DOCUMENT RESUME

ED 240 535 CS 007 526

AUTHOR	Perfetti, Charles A.
TITLE	Discourse Context, Word Identification and Reading Ability.
INSTITUTION	Pittsburgh Univ., Pa. Learning Research and Development Center.
SPONS AGENCY	National Inst. of Education (ED), Washington, DC.
REPORT NO	LRDC-1983/21
PUB DATE	83
NOTE	12p.; Reprinted from "Language and Comprehension," J. F. Le Ny and W. Kintsch, Eds.
PUB TYPE	Viewpoints (120) -- Reports - Evaluative/Feasibility (142) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Comparative Analysis; *Context Clues; Decoding (Reading); *Models; *Reading Ability; Reading Difficulties; *Reading Rate; Reading Research; Reading Skills; *Word Recognition; *Word Study Skills

ABSTRACT

One model of interactive processing useful in describing word identification processes in discourse context is of a weakly interactive type. This type assumes that the time to identify a word in context is an activation function, whereas the time to activate a word in memory beyond some criterial identification thrashold is a multiplicative function of context plus the individual's basic word processing rate. Studies confirm this model's predictions for individual differences in the tima to read a word in context: skilled readers identify words more quickly and are affected less either by context or by stimulus degrading than unskilled readers. Conversly, while less skilled readers are more dependent on context to compensate for less efficient word idantification skills, they are less able to use context to predict words. (HOD)

LEARNING RESEARCH AND DEVELOPMENT CENTER

1983/21

DISCOURSE CONTEXT, WORD IDENTIFICATION AND READING ABILITY

CHARLES A. PERFETTI

University of Pittsburgh

DISCOURSE CONTEXT, WORD IDENTIFICATION AND READING ABILITY

Charles A. Perfetti

Learning Research and Development Center

University of Pittsburgh

1983

The research reported herein was supported by the Learning Research and Development Center, supported in part as a research and development center by funds from the National Institute of Education (NIE), Department of Education. The opinions expressed do not necessarily reflect the position or policy of NIE and no official endorsement should be inferred

LANGUAGE AND COMPREHENSION
J.-F. Le Ny, W. Kintsch (editors)

DISCOURSE CONTEXT, WORD IDENTIFICATION AND READING ABILITY

Charles A. Perfetti

Learning Research and Development Center
University of Pittsburgh
Pittsburgh, Pennsylvania
U.S.A.

In this paper, I discuss some relationships between children's reading ability and the processes of word identification within discourse contexts. In so doing, I will discuss interactive processes in reading and attempt to demonstrate how some relatively weak interactive assumptions can provide a framework for understanding reading ability.

Interactive Processes in Reading

The essential feature of an interactive model is that multiple sources of information combine to produce some process such as word identification. Models which are weakly interactive do not have direct influences of one information source on another source, while models which are strongly interactive do have such influences. Examples of the former are Morton's (1969) logogen model, McClelland's (1979) Cascade model, and the reading ability model described by Perfetti & Roth (1981). In these models, the processes are interactive in that decisions of word identification are guided by both higher-level conceptual information and by graphic information. Thus discourse context (conceptual guidance) and the printed letters affect word identification, but do not necessarily directly influence each other. By contrast, models that are powerfully interactive (Rumelhart, 1977; Rumelhart & McClelland, 1981) not only describe word identification as dependent on both graphic data and conceptual data, but they also allow direct influences between contextual processes and graphic processes. It is quite possible that the more powerfully interactive models will prove to be correct or at least necessary for some processes of word identification (see Rumelhart & McClelland, 1981). However, weakly interactive models are sufficient to examine certain important questions of reading ability. In fact they are quite sufficient to account for rather intricate influences of context on identification (Massaro, 1980).

