimental texts, they are not.

One final point must be addressed. It may be possible to defend a strong distinction between linguistic knowledge and "real world" knowledge, but it is unnecessary except for special purposes beyond our own. Moreover, it is difficult to argue this distinction in the case of semantics. Indeed, this difficulty was the fatal criticism of the semantic theory of Katz and Fodor (1963), which attempted to hold a sharp distinction between a finite set of systematic meaning features that defined concepts and an indefinitely large set of nonsystematic features that individuated concepts. Bollinger (1965) argued, successfully we believe, that such a distinction was ultimately unprincipled.

The question is, are we not in the same position as Katz and Fodor in claiming

that some kinds of knowledge (world knowledge) affect interpretations whereas other kinds of knowledge (linguistic knowledge) affect meaning comprehension? No. The critical difference is that we are not assuming a sharp distinction between linguistic knowledge and world knowledge for concepts in general. Whereas a distinction between meaning and interpretation is critical, the epistemological source of the meaning features is not.

The words hammer, accountant, stake and desk all refer to concepts that are organized through real world experience. However, their common attributes constitute their typical meanings and it is these meanings that constrain comprehension. Thus, whether some object is called a desk or a table can be a matter of doubt, but its preferred designation will reflect the typical usage pattern of a broad language community. In short, the more an object resembles a typical desk the more likely it is to be referred to by desk. On the comprehension side, the reader's "default" particularization (interpretation) of desk is presumably based on the prototype. There is no issue here of linguistic vs. nonlinguistic, except for the syntactic category, noun in this case, which plays a specific role in comprehension not necessarily dependent on conceptual structure.

Verbs present a slightly different situation, because their semantic values comprise a real semantic structure rather than a loosely structured feature list. Pound, for example, is a verb that semantically takes three arguments--a pounder, a thing pounded, and a pounding instrument. This is the basic schema of the action of pounding and constitutes its core meaning. Assigning values to the variables--who pounded what in what manner--is the process of particularization, or more generally, interpretation. There are syntactic consequences of the argument structure, with the arguments

mapping into syntactic functions such as subject, direct object, and object of a preposition. Nevertheless, even in the case of verbs, it is not necessary to assume a sharp boundary between linguistic and nonlinguistic knowledge in the representation of the verb meaning. (The syntactic constraints on the verb are another matter.) Instead, we assume that the argument structure constitutes part of the core meaning of the verb. Obviously, learning the core meaning of a verb like pound is a matter of extracting the core properties from pounding instances observed in the world. Thus for both nouns and verbs as names of concepts there are two kinds of knowledge, although the distinction is not linguistic vs. nonlinguistic. The relevant distinction is between the knowledge that comprises the core meaning of the concept and knowledge that comprises the particularization of the concept in context. This distinction appears to be roughly parallel to that originally made by Frege (1892) between sense and reference. With such a distinction, it is important to make clear where the effects of knowledge are. We think that comprehension of core meaning is not typically subject to the effects of knowledge. Demonstrations of knowledge effects have typically shown effects on interpretation, not on meaning comprehension.

The Impenetrability of (Some) Comprehension Processes

The second part of the argument is that some processes of comprehension are not easily penetrated by "outside" sources of information. Any such impenetrable process will, therefore, not be influenced by knowledge. Thus, we assume that comprehension occurs within a processing system that has some constraints on the interaction of its components. A strong form of this argument is that a language processor consists of noninteracting autonomous components (Forster, 1979).

Such an argument recently has taken on new life as the modularity thesis (Fodor, 1983). The modularity thesis is one we find congenial, but there are aspects of it that are quite beyond our present purpose. For example, the assumption that modular cognitive systems are innate is reasonable but probably unnecessarily strong for our more modest purpose, which is to argue that knowledge doesn't affect comprehension at all levels. For this, we need to argue only that processes of comprehension, in some sense of comprehension, do not have much access to knowledge, expectations, beliefs, or any other source of imported information. Such a comprehension process would be "informationally encapsulated" (Fodor, 1983) in that it has access only to certain kinds of information and not others. Such a process is a rapidly executing computational process that is driven by data structures for which it is specialized.

Acquired Modularity. What we want to add to the modularity concept is the idea that modularity can be acquired. More specifically, the characteristic of impenetrability or information encapsulation can be acquired as the result of extended practice. The mechanism for modularity acquisition is the gradual specialization of data structures that are sufficient to trigger the computation. Whether a process that acquires its modularity has just the characteristics of modules that are assumed to be based on innate mental structures is an open question. However, the property they would share under any analysis is impenetrability, so we should perhaps refer to acquired impenetrability rather than acquired modularity. There are at least two comprehension processes that are impenetrable by knowledge, beliefs, and expectations. One has acquired impenetrability, whereas the impenetrability of the second one may reflect some innate components. The first is a word identification and the second is sentence parsing.

Word Identification

In the case of word encoding, the process of lexical access, understood as some minimal identification of a word, appears to be relatively impenetrable. In skilled reading, the identification of a printed letter string is under the control of the input string through its connections with a mental representation of the word. The information in the letter string is sufficient to activate the word representation, and this activation process executes so rapidly that there is little possibility for knowledge to penetrate the process.

This observation was developed by Perfetti and Roth (1981) to account for individual differences in reading skill. A result in the literature on children's reading is that high skill readers' word identification is less facilitated by context than is low skill readers' (Perfetti, Goldman, & Hogaboam, 1979; Stanovich & West, 1981; Perfetti & Roth, 1981; West & Stanovich, 1978). The studies showing this result have used latencies to name printed words and lexical decision tasks, with sentence and discourse contexts arranged to facilitate or inhibit the recognition of a word. It is particularly interesting for our argument that Perfetti and Roth (1981) showed that degree of context facilitation for word identification is a function of the word's identification time in isolation. In their analysis the time to identify a word in isolation was variable either because of the perceptual quality of the word--it varied in its degree of visual degrading--or because of the speed of a particular reader in identifying the word in context. It did not matter which of these two was the source of the word's "basic" identification speed. Whether measured by individual subjects or individual words, the word's basic identification rate determined the degree of context facilitation. A word that was identified slowly in context showed greater context facilitation than a word identified

rapidly. This is exactly the result one would expect according to the impenetrability argument. The penetration of the word identification process by knowledge, belief, or expectations is possible only to the extent that the identification process is slow executing. In skilled reading with a high quality perceptual input, word identification is too rapid for penetration. With a reader of low skill or a perceptual input of low quality, word identification is not too rapid for penetration, and context effects become more likely.

This raises the question of whether a rapidly executing impenetrable process differs fundamentally from a slower executing penetrable process or whether it is merely faster. The answer we prefer is that there may be some qualitative differences, but this preference is not critical for our argument. According to this view the impenetrable process triggers when a stimulus pattern, a letter string, activates the word representation containing that pattern. The slower penetrable process seems to take whatever incomplete output it obtains from this initial process and adds information to it in the form of expectations, etc. Word identification may have some of the characteristics of problem solving in such a case. This is the work of an executive central processor rather than a word-recognition module. On the other hand, there may be little reason to prefer this qualitative description of the difference to one that says that time to execute is the only difference. This alternative description is simply that expectations and knowledge potentially affect every process but they usually lose the race when a skilled reader processes a familiar word. Either description will serve the present argument.

This account appears to overlook the fact that there are facilitative effects in word recognition that do not depend on slowly executing recognition processes. Priming

effects have been observed in lexical decision tasks in which the interval between a priming word and a target word is under 250 milliseconds (Neely, 1977; DeGroot, 1983), a time probably too short to allow any facilitating expectation processes to execute. Furthermore, priming effects have been observed under conditions in which the prime itself was not perceived because of a brief-exposure-plus-masking procedure (Fowler, Wolford, Slade & Tassinary, 1981). Such cases suggest a very fast acting context effect, and are consistent with a two-process theory of context effects, one operating quickly and automatically and the other operating slowly and only with attention shifts (Neely, 1977; Posner & Snyder; 1975 Stanovich & West, 1981).