For reading ability, an important question is this: Do children of different reading abilities differ in their lower-level processes, their higher-level processes or both? Of course, both "higher-level" and "lower-level" include a large domain of comprehension and identification processes and it is inevitable that children of different reading ability will differ in many of these processes. Here, I restrict discussion to just the process of identifying printed words and the contributions to this process of lower-level word coding ability and higher-level expectations based on sentence comprehension. For individuals there are two relevant processing components: (1) The speed of basic word identification (Word Identification Speed) and (2) The accuracy of word prediction, given a discourse context (Context Sensitivity). The questions are how these two components affect a reader's time to identify a word in context and, especially, is the problem of the low ability reader mainly in word identification or context sensitivity? Equivalently, is the advantage of the skilled reader mainly in word identification, context sensitivity, or both?

The model I propose is one of the weakly interactive type that assumes the time to identify a word in context is an activation function, where the time to activate a word in memory beyond some criterial identification threshold is a multiplicative function of context and a person's basic word processing rate. The word processing rate function grows exponentially over time, quickly reaching asymptote. Further, both the word processing rate (r) and the context component (k) can be considered parameters of individual differences or of texts and words. Thus a skilled reader has a faster rate (r) than an unskilled reader and a short and frequent word has a faster rate than a long and rare word. Similarly, a skilled individual of high context sensitivity has a higher k value than a less skilled individual and a highly predictable context has a higher k value than a less predictable context.

This model makes certain predictions for individual differences in the time to read a word in context. It predicts, in particular, that if two individuals differ in basic coding rate (r), the one with the slower rate will be more affected by context. Relative to a condition of no context, i.e., isolated word identification, a facilitative context increases the word identification rate of all readers. However it increases the rate of the slow readers more than the fast readers. Interestingly, a misleading context should have the same effect, but in the opposite direction. It should slow the rate of the slow reader more than the rate of the fast reader.

The formal basis for these predictions is that the word identification rate (r) is an exponential growth function whereas the context factor (k) is a multiplicative constant. Context does not directly affect the process of word identification. Instead, it adds activation to the word's location in memory, in effect reducing the amount of data required from the graphemic level. However, identification can occur quite well without a context, but not without a word. Thus, the context-free word identification rate is the overall rate limiting factor in the activation of a word in memory.

Discourse Context and Predictability

It is commonplace to assume that word identification is aided by discourse context. How is this accomplished? It is possible that active predictive processes operate during reading. Thus, a reader (or, for that matter, a listener) may actively generate predictions about what will appear. Indeed, in the studies to be summarized here, asking subjects to predict words in texts is the way that contextual constraint is assessed. However, if we think about the process of skilled reading, we can imagine instead that active prediction, as anything more than a metaphor, is an unlikely process. In most contexts, predicting words takes longer than reading them. Furthermore, texts seldom contain words that are completely predictable, and except for such complete redundancy, it is difficult to imagine any advantage to predicting a word and then having to replace the prediction with the actually occurring word. Another possibility is that context effects are passive processes, rather than active ones. The mechanism for context effects would be something more akin to spreading activation (Collins & Loftus, 1975), although it might be rather more constrained by syntactic factors than is the case with other situations of memory activation. Furthermore, in the case of text reading, activation of semantic links may be thought of as resulting from the general semantic content of the text and the more specific semantic links activated by the sentence currently being read. Much remains to be understood about such processes, but the assumptions that there are rapid passive activation processes as well as slower, active predictive processes are seen in the general facilitation and inhibition model of Posner and Snyder (1975). This model has been applied to the specific case of reading words in context by Stanovich and West (1979; Stanovich, 1981). By this view, it is the passive attention-free mechanism that provides most of the context facilitation effect.

This view of contextual processes is not to deny the role of active, predictive processes in comprehension. The mental activities associated with integrating text propositions with memory structures and anticipating text structures are just two examples of comprehension activities that seem to involve some active processes that have prediction-like qualities. However, because such processes make demands on central processing resources, that is all the more reason to suppose that simpler word processes should not make heavy demands on these same resources. Thus a passive "predictive" system serves better than an active one as far as words are concerned. Both in the model discussed above and the experiments discussed below, the assumption is that the context factor is one that describes the predictability of words in texts, but not necessarily the active prediction of words by readers.