A quickly-executing contextual priming process is consistent with the impenetrability hypothesis, especially if this process is restricted to superficial lexical links. That is, activation may spread locally through a memory network from one word to a related neighbor. If the neighboring word is then quickly presented visually it will be "recognized" more quickly than otherwise. (The usual way of thinking about this quicker recognition is to assume that recognition is a decision process relative to some threshold value. The threshold is reached more quickly following priming because a word's representation already has some activation from the priming connection (Morton, 1969).) This is consistent with the impenetrability hypothesis, because the effect does not involve imported knowledge or expectations. It involves only a very local lexically based effect that occurs, in modularity terms, within the lexical module.

It is interesting in this regard that the evidence suggests that the spread of activation may be even more local than is usually implied by the concept of "spreading activation." DeGroot (1983) has shown that within 240 milliseconds (SOA), priming of a lexical decision occurs across one associative link but not across two links. Thus, the

word bull can prime cow and cow can prime milk, but bull does not seem to prime milk. Based on DeGroot's results, we are inclined to say that the spread of activation is very restricted, perhaps to immediate lexical neighbors.

Providing stronger support for the impenetrability hypothesis are the results of the experiments of Swinney (1979) and Onifer and Swinney (1981). Swinney (1979) used a cross modal priming paradigm in which subjects heard an ambiguous prime word as part of a sentence. The priming word triggered a visual presentation of a word for lexical decision. For example the auditory prime bug was presented in a biasing sentence "The man was not surprised when he found several spiders, roaches and other bugs." The lexical decision followed immediately for ant or spy, each related to one sense of bug, or a control word. The result was a priming effect for both related words, compared with the control, even though context should have biased only one word, ant in this case. Thus, we have a case in which a contextually based expectation cannot penetrate lexical processing. There is the basic lexical priming effect but no effect based on what the word means in context. After a longer interval, however, the priming is selective, only ant and not spy showing an effect. Such a result suggests a two process account of semantic encoding, a preliminary short-lived stage in which all the multiple meanings represented by a word are activated and a second slower stage in which the contextually appropriate meaning is selected. The first stage is impenetrable, the second is penetrable.

There is an important additional result from Swinney's paradigm for impenetrability. Kintsch and Mross (1985) replicated the Swinney experiment but in addition included a condition of "thematic" priming. Thematic primes derive from the model of the text presumably being constructed by the reader. For example, in a text

about a man who is in danger of missing a very important plane, the word "gate" would be presented for lexical decision (at the asterisks) as the subject heard this sentence: ... so he hurried down to his plane ***. The result was no priming effect, presumably because there were no local associations between plane and gate. By contrast, a lexical decision on fly was facilitated because of its strong association with plane. This result supports the hypothesis that thematic knowledge from a text does not penetrate word recognition, specifically meaning activation.

Sentence Parsing

The second component of comprehension that may show relative impenetrability is sentence parsing. Although we think sentence parsing is one that is properly understood as a process that operates on a specialized linguistic vocabulary, and thus lends itself to strong claims about syntactic modules, we again think that a weaker assumption is sufficient for our argument. We assume that an early stage of comprehension involves a preliminary attachment of words and phrases to other words and phrases. The process by which these attachments are made is parsing. The output of parsing is the basis for a semantic analysis of the sentence and, in particular, it is preliminary to the propositional representation of sentences.

When a reader or listener encounters The beer is in the refrigerator next to the tomatoes the parsing process readily attaches the phrase next to the tomatoes to beer rather than to the refrigerator. However, an attachment to the refrigerator is syntactically possible and in a context that allows two refrigerators this attachment is readily made: There's a restaurant kitchen with several refrigerators, one of which sits next to a large container of tomatoes. The speaker locates the beer as being in the

refrigerator that is next to the tomatoes. However, it appears that attaching the final prepositional phrase to the immediately preceding noun phrase is not the preferred strategy. It requires an intermediate noun phrase node to be constructed "above" the noun phrase node that represents by the refrigerator, in violation of what Frazier (1979; Frazier & Rayner, 1982) calls the minimal attachment strategy. Attaching next to the tomatoes to the beer is a minimal attachment with no higher syntactic node being required.

Of course what's interesting about minimal attachment, or any other syntactically defined parsing principle, is exactly its lack of reference to nonsyntactic information. In the refrigerator example, however, semantics and pragmatics add their weight to the minimal attachment reading. In a sentence such as The beer is in the refrigerator next to the wall, the influence of semantics is in the opposite direction. Minimal attachment prefers the same attachment as before, next to the wall with beer, but clearly this interpretation is not working as well here as the alternative attachment--next to the wall with refrigerator. However, there is evidence that the preference for the minimal attachment is strong enough that readers take longer to read a sentence that requires the nonminimal attachment (Frazier & Rayner, 1982). Furthermore, even when story contexts strongly bias the nonminimal reading, the preferred reading may still be the minimal attachment reading, at least for some sentence types (Ferreira & Clifton, in press).

The basis for syntactic preferences is a matter not easily resolved. They may reflect constraints on syntactic tree building that in turn reflect psychological processing principles, e.g. minimal attachment, or they may reflect knowledge about environments associated with lexical items, especially verbs (Ford, Bresnan & Kaplan, 1982). For our

argument, the ultimate source of parsing principles is not critical, except that it cannot lie primarily in a general knowledge component. Parsing principles reflect linguistic knowledge that is essentially (as opposed to "under all conditions") independent of general knowledge. Most important is the possibility, now demonstrated for at least some sentence construction that these principles are not overridden by knowledge, context, and expectations (Frazier & Rayner, 1982; Ferreira & Clifton, in press). That is, they are impenetrable.

Summary

In this section, we have argued that reading is a restricted-general ability. Two related arguments make the case for this claim. One is that meaning comprehension and interpretation are not the same. Meaning comprehension is driven by the text in accord with constrained principles of symbol meaning and syntax. Interpretation is unconstrained and inference-rich. The effects of knowledge are largely on interpretation through such processes as particularization and inference-building. Meaning comprehension is relatively free of knowledge influences.

The second argument is that some comprehension processes, at least some that comprise meaning comprehension, can acquire impenetrability. Such processes can be thought of as modular, but their significant feature is their resistance to knowledge penetration. They are rapidly executing and computationally autonomous. Lexical access and sentence parsing are both candidates for impenetrable modular processes. Word identification becomes impenetrable with increasing reading skill and parsing seems to follow structural principles. The implication of this argument is that skilled reading is a general ability free of specific knowledge influences in the processes of (a)

word identification and (b) syntactic parsing. These are early occurring processes on which depend the assembly of propositions from sentences. Thus, there are grounds for identifying general reading ability with the linguistic processes that enable the encoding of propositions.

Implications for Research on Reading Ability

The argument that reading is in large part a restricted-general linguistic process has implications for theories and research in reading ability. Most important is that ability in reading depends on linguistically-based processes that support word identification, parsing, and proposition encoding. It depends less on abilities to apply special knowledge, draw inferences, make elaborations, and apply interpretative schemata to the outcome of meaning comprehension. These latter processes are important for the reader's construction of an interpreted representation, i.e. a situational model or, more generally, a mental model (Johnson-Laird, 1984). However, they are peripheral abilities in two ways, according to our argument. First, those inferential processes that are necessary to maintain coherence often will be triggered automatically for skilled readers by local text features in mundane texts. Second, for difficult texts, such processes are qualitatively peripheral, in that conscious problem-solving procedures must be applied. Again, we see no reason yet to identify reading with problem solving or thinking.

This is not an entirely definitional matter. Suppose that in an idealized experiment free of all measurement and sampling error, we can identify a group of low ability comprehenders as defined by poor performance at answering inference questions based on their reading. To explain this inference-making "deficit" there appear to be

these four theoretically interesting possibilities: (a) specific knowledge deficits; (b) no specific knowledge deficits, but a systematic failure to apply knowledge to text reading; (c) an unspecified inability to make inferences in texts; and (d) a reduced ability to encode propositions.

The strong form of the knowledge hypothesis predicts (a). It may also predict that further testing of subjects changes their ability classification as different knowledge requirements are encountered. However, it is not falsified by finding that repeated measures over variable knowledge domains does not change classification. Individuals obviously can differ in total knowledge across many domains.

A weak form of the knowledge hypothesis would predict (b), that knowledge use, not knowledge itself, is decisive. A general strategy hypothesis would predict (c), but in fact, (b) and (c) would be very difficult to distinguish. They both depend on demonstrating the availability of knowledge and its nonuse during reading.

Alternative (d) is consistent with the restricted-general model of reading ability, but this outcome is not predicted by it without an additional assumption concerning processing efficiency. With the addition of such an assumption alternative (d) predicts that observed difficulties in inferential comprehension arise in unobserved difficulties in meaning comprehension (i.e. proposition encoding).

Naturally, a real experiment is likely to produce complicating results. Many readers of low ability can be expected to show deficits in knowledge, inference making, and meaning comprehension. Such inter-skill correlations are so common that determining causal directions in abilities has been very difficult. In fact, no hypothesis has to claim that it accounts for all higher-level comprehension variance. But to be

taken as central, rather than peripheral, in the theory of reading ability, it must account for a large share. That is, in principle, the inference-deficit model of ability must predict many cases of poor inference performance in the absence of basic meaning comprehension deficits. The restricted-general model must make just the opposite prediction.

In fact, there is little actual research that can provide adequate tests of these alternatives, despite the considerable amount of informative research on reading. Studies that have shown low ability readers to have inference problems have not adequately assessed their basic meaning comprehension abilities, including word identification. Similarly, studies that have shown links between basic processes and reading ability have not assessed knowledge-related and inference factors. Of course, it is difficult to functionally separate meaning and inferences sufficiently for testing, even though we have argued for a clear conceptual separation. (It is not impossible, however, to achieve functional separation.)

There are studies that are suggestive for these issues. For example Oakhill (1982) identified groups of seven and eight year old children that were equivalent on word identification accuracy but unequal on a test of comprehension.[1] A subsequent test presented spoken three-sentence "stories" and then a recognition memory test. The key data were false recognition responses to inferences based on a plausible interpretation of the "story." Although both groups made more false recognitions to plausible inferences than to implausible ones, this difference was greater for skilled comprehenders. But skilled comprehenders also showed a nonsignificant advantage over less skilled comprehenders in recognition of actually occurring sentences. Thus, while it's tempting to interpret these results as singling out inference making as the key problem for low

skill comprehension, they do not strongly rule out the hypothesis that skilled readers establish a more accurate meaning representation from which to make inferences. It is our conclusion that other studies of inference and elaboration also have largely failed to separate these factors.

Of course, research on children's reading ability has shown a pervasive association between comprehension and lower level linguistic processing (Perfetti, 1985). Of the many factors that have distinguished high and low comprehension groups, the most pervasive in our research (summarized in Perfetti, 1985) have been the following: Compared with less skilled readers, skilled readers show (a) word identification processes that are more accurate and more rapid, less affected by stimulus variables (e.g. word frequency and lexicality) and less affected by discourse context; (2) a greater working memory capacity, as assessed in linguistic memory tasks in both spoken and written forms; and (3) shorter times to understand simple one-proposition sentences.

Thus, in this picture, the skilled reader is characterized by rapidly executing context-free word identification processes and an effective linguistic memory that enables facile meaning comprehension for sentences. It is possible that a richer characterization is needed, specifically one that adds an ability to use knowledge or inference making to effectively turn a meaning representation into an interpreted representation. However, although such factors are clearly important for a theory of interpretation, their centrality in a theory of reading ability is less certain at the moment.

Finally, on the specific question of the role of knowledge in reading ability, we can refer to some results of a still on-going study of 4th through 7th grade children. Although tentative, the results strongly suggest an important but limited role of

knowledge in children's reading of knowledge-demanding texts. Subjects are assessed for domain specific knowledge in football and for general reading comprehension ability, producing four groups defined by the four combinations of high and low knowledge and high and low reading ability. (Low knowledge subjects can be characterized as having very little knowledge of the goal structure and rules of football.) Subjects read football and nonfootball texts, and are given a test of speeded word identification.

According to the restricted-general model of reading ability, we expect to find that a skilled reader can attain some comprehension of a knowledge-demanding text even when he or she lacks much knowledge. Of course, to the extent that specific knowledge is required for text interpretation, then we should find, as other studies have, that high-knowledge subjects comprehend more of the text than low-knowledge subjects. The results so far are fully consistent with these predictions. High knowledge subjects show better comprehension but only for a football text. High ability readers outperform low ability readers for both texts at both levels of knowledge.

These of course are very superficial results. We need to know much more about what low-knowledge high skill readers are comprehending in a knowledge-demanding text, and how this differs from what both high knowledge subjects and low skill subjects are comprehending. Can we see more evidence of a meaning representation in the high skill-low knowledge subjects and more evidence of an interpreted representation in high knowledge subjects? There are related questions concerning control of processing times, e.g. does a knowledge-demanding text cause alterations in reading rate by subjects lacking knowledge? If research similar to the study described here can provide some answers to these questions, the claim that there are restricted but generalized reading abilities can be given a serious test.

Linguistic and Nonlinguistic Sources of Writing Skill

We think that the same issues of language competence present in reading are also present in writing. The processes of reading and writing are different in important ways, and writing is not simply the inverse of reading. However, to the extent that general language competence is in fact general and to the extent that it involves the processes we suggest here, we should observe those processes in writing.

Meaning and Interpretation

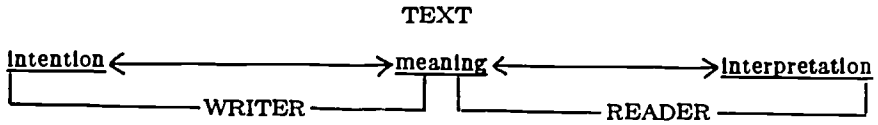
The distinction between intention and meaning is again important, although because of the nature of writing, important in different ways. We described comprehension as requiring both meaning and interpretation, and the reader's goal as constructing an interpretation from meaning. The writer's goal, however, is to guide the reader to some particular interpretation through the meaning of specific text. As we have argued, there are factors beyond the text that affect readers' interpretations, an important one being the reader's prior knowledge. The knowledge that a given reader brings to bear on a text is, however, largely beyond the control of the writer of that text. The writer has direct control only of the text meaning with only probabilistic indirect influence on interpretation.

Nevertheless, the skilled writer uses meaning to influence interpretation as much as possible. From this perspective, the writing of texts such as those in the Bransford and the Anderson experiments, because of ambiguities or underspecified reference, did not use meaning to constrain (or even establish) their interpretations. This is a situation not entirely unfamiliar to the teacher of writing who, during conferences with students,

frequently hears detailed explanations of "What I meant there," explanations that often have little to do with what actually appeared on the page. Writing well entails controlling meaning and only through that, interpretation.

In order to control meaning, however, the writer must first deal with his own "semantic intention," the writer's counterpart to the reader's interpretation. That is, the writer's intention derives from the writer's idiosyncratic experiences, knowledge, point of view, etc., and it is the writer's task to forge that often unwieldy mix of purpose and message into a text--a text with a meaning that is both relatively unambiguous (if not "precise") and independent of personal context (if not "universally comprehensible"). Thus the writer must be concerned with two levels of interpretation, his own intention and the reader's interpretation, as well as with the text's meaning, which mediates the two.