Studies of Context and Identification

The model discussed above implies that, compared with high ability readers, low ability readers should have word identification rates that are slower, increased more by facilitative context, and decreased more by misleading context. The first of the predictions is already well established (e.g., Perfetti & Hogaboam, 1975). Low ability readers have slower times in identifying words. In the interactive framework, the questions are how context and graphic data combine in identification and whether low ability readers are less skilled at use of context, graphic data, or both. An experimental approach to these questions is to vary the predictive quality of context, thus observing the contribution of context, and the graphic quality of the word, thus observing the contribution of graphic data.

In the first experiment to be discussed, children (average age 9) were presented with three kinds of contexts, defined according to whether a given word was highly predictable, unpredictable, or anomalous in the given context. The contexts were two sentences in length. Examples of each type are given below for the word cage.

Predictable. The lion was the most dangerous animal we had seen at the zoo. The guard warned us not to stick our hands through the bars of his cage.

Unpredictable. We discovered having a pet isn't easy. Our new pet needed lots of things, but first of all, we got him a cage.

Anomalous. There were lots of things that John had to do before he could go out and play with his friend. He had to wash the dishes, finish his school work, and clean up his cage.

For the American children of our research population, the word cage in the highly predictable context was, in fact, highly predictable. We measured the predictability of these contexts by asking children to predict what word would occur at the end of the second sentence. The average predictability was 80% for the highly predictable contexts, 3% for the unpredictable contexts, and 0% for the anomalous contexts. If we compare these three context types to normally occurring texts, we conclude that the unpredictable type is rather typical. Exact words are not often predictable. However the differences between an unpredictable context and an anomalous one is more important than a mere 3% predictability. An unpredictable context is unpredictable only in that the word that occurs is one of many that could occur in that context. The word conforms to the semantic constraint of the context. By contrast, an anomalous context is one which imposes semantic constraints different from the semantic properties of the target word. Thus, the final word is not merely unpredictable, it is semantically anomalous.

How will readers of different skill identify the target words in such contexts? According to general features of the model, predictable contexts should produce shorter latencies than unpredictable contexts, regardless of reading skill. However the facilitative effect of predictability should be greater for less skilled readers than for skilled readers. As for anomalous contexts, they might be expected to have some effect in increasing identification latencies. However, this negative effect should be greater for less skilled readers than for skilled readers, according to the model. (See Perfetti & Roth, 1981, for illustrations of these predictions.)

The results of this experiment are shown in Figure 1. Relative to unpredictable

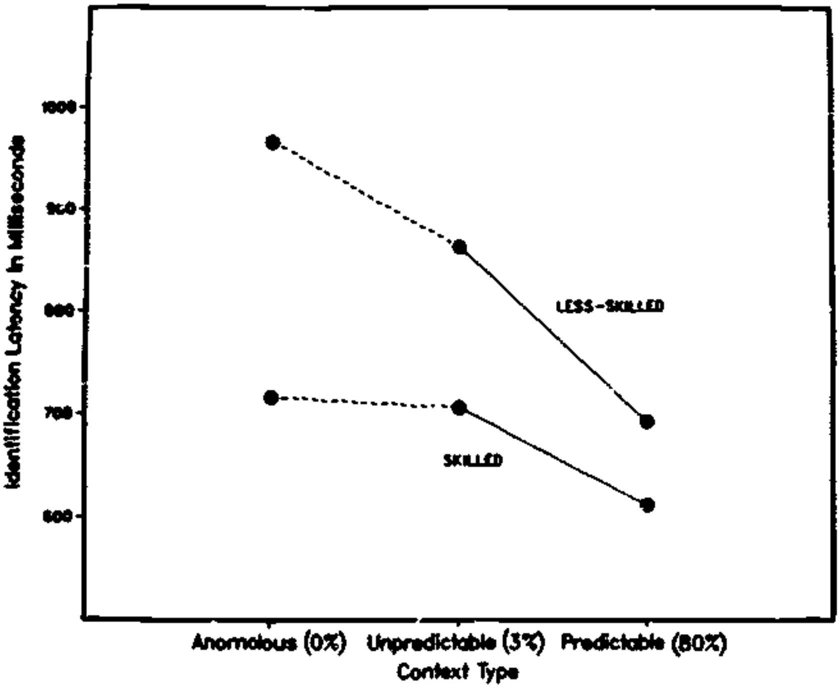

Fig. 1. Identification latencies of skilled and less-skilled readers for three types of contexts. Data from Perfetti & Roth (1981)