This mediation is far from perfect, however, because of the idiosyncratic nature of intention and interpretation. Rather than the pristine "transformer" metaphor popular in communication theory, which involves sender, message, and receiver, we have something more like the following:



The writer's personal knowledge and purpose interact with a text during its creation, affecting the text's developing meaning and, in turn, being affected by it. The situation is similar for the reader, as the Anderson and Bransford experiments demonstrate. For

there to be much correspondence at all between the writer's intention and the reader's interpretation, the text's meaning must be clear and well articulated.

Turning Intention Into Meaning

Research on the development of writing skill indicates that less-skilled writers often fail to make the distinction between intention and meaning. Rather than focusing on their text's meaning, some writers remain locked within their own personal intention. Flower (1979) describes such writing as "writer-based" in contrast to "reader-based." In reader-based prose, meaning is clearly specified: concepts are well articulated, referents are unambiguous, and relations among concepts are presented within some logical organization. The result is an autonomous text (Olson, 1977) that adequately imparts its meaning to the reader without relying on unstated knowledge or external context. In contrast, writer-based prose is full of idiosyncratic phrases that are loaded with semantic content for the writer--meaning that is not, however, articulated for the reader. Textual referents are often ambiguous or even completely lacking, as the writer works from a position of privileged knowledge not shared with the reader. Furthermore, the overall text organization is often idiosyncratic, reflecting the writer's associative path of discovery rather than an organization that aides the reader's interpretation. Flower (1979) points out that writer-based prose is often produced by accomplished writers in early drafts. Skilled writers, however, rework those early drafts, expanding compressed meaning and supplying an organization that will be clear to the reader.

Flower's (1979) descriptions pertain to less-skilled college-age writers, but similar descriptions also apply to children's early writing. Bartlett (1982) found that younger children are often incapable of resolving pronomial ambiguity in their own writing, while

they are somewhat better at doing it in the writing of others. Again the explanation seems to involve the writer's privileged knowledge, that is, the writer's intentions that never get expanded into meaning in the text. When forced to become an external reader who is no longer immersed in underlying intention, children can better see the limitations of a text's meaning.

That the problem is one of linguistic specification rather than one of cognitive recognition of potential ambiguity was made clear in a study of children's use of referential devices in narratives (Bartlett & Scribner, 1981). In narrative contexts in which there were multiple characters of the same sex and same age (i.e., contexts in which references to "the man" or "the girl" would lead to ambiguities), children tended to use a wider variety of referring expressions. They may not have been successful in consistently avoiding referential ambiguity, but they did seem aware of potential difficulties. Thus, it is not the case that children's representations (i.e., interpretations) are somehow faulty or underspecified. Rather, children fail to turn their private interpretations into adequate public meaning.

Young children's texts also typically reflect the child's own discovery process, with little reorganization to make the ideas coherent for the reader. Scardamalia and Bereiter (1982) describe how this "knowledge telling" strategy functions to reduce the cognitive load of text production. Children interpret the writing task as a request for what they know about the topic, and they comply with that request by giving their private intention, not by creating a text with its own public meaning. Children's texts typically contain information in exactly the form and order it was retrieved from memory. Even with explicit tutoring in pre-writing planning behaviors, children younger than 12 often generate actual sentences while "planning" and then simply recopy them verbatim while "writing" (Burtis, Bereiter, Scardamalia, & Tetroe, 1983).

Thus, for many young children writing is a "first come, first served" serial process of information retrieval. Little editing is done to change the form of the final text from the form of the retrieved information. The National Assessment of Educational Progress (1977) showed that 40% of the nine-year-olds tested, 22% of the thirteen-year-olds, and 32% of the seventeen-year-olds made no revisions after their first drafts were completed. As Nold (1981) points out, the NAEP did not examine editing that might have gone on during the generation of the first draft, but this criticism seems relevant only for the older writers. In our observations of children up to the age of fourteen, relatively little on-line editing occurs routinely.

For example, we (McCutchen & Perfetti, 1982) found that the writing of children in second and fourth grade directly reflected memory search processes rather than text-constrained processes. Their writing was simulated by a model that had direct memory readout as the main process in writing. Increasing text constraints began to emerge in the model of older children's writing (but even there to only a limited extent).

This description of writing as controlling the interpretation of the reader through the meaning of the text is, of course, derived from an adult perspective of literacy. Just as skilled writers may produce "writer-based" first drafts with no intention of passing them on to readers, young children also may write with no expectation of a reader. In both cases--the first draft of a skilled writer and the idiosyncratic writings of a young child--the main objective may be to explore one's own private interpretations. The skilled writer, having completed this self-discovery process, then goes on to reformat the text for presentation to the public. The young child, however, may have no such goal. Especially for children just learning to write (ages 5 to 7, or even younger), writing may not be the communicative act we describe here. Rather, writing for the young child may

simply be another form of symbolic play, much like drawing and make-believe, the purpose of which lies more in the process than the product (Gundlach, 1981; Read, 1981; Vygotsky, 1978). Evaluative statements by children around age seven typically concern their own affective responses to texts' topics (that is, their own interpretation of the texts), and only later do children's comments come to reflect aspects of the texts such as coherence and creativity (Hilgers, 1984).

Perhaps, then, children's earliest writing should not be evaluated in the way we describe here. However, just as invented spellings of precocious children gradually come to conform to standard English spellings (Bissex, 1980; Read, 1981), children's written texts (especially those produced in school) are eventually required to be more than private symbolic play. Writing is eventually required to be a communicative act between writer and reader, and children generally come to realize that fact, as early writing behaviors such as drawing and talking aloud are replaced by more adult-like writing behaviors such as rereading and silent transcription (Cioffi, 1984). It is this aspect of writing--writing as schooled language competence--that we are addressing here. However, this early function of writing as symbolic play might help to explain why some writers find it so difficult to move from private interpretation to public meaning.

Restricted-General Linguistic Processes in Writing

We have argued that the writer's goal is to create meaning from his or her own intention. In the same way that the reader's knowledge can affect the reader's interpretation of a text (Anderson et al., 1978; Bransford & Johnson, 1973; Spilich et al., 1979), the writer's knowledge affects the writer's intention and thus the text itself. However, just as there are general reading processes that seem impenetrable by

knowledge and expectations, such as word recognition processes and syntactic parsing processes, there also seem to be generalizable writing skills that are independent of domain-specific knowledge.

McCutchen (in press) showed that developmental differences observed in children's writing skill were not solely attributable to differences in domain-specific knowledge. Groups of children high and low in knowledge of football were studied, with subject pairs matched on reading ability and equally distributed across grades four, six, and eight. (Football was chosen as a knowledge topic since it is a recreational interest that, as such, seems not to be correlated with school performance.) While there was an effect of knowledge of topic in that study, such that children generated more coherent texts when they were knowledgeable on the topic, this knowledge effect did not eliminate developmental differences. Even with knowledge controlled, older children generated more coherent texts than did younger children, thus demonstrating a role for general language competence independent of domain-specific knowledge. Furthermore, older children's ability to write more coherently reflected those areas of language competence we assume are most affected by schooling: (1) vocabulary size and semantic precision, and (2) syntactic repertory. Older children more often linked their sentences into a coherent discourse using linguistic devices such as semantically related lexical items and subordinate clauses, and they did their best to articulate their arguments, even when their lack of detailed knowledge forced them to argue in generalities, citing, for example, famous players or team spirit as reasons why a given team would win the championship. Younger children who had lots of relevant knowledge often offered more penetrating analyses of a team's strengths and weaknesses (e.g., a quarterback's passing ability, an offense's running game), but their texts still reflected a "knowledge-telling" approach to writing, with simple lists of reasons and no substantiation of their arguments.

There are two points we want to make from these observations. First, and most obvious, is that domain knowledge is not sufficient for coherent writing. Second, domain knowledge, beyond some minimum, may not be necessary. Of course it presumably is necessary for informed writing, interesting writing, well-argued writing, etc. However, the ability to use language competence to bootstrap discourse processes, even in the absence of a high level of domain knowledge, is the essence of schooled language competence.

Certainly, linguistic knowledge and procedures require semantic content upon which to operate, and the richness of the underlying knowledge base has important implications for the quality of the resulting text. What is expressed in the text comes ultimately from the knowledge base of the writer. Let us assume, for convenience, that the knowledge representation can be described by a semantic network. When the network contains a large number of differentiated concept nodes and a richly elaborated network of relational ties among them, the writer has an excellent source of semantic "raw material" to turn into a discourse. A writer who lacks knowledge on a given topic must work from an impoverished knowledge base containing few concept nodes and a sparse network of relational links among them. Thus, the writer low in relevant topic knowledge must work harder to create a coherent discourse, making inferences and indirect memory searches through a sparse and disjoint knowledge base. By contrast, the writer high in topic knowledge can, to a large extent, simply retrieve coherent information structures from memory.

Even for the high-knowledge writer, however, coherent information retrieved from memory does not necessarily guarantee a coherently related discourse. The transformation of semantic information into language is a nontrivial cognitive task. Sets

of propositions do not comprise a text. Those propositions must be specified in language, that is, specified by particular words within particular syntactic arrangements, and empirical evidence demonstrates that there is considerable planning time required during speech production which corresponds to manipulating propositions and turning them into syntactic units (Ford & Holmes, 1978). Thus, even after semantic information is retrieved from memory, the speaker or the writer is still faced with the task of coordinating semantic propositions within appropriate syntactic sentence frames and then, within an extended discourse, coordinating those sentences within appropriate discourse frames.

Components of Generalized Writing Competence

Earlier we defined writing competence as productive control over the grammatical devices of language in the service of some communicative intent. What sorts of knowledge comprise writing competence under this definition? Likely candidates seem to be (1) discourse schema knowledge, (2) lexical knowledge, and (3) syntactic knowledge and procedures, all of which interact. The first seems most relevant in clarifying the writer's communicative intent, while the remaining two constitute productive control over the symbol systems of language.

Discourse schema knowledge, which has been the focus of considerable research (Meyer, 1975; Stein & Glenn, 1979; Stein & Trabasso, 1981), is the knowledge of discourse forms. Although it is possible to think of some discourse schemata, story grammars for example, as derivative from non-textual, event-world knowledge, our assumption is they must include linguistic and textual information. They include knowledge of the general structure and ordering of information within a given discourse,

the typical qualitative nature of that information, and the kinds of linguistic ties that link that information into a coherent discourse. Knowledge of a general narrative schema, for example, specifies that events revolving around one or more main characters be temporally and causally linked, typically with linguistic connections such as "then" and "so," although inferences based on real-world event knowledge often permit omission of explicit links (McCutchen, 1985). There are substantial data suggesting that even relatively young children have at least rudimentary narrative schemata (Brown, 1976; Brown & Smiley, 1977; Stein & Glenn, 1979). Expository texts, on the other hand, have a very different structure built on the presentation of a main point followed by explanation, description, or argumentation in support of that main point. Rather than temporal-causal relations among events, expository texts require logical-causal relations among arguments, which often take linguistic forms such as "but," "also," "because," or "since" (McCutchen, 1985). While not typically appearing as early as narratives, expository (and other non-narrative) schemata do seem to develop eventually (Bereiter & Scardamalia, 1981; Freedle & Hale, 1979; Meyer, 1975; Waters, 1980).

A second source of linguistic knowledge important in the writing process is lexical--the knowledge of words including their meanings, their form class, their orthographic, phonemic and morphemic structure, etc. Some of this knowledge, such as orthographic knowledge (i.e., spelling) may be rather explicit, while knowledge of form class or morphological derivation may be more implicit--less available for articulation but available for use at a functional level in sentence generation. A writer may, for example, nominalize a verb from an earlier sentence in order to maintain textual coherence. Or, as in the case of a young writer we studied, a writer could move from a discussion of being the "hero" of the football game to his next point with the phrase "Besides glory."

The semantic relatedness of "hero" and "glory" permitted the writer to make this rather sophisticated transition, freeing him from more mundane coherence devices such as verbatim repetition.

Also available as part of general linguistic knowledge, often implicitly, is knowledge of syntactic constructions and procedures for coordinating those constructions during sentence generation. This syntactic knowledge is more than the knowledge of grammar that underlies basic language competence, more, that is, than the tacit knowledge of all possible permissible linguistic strings. It is knowledge of the strings that are locally appropriate within the developing discourse. By "locally appropriate" we mean a fairly restricted region of text development that influences the syntactic form of a given sentence. Locally appropriate syntactic knowledge and flexibility enable construction of sentences that for example, honor the given-new constraint. (See Clark & Haviland, 1977). Furthermore, together with adequate lexical knowledge, syntactic flexibility permits the coordination of multiple concepts within a single sentence, for example, highlighting some concepts in main clauses as others are relegated to subsidiary or explanatory roles within subordinate clauses. Such coordination of multiple concepts is especially crucial in discourse production, where the main thread of the developing discourse may be carried along in main clauses while subordinate clauses often serve to maintain coherence--clarifying or affirming presuppositions, specifying relations, and the like.

The relationship among these three types of linguistic knowledge is not specifiable in detail, but they probably contribute to actual writing performance through fairly complex interactions. Discourse schema knowledge specifies the general nature of the discourse and the types of relations typically required to maintain discourse coherence.

Lexical and syntactic knowledge enable manipulation of words and phrases to honor the discourse requirements of the schema. The interplay among these knowledge sources--recognizing discourse requirements and having the linguistic competence to fulfill those requirements--is a large component of the schooled language competence underlying writing skill.

Impenetrability Revisited

In our discussion of reading we suggested that reading skill entails acquisition of rapidly executing linguistic processes, specifically word identification and syntactic parsing, processes that are largely impenetrable by external (i.e., nonlinguistic) knowledge, expectations, or beliefs. Skilled reading, thus involves linguistic processes that operate independently of an executive processor, although executive control may be required during high-level text processing, such as repair of text, comprehension failures, monitoring of reading rate, etc.

Such an executive processor, however, has a much larger role in writing. The fact that sentence production is both slower and less automatic than sentence parsing is a clear indication of this. Moreover, studies of on-line writing behaviors (Flower & Hayes, 1980, 1981, 1984; Hayes & Flower, 1980; McCutchen, 1984) reveal the multiple sources of information that skilled writers continually consult: information in the writing assignment itself, information about the topic from long-term memory, information about the perceived audience, information about the writer's goals and how to achieve them (e.g., being clear, being interesting, being humorous), and information from the text as it develops (e.g., what points have and have not been made, what words or syntactic constructions have been used so far).

The main point to be drawn from this work is the cyclic, interactive nature of writing processes. Skilled writing is not the serial operation of autonomous sentence generation procedures, but a process of sentence generation continually interrupted by editing and planning procedures, which in turn are interrupted by generation procedures. Skilled writing necessitates breaking out of serial "knowledge-telling" processing (Scardamalia & Bereiter, 1982) and replacing it with more flexible processing that moves from the writer's knowledge base, to the developing text, to the potential reader's interpretation of the text, and back again. Moreover, the syntactic processes that may be relatively impenetrable in comprehension are very penetrable in the much slower process of producing a sentence under multiple discourse constraints. An executive processor, in a sense, has to come to have access to the information that is otherwise concealed in the syntactic module.

Thus, a critical difference between reading and writing is the importance of executive control during writing, and in particular, the growing control of executive processes over general language skills. During both reading and writing, however, these language skills have to be up to the demands placed on them. Both reading and writing require efficient manipulation of the symbol structures that comprise language, at the word level as well as at the syntactic level. During reading, word meanings must be rapidly retrieved in response to orthographic strings and their contextually appropriate meanings encoded. Sentences must be parsed and semantic roles assigned. During writing, semantic intentions must prompt retrieval of appropriate syntax and lexical items, often several since text constraints can make some wordings more appropriate than others.[2] The difference between reading and writing, however, is that to a large extent the text dictates the reader's options, and thus control strategies play a lesser role.