contexts, predictable contexts were facilitated for latencies of both skilled and less skilled readers, but more so for less skilled readers. Anomalous contexts produced longer latencies only for less skilled readers, at age 9. For subjects one-year younger, the results (not shown) were that both skilled and less skilled readers were negatively affected by context. A possible age difference in the effect of anomaly is consistent with the results of Stanovich and West (1979) that children, but not adults, were negatively affected by anomalous contexts.

Thus there is support in these data for the prediction of differential context effects for readers of different skill. This is consistent with the general assumptions of the model that the effects of context will depend on the basic context-free identification rate and that it is this rate that distinguishes readers of different skill. Skilled readers are less affected by context because their basic word identification process executes very rapidly. Readers of lower skill have slower basic rates that have not executed before the effect of context is seen. Because of the general developmental differences (Stanovich & West, 1979) as well as differences between skill levels, it may be correct to suggest the following generalization: As an individual becomes older and more skilled in reading, his reliance on context is reduced. His basic context-free processes become more important in determining his identification of words in context.

In the experiment discussed above, words were always seen in some context. Thus, there was no comparison between identification times in context and basic identification times. By definition, the latter are based on words viewed in isolation. Such comparisons are available from the experiments of Perfetti, Goldman, and Hogaboam (1979), which were carried on with subjects from the same population. In these experiments, the context was actually an entire short story with occasional target words to be identified on a screen. The target words varied widely in their predictability from the text. The major results were similar to those described above. The function relating identification time to predictability showed a larger slope for less skilled readers than for skilled readers (intercepts, of course, were also different). That is, an increase in predictability was associated with a larger reduction in identification time for less skilled readers.

In addition, the Perfetti et al (1979) experiments had a condition in which words, comparable to those from the story, were viewed in isolation. In the isolation conditions, ability differences were at their largest. In fact, the skilled readers were about as fast in identifying an isolated word as they were at identifying an unpredictable word in context. Less skilled readers, by contrast, were helped even by unpredictable words in context (compared with isolated words). This last fact demonstrates that context has effects that aren't measurable by the probability that subjects will predict a given word, at least when the sample is not large. The main point is that when basic word identification is compared with content-aided word identification, the ability factor is seen most clearly in basic identification time. Predictive contexts help the less skilled reader more than the skilled reader and the more predictable the word is, the more he is helped. And when the word is anomalous rather than predictable the less skilled reader is slowed even more.

Studies of Degrading and Context

The strategy of the studies summarized above was to observe the influence of context by varying the predictability of a word. This, in effect, reduces the reliance on basic word processing, except where the context and the target word are anomalous. Within an interactive model, the other side of the problem can be examined by manipulating the difficulty of word processing. One way to do this is to visually degrade the word target. The assumption is that degradation slows the rise of the word activation function, because graphic data accumulates more slowly. It forces a greater reliance on word knowledge and decoding ability. It also presents an opportunity to slow down the word processing of skilled readers to observe whether they then mimic less skilled readers.

Examples of the sort of degrading we (Perfetti & Roth, 1981) carried out are shown in Figure 2. These three levels of degrading, defined by the percentage of

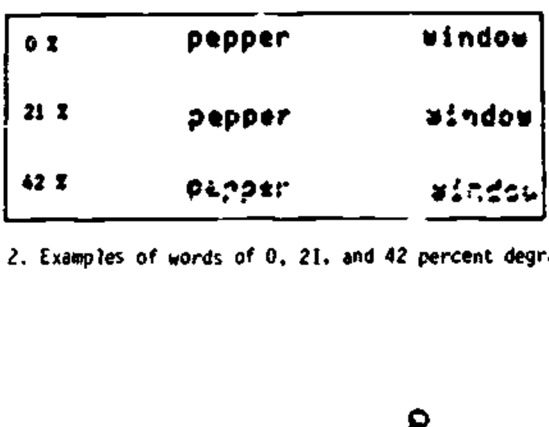

Fig. 2. Examples of words of 0, 21, and 42 percent degrading.