The writer is not so constrained, and control processes gain importance. Extending these descriptions, we might characterize developmental and individual differences in writing skill in terms of the adequacy of general linguistic skills and their amenability to executive control.

Using a serial, knowledge-telling strategy, young children make few executive decisions about how ideas are arranged in their texts or how sentences are syntactically constructed. Information is retrieved from memory and apparently clothed in the first linguistic expression that comes to mind. As we described earlier, young children are often satisfied with writing down their own idiosyncratic intention. They do not attempt to create explicit meaning in their texts apart from that privileged knowledge, and they make few demands on language competence. They write relatively simple sentences, and as a result, often produce relatively incoherent texts (McCutchen, in press; McCutchen & Perfetti, 1982). And it seems not as though the language competence itself is lacking, since young children often use more complex syntactic constructions in their speech than they do in their writing (Loban, 1976; O'Donnell, Griffin, & Norris, 1967). Rather, children seem not to shape their written sentences in response to the multiple discourse demands heeded by skilled writers (e.g., audience, tone, clarity, textual constraints). Thus, in the writing of many children, their language skills have not come under the executive control that writing requires. For such writers, linguistic procedures remain relatively impenetrable.

In the normal development of writing skill this situation seems to change. With age, and especially with schooling, most children become better able to shape their language to the discourse requirements of their texts, and they write more coherent texts as a result. In fact, older children come to use more complex syntax in their writing than in their speech (Loban, 1976; O'Donnell et al., 1967).

However, attention to the discourse demands of written texts is not all there is to writing skill. As the writer allows factors such as clarity, audience, tone, and coherence to affect his or her linguistic choices. the language required to address simultaneously all those factors can become increasingly complex. For example, the writer might want to interject a comment that will amuse, but not sidetrack the reader from the main point. This might require some sort of subordination, a parenthetical phrase, or some other complex syntactic construction. Once the need for syntactic complexity is recognized, an extended linguistic competence must be there to meet that need. This extended linguistic competence, as opposed to basic linguistic competence, is far from universally acquired.

There are many adolescents and young adults who have not mastered the syntax they need to coordinate the complexity they wish to express. They can be found across the country in remedial writing classes, and they have syntactic problems unlike those of younger children. Rather than ignoring the complex discourse demands in written language, these writers "mismanage" that complexity (Shaughnessy, 1977). That these writers are different from young immature writers is a point worth emphasizing. Younger writers may occasionally omit a word, but they rarely garble syntax. Young writers seem not to tax their syntactic competence because, we suggest, their sense of discourse never demands it of them. It is not until writers reach a certain level of maturity that they even attempt to express many ideas (more than five distinct propositions, for example) within a single sentence. It is that complexity, and the sophisticated syntax that it requires, that proves so problematic for many older writers.

One eighth grade writer we have studied shows some recognition of the complex discourse demands in written language, and it is his attempt to address that complexity,

without adequate control over the requisite syntax, that seems the source of his problem. Consider one of his sentences:

> "It was late in the fourth quarter with 50 seconds left on the clock with the steelers quarterback Terry, who throw a long pass in which John had cot and scored a touchdown and game went into overtime with the score 7 to 7."

The writer has at least eight propositions that he is trying to coordinate: (1) it was late in the game; (2) 50 seconds remained; (3) Terry threw a pass; (4) Terry was the Steeler quarterback; (5) John caught the pass; (6) John scored a touchdown; (7) the score was tied at 7; and (8) the game went into overtime. With some work, all eight propositions can be combined into a single sentence: It was late in the game, with only 50 seconds remaining, when Steeler quarterback Terry threw a pass, which John caught and took in for a touchdown, tying the score at 7 and sending the game into overtime. There are, of course, other possible phrasings, but all require rather sophisticated clausal subordination. Such sophistication is beyond this particular writer, but his attempt is revealing. He does not write several short sentences, as a much younger writer would. He seems to have an impressionistic sense of what formal written English is like, but he does not have mastery of the linguistic structures that give written language its peculiar form. This writer attempts to respond to the discourse demands of written language, but he does not have productive control over the grammatical devices that would express his intent.

Reading, Writing, and Language Competence

We have argued here that there exists general language competence that underlies

both reading and writing skill, and we have tried to distinguish this schooled language competence from more basic communicative language skills. We have suggested that schooled language competence builds on more basic language competence, and like basic competence, depends at its core on linguistic symbol manipulation. Schooling, however, seems to extend both the linguistic options open to the child (increasing the child's vocabulary and syntactic repertoire) and the linguistic demands placed on him. With each year in school, children are increasingly required to gain information through reading and demonstrate their learning through writing (although the second perhaps too infrequently). These forms of linguistic interactions, stripped of much of the contextual information inherent in conversational interactions, require a different competence from the child--competence based more on language and less on real world knowledge.

Furthermore, we suggest that reading and writing do not have only shared features, and for this reason, we might expect some disassociation between reading skill and writing skill. While skilled reading entails increasing encapsulation and automaticity of linguistic subskills (Perfetti, 1985), skilled writing requires that language processes become increasingly open to external discourse demands such as purpose and audience, in a given text. Reading requires that linguistic procedures fire smoothly and rapidly, accessing a particular meaning when confronted with a given grapheme string or computing a particular syntactic parse when confronted with a given clause arrangement. Alternative words or phrasings are irrelevant, since reading requires recovering a meaning and an interpretation from the specific words and phrases present in the text being read. Consideration of such alternatives, however, is part of writing skill, since some choices are more appropriate than others within a given discourse.

A person could be skilled at reading and <u>not</u> at writing for several reasons. First,

one might not subject discourse production procedures to executive control--an executive that is largely unnecessary for skilled comprehension, we have argued. While active strategy use has been used successfully as a remedial technique to improve poor comprehension skills, skilled reading is a more passive cognitive activity than writing, since a by-product of skill in reading is increased automaticity of many processes. Second, one might be able to derive meaning from lexical and syntactic forms without having enough control over those forms to generate them. Such asymmetries between comprehension and production are not uncommon in language learning.

What seems somewhat surprising is the apparent rarity of severe disassociation between reading and writing skill. In a correlational analysis of McCutchen's data (in press), the overall correlation between reading ability and writing skill was .50 for all grades combined (as measured by the Spearman rank-order correlation coefficient), and as might be expected, the correlations were higher when each grade was analyzed separately: .65 for fourth graders, .62 for sixth, and .78 for eighth. The measure of reading ability was percentile rank on the reading subsection of the California Achievement Test, and the measure of writing ability was an index of coherence in the children's texts. (See McCutchen (in press) or McCutchen and Perfetti (1982), for a description of the coherence analysis.) While our coherence analysis taps local features of discourse, it is probably correlated with more global evaluations of writing quality, if we may extrapolate the results of a study of college students' essays by Witte and Faigley (1981) using a similar coherence analysis. In their study, texts that were subjectively rated high contained more cohesive ties than did texts rated poor. Thus, if coherence, as an analytic index of writing skill, is associated with reading comprehension skill, it is likely that other less analytic indexes are also. Furthermore, other analytic measures also show reading and writing to be associated (Loban, 1976).

Such correlations lend support to our claims about general language competence underlying both reading and writing skill. It is especially interesting that the correlation in the McCutchen data (in press) was highest for the older children. By grade eight, children may have recognized the general discourse demands of text production, abandoning early knowledge-telling strategies in favor of more sophisticated executive strategies. If so, then what remains to determine writing ability is the child's productive control of lexical and grammatical devices. We have argued that such linguistic processes also underlie reading ability. Thus, an increased correlation for older children could reflect the central role in both reading and writing of linguistic symbol manipulation that becomes more visible as basic strategies for writing are partly acquired. There are other possible explanations, however. We imagine that many would argue that the increased knowledge and inference demands of writing, on the one hand, and of comprehension tests on the other, account for any increased correlations that might be observed.

It is obvious that there is much more to learn about the relationship between reading and writing. The view that inference-rich knowledge driven processes form their most compelling link may be correct in some sense. Our purpose has been to provide a different perspective. one that allows the commonalities of reading and writing to be seen in the basic linguistic skills that they share and their differences to be seen in their vastly unequal reliance on other things.

Conclusion

We have argued that a set of restricted-generalized abilities underlie both reading and writing. A major entailment of this argument is the rejection of knowledge-based

and strategy-based approaches to language competence. The central features of schooled language competence arise from linguistic skill: A schooled extension of basic linguistic abilities. Prominent among these are skilled extensions of basic syntactic abilities and lexical knowledge.

Important to our argument is a principled distinction between meaning and interpretation. Comprehension implies achieving text representations that are richly interpreted. However, it equally implies a process of relatively uninterpreted representations enroute to more richly interpreted texts. These meaning representations are achieved in part by comprehension processes, e.g. word identification and syntactic parsing, that have low penetrability. They are not readily influenced by knowledge and expectations when carried out skillfully and routinely. Reading ability is centrally the reflection of these processes and only peripherally the reflection of knowledge-dependent inferential processes.

Writing shares these features with reading. However, whereas the "passive" language processes are central in reading, writing calls much more on the active control of these processes. Although knowledge remains only peripheral in writing, language abilities must be considerably extended. Language processes come to be visible to an executive control process, losing much of their impenetrable flavor. They operate under more complex demands imposed by discourse requirements and multiple writing goals. Linguistic abilities retain their central importance; indeed they must be better to meet these demands.

There are specific empirical consequences of our analysis; although for both reading and writing, existing research results are not decisive. On the other hand, we

conclude that recent research demonstrates a role for knowledge-free general abilities in both reading and writing.

Acknowledgement

Some of the research described in this chapter was funded by the Office of Educational Research and Improvement through a grant to The Learning Research and Development Center, University of Pittsburgh.

References

Anderson, R. C. & Ortony, A. (1975). On putting apples into bottles--a problem of polysemy. Cognitive Psychology, 7, 167-80.

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. (1976). Frameworks for comprehending discourse. (Technical Report No. 12). Urbana: University of Illinois Laboratory for Cognitive Studies in Education.

Anderson, R. C., Spiro, R. J., & Anderson, M. C. (1978). Schemata as scaffolding for the representation of information in connected discourse. American Educational Research Journal, 15, 433-440.

Applebee, A. N. (1982). Writing and Learning in School Settings. In What Writers Know, The Language, Process, and Structure of Written Discourse, New York: Academic Press, Inc.

Bartlett, E. J. (1982). Learning to revise: Some component processes. In M. Nystrand (Ed.), What writers know. New York: Academic Press.

Bartlett, E. J. & Scribner, S. (1981). Text and context: An investigation of referential organization in children's written narratives. In C. H. Frederiksen and J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written language, (Vol. 2). Hillsdale, NJ: Erlbaum.

Bereiter, C. & Scardamalia, M. (1981). From conversation to composition: The role of instruction in a developmental process. In R. Glaser (Ed.), Advances in instructional psychology, (Vol. 2). Hillsdale, NJ: Erlbaum.

Bissex, G. L. (1980). Gyns at wrk: A child learns to read and write. Cambridge, MA: Harvard University Press.

Bolinger, D. (1965). The Atomization of Meaning. Language, 41, 4, Oct.-Dec.

Bransford, J. D. & Johnson, M. K. (1973). Considerations of some problems of comprehension. In W. G. Chase (Ed.), Visual information processing. New York: Academic Press.

Brown, A. L. (1976). The construction of temporal succession by preoperational children. In A. D. Pick (Ed.), Minnesota symposium on child psychology, (Vol. 10). Minneapolis: University of Minnesota.

Brown, A. L. & Smiley, S. S. (1977). Rating the importance of structural units of prose passages: A problem of metacognitive development. Child Development, 48, 1-8.

Burtis, P. J., Bereiter, C., Scardamalia, M. & Tetroe, J. (1983). The development of planning in writing. In C. G. Wells & B. Kroll (Eds.), Exploration of children's development in writing. Chicester, England: Wiley.

Chase, W. G. & Simon, H. A. (1973). The mind's eye in chess. In William G. Chase (Ed.), Visual information processing. New York: Academic Press.

Chi, M. T. H., Glaser, R., & Rees, E. (1982). Expertise in problem solving. In R. J. Sternberg (Ed.), Advances in the psychology of human intelligence (Vol. 1, pp. 7-76). Hillsdale, NJ: Erlbaum.

Cioffi, G. (1984). Observing composing behaviors of primary-age children: The interaction of oral and written language. In R. Beach & L. S. Bridwell (Eds.), New directions in composition research. New York: Guilford.

Clark, H. H. & Haviland, S. E. (1977). Comprehension and the given-new contract. In R. O. Freedle (Ed.), Discourse production and comprehension. Norwood, NJ: Ablex.

DeGroot, A. M. B. (1983). The range of automatic spreading activation in word priming. Journal of Verbal Learning and Verbal Behavior, 22, 417-436.

Dooling, D. J. & Lachman, R. (1971). Effects of comprehension on retention of prose. Journal of Experimental Psychology, 88, 216-222.

Ferreira, F. & Clifton, C., Jr. (in press). The Role of Context in Resolving Syntactic Ambiguity. Amherst, MA: University of Massachusetts.

Flower, L. (1979). Writer-based prose: A cognitive basis for problems in writing. College English, 41, 19-37.

Flower, L. S. & Hayes, J. R. (1980). The dynamics of composing: Making plans and juggling constraints. In L. W. Gregg & E. R. Steinberg (Eds.), Cognitive processes in writing. Hillsdale, NJ: Erlbaum.

Flower, L. & Hayes, J. R. (1981). Plans that guide the composing process. In C. H. Frederiksen and J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written language, (Vol. 2). Hillsdale, NJ: Erlbaum.

Flower, L. & Hayes, J. R. (1984). Images, plans, and prose: The representation of meaning in writing. Written Communication, 1, 120-160.

Fodor, J. D. (1983). Parsing, Constraints and the Freedom of Expression. Montgomery, Vermont: Bradford Press.

Ford, M., Bresnan, J. W. & Kaplan, R. M. (1982). A competence-based theory of

syntactic closure. In J. W. Bresnan (Ed.) The Mental Representation of Grammatical Relations. Cambridge, Mass.: MIT Press.

Ford, M. & Holmes, V. M. (1978). Planning units and syntax in sentence production. Cognition, 6, 35-53.

Forster, K. I. (1979). Levels of processing and the structure of the language processor. In W. E. Cooper and E. C. T. Walker (Eds.) Sentence Processing: Psycholinguistic Studies presented to Merrill Garrett. Hillsdale, NJ: Erlbaum.

Fowler, C. A., Wolford, G., Slade, R., & Tassinary, L. (1981). Lexical access with and without awareness. Journal of Experimental Psychology: General, 110, 341-362.

Frazier, L. (1979). On Comprehending Sentences: Syntactic Parsing Strategies. Doctoral Dissertation. Bloomington, IN: Indiana University Linguistics Club.

Frazier, L., & Rayner, K. (1982). Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. Cognitive Psychology, 14, 178-210.

Freedle, R. O. & Hale, G. (1979). Acquisition of new comprehension schemata for expository prose by transfer of a narrative schema. In R. O. Freedle (Ed.), New directions in discourse processing. Norwood, N.J.: Ablex.

Frege, G. (1892). Uber Sinn und Bedeutung. Zeitschrift fur Philosphie und philosophische Kritik, 100, 25-50. Translated in P. T. Geach and M. Black (eds.) Philosophical Writings of Gottlob Frege. Oxford: Blackwell, 1952.

Fromkin, V. A. (Ed.) (1973). Speech errors as linguistic evidence. The Hague: Mouton.

Fromkin, V. A. (Ed.) (1980). Errors in linguistic performance. New York: Academic Press.

Gundlach, R. A. (1981). On the nature and development of children's writing. In C. H. Frederiksen and J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written language, Vol. 2. Hillsdale, NJ: Erlbaum.

Hayes, J. R. & Flower, L. S. (1980). Identifying the organization of the writing process. In L. W. Gregg & E. R. Steinberg (Eds.), Cognitive processes in writing. Hillsdale, NJ: Erlbaum.

Hilgers, T. L. (1984). Toward a taxonomy of beginning writers' evaluative statements in written composition. Written Communication, 1, 365-384.

Johnson-Laird, P.N. (1984). Mental Models. Cambridge, MA: Harvard Univ. Press.

Katz, J. J. (1966). The Philosophy of Language. New York: Harper and Row.

Katz, J. J. & Fodor, J. A. (1963). The structure of a semantic theory. Language, 39, 170-210.

Kintsch, W. (1974). The representation of meaning in memory. Hillsdale, NJ: Lawrence Erlbaum Associates.

Kintsch, W. (1986). General strategies for comprehension, talk to be presented at 1986 American Educational Research Association Annual Meeting.

Kintsch, W. & Mross, F. (1985). Context Effects in Word Identification. Journal of Memory and Language, 24, 3.

Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. Psychological Review, 85, 363-394.

Larkin, J. H., McDermott, J., Simon, D. P., & Simon H. A. (1980). Expert and novice performance in solving physics problems. Science, 80, 1335-1342.

Loban, W. D. (1976). Language development: Kindergarten through grade twelve. (Research Report No. 18). Urbana, IL: National Council of Teachers of English.

McCutchen, D. (1984). Writing as a linguistic problem. Educational Psychologist, 19, 226-238.

McCutchen, D. (In press). Domain knowledge and linguistic knowledge in the development of writing ability. Journal of Memory and Language.

McCutchen, D. (1985). Children's discourse skill: Form and modality requirements of schooled writing. Unpublished manuscript.

Meyer, B. (1975). The organization of prose and its effect on memory. Amsterdam: North Holland.

Morton, J. (1969). Interaction of information in word recognition. Psychological Review, 76, 165-178.

National Assessment of Educational Progress (1981). Three National Assessments of Reading: Changes in Performance, 1970-80. Denver, CO: NAEP.

Neely, J. H. (1977). Semantic priming and retrieval from lexical memory: The roles of inhibitionless spreading activation and limited-capacity attention. Journal of Experimental Psychology: General, 106, 1-66.

Nold, E. W. (1981). Revising. In C. H. Frederiksen and J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written language, Vol. 2. Hillsdale, NJ: Erlbaum.

Oakhill, J. (1982). Constructive processes in skilled and less skilled comprehenders' memory for sentences. British Journal of Psychology, 73, 13-20.

O'Donnell, R., Griffin, W. & Norris, R. (1967). Syntax of kindergarten and elementary school children: A transformational analysis. (Research Report No. 8). Champaign, IL: National Council of Teachers of English.

Olson, D. (1977). From utterance to text: The bias of language in speech and writing. Harvard Educational Review, 47, 257-281.

Onifer, W. & Swinney, D. A. (1981). Accessing lexical ambiguities during sentence comprehension: Effects of frequency of meaning and contextual bias. Memory & Cognition, Vol. 9, No. 6.

Palinscar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. Cognition and Instruction, 1(2), 117-175.

Perfetti, C. A. (1984). Reading Acquisition and Beyond: Decoding Includes Cognition. American Journal of Education, 93, 1, 11, 40-60.

Perfetti, C. A. (1985). Reading ability. New York: Oxford University Press.

Perfetti, C. A. (In press). Language, speech, and print: Some asymmetries in the acquisition of literacy. In R. Horowitz & S. J. Samuels (Eds.), Comprehending oral and written language. New York: Academic Press.

Perfetti, C. A., & Roth, S. F. (1981). Some of the interactive processes in reading and their role in reading skill. In A. M. Lesgold & C. A. Perfetti (Eds.), Interactive processes in reading (pp. 269-297). Hillsdale, NJ: Erlbaum.

Perfetti, C. A., Goldman, S. R., & Hogaboam, T. W. (1979). Reading skill and the identification of words in discourse context. Memory and Cognition, 7, 273-282.

Posner, M. I., & Snyder, C. R. R. (1975). Attention and cognitive control. In R. Solso

(Ed.), Information processing and cognition: The Loyola symposium. Hillsdale, NJ: Erlbaum.

Read, C. (1981). Writing is not the inverse of reading for young children. In C. H. Frederiksen and J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written language, (Vol. 2). Hillsdale, NJ: Erlbaum.

Rosch, E. (1973). On the internal structure of perceptual and semantic categories. In T. M. Moore (Ed.), Cognitive Development and the Acquisition of Language. New York: Academic Press.

Ryan, E. B. (1982). Identifying and remediating failures in reading comprehension: Toward an instructional approach for poor comprehenders. In G. E. MacKinnon & T. G. Waller (Eds.), Advances in Reading Research, (Vol. 3). New York: Academic Press.

Scardamalia, M. & Bereiter, C. (1982). Assimilative processes in composition planning. Educational Psychologist, 17, 165-171.

Shaughnessy, M. (1977). Errors and expectations: A guide for the teacher of basic writing. New York: Oxford.

Spilich, G. J., Vesonder, G. T., Chiesi, H. L., & Voss, J. F. (1979). Text-processing of domain-related information for individuals with high and low domain knowledge. Journal of Verbal Learning and Verbal Behavior, 18, 275-290.

Stanovich, K. E., & West, R. F. (1981). The effect of sentence context on on-going word recognition: Tests of a two-process theory. Journal of Experimental Psychology: Human Perception and Performance, 7, 658-672.

Stein, N. L., & Glenn, C. G. (1979). An analysis of story comprehension in elementary school children. In R. Freedle (Ed.). Advances in discourse processing 2: New Directions in discourse processing. Norwood, NJ: Ablex.

Stein, N. L., & Trabasso, T. (1981). What's in a story: An approach to comprehension and instruction. In R. Glaser (Ed.), Advances in instructional psychology, (Vol. 2). Hillsdale, N.J.: Erlbaum.

Swinney, D. A. (1979). Lexical access during sentence comprehension. Reconsideration of context effects. Journal of Verbal Learning and Verbal Behavior, 18, 645-659.

van Dijk. T. A., & Kintsch, W. (1983). Strategies of discourse comprehension. New York: Academic Press.

Voss, J. F., Greene, T. R., Post, T. A., & Penner, B. C. (1983). Problem solving skill in the social sciences. In G. H. Bower (Ed.), The psychology of learning and motivation: Advances in research theory, (Vol. 17). New York: Academic Press.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. (M. Cole, V. John-Steiner, & E. Soubermen Eds. and Trans.), Cambridge, MA: Harvard University Press.

Waters, H. S. (1980). "Class News": A single-subject longitudinal study of prose production and schema formation during childhood. Journal of Verbal Learning and Verbal Behavior, 19, 152-167.

West, R. F. & Stanovich, K. E. (1978). Automatic contextual facilitation in readers of three ages. Child Development, 49, 717-727.

Witte, S. P. & Faigley, L. (1981). Coherence, cohesion, and writing quality. College Composition and Communication, 32, 189-204.

Wittgenstein, L. (1953). Philosophical Investigations. Translated by G. E. M. Anscombe. New York: Macmillan.

[1]Such groups have been identified in other research, always, as far as we know, equating accuracy of word identification and not speed of identification. It is much better to assess the speed, as an index of processing facility.

[2]Note that these same processes occur in speech production. (See Fromkin, 1973, 1980). Writing differs from speaking primarily in its higher standards for well-formedness and its expanded opportunities for planning and editing.