features deleted, were used in one experiment and in another experiment there were four levels beyond zero - 14%, 21%, 28% and 42%. In addition to varying the quality of the word through degrading, we varied the predictability of the word in discourse context. In one experiment context was provided by sentence pairs and in another experiment by one of the stories of Perfetti et al (1979).

Since the experiments produced similar results, I will describe just one. Contexts were high, moderate, and low in the constraint on target words provided by contents. In order to provide a more sensitive measure of predictability, subjects were given 15 seconds to predict words that might complete a two-sentence text. High constraint contexts allowed prediction of the target by nearly all subjects (93.5%) while the low constraint contexts practically never allowed correct prediction (<1%) within the 15 second period. The moderate constraint texts were intermediate in predictability, and, in that sense, more typical. A point about these texts is that they demonstrate that constraint and predictability are not quite the same. The constraint produced by a text can be indexed by the number of different words generated in the 15 second period. More constraint is fewer word types. As can be seen from Table 1, the mean number of words (word

Table 1

Context Constraint and Target Predictability for Three Context Types

Type	Mean Number of Word Types	Percentage of Target Predictions	
		Skilled	Less Skilled
High Constraint	12.4	92.9	94.4
Moderate Constraint	27.8	23.7	15.2
Low Constraint	36.4	3.2	0.1

Note: Number of Word Types is the total number of unique words produced per Context by 30 subjects within 15 seconds. Data are from Table 2 of Perfetti and Roth (1981).

types) generated for the high constraint contexts was much smaller than for the other two contexts. Thus the target is more predictable, in that most subjects predict it, and the context is more constraining in that fewer words fit.

Turning now to the identification results, the questions are (1) whether degrading affected less skilled readers more than skilled readers; (2) whether context affected less skilled readers more than skilled readers, (3) whether the effects of degrading were reduced by context. As can be seen from Table 2, the results answer each of these questions in the affirmative. Of course there were also the expected main effects of context, degrading and skill. Highly constraining contexts were practically unaffected by degrading. Moderate-constraint contexts showed little effect of degrading except for severe (42%) degrading. By contrast identification of isolated words and words in low constraint contexts were much affected by degrading. The exact nature of this context by degrading interaction is informative. Its major component is the contrast between the high constraint context and the other three. Degrading effects are in fact observed except when the word is completely predictable. Under such conditions, conceptual guidance is so powerful that minimal data from print is required. These situations are not typical of most texts.

As for reading skill, skilled readers were less affected by context than less skilled readers. This result replicates that of the previously described study.

Table 2

Two-Way Interactions of Context, Skill, and Degrading
(Word Identification Latencies (Item Means) from Perfetti and Roth, 1981)

		Context		
Degrading	Isolation	Low	Moderate	High
0	1.03	.85	.85	.57
21	1.29	1.28	.99	.63
42	1.93	1.52	1.33	.68

		Context		
Skill				
Low	1.64	1.38	1.18	.67
High	1.19	1.05	.94	.58

	Degrading		
Skill	.0	.21	.42
Low	.90	1.16	1.14
High	.76	.93	1.58

In addition, the difference between skilled and less skilled readers decreased systematically with increasing contextual constraint. The two groups were maximally different for words in isolation and nonsignificantly different when words were 94% predictable. With respect to degrading, skilled readers were significantly faster than less skilled readers under all conditions, but their advantage was especially large at the highest level of degrading. The explanation for this effect appears to lie in the superior ability of the skilled reader in applying higher level orthographic constraints. These kinds of constraints are exactly what is needed to help identify letters when individual letters resist recognition. For example, evidence that the second letter is <u>l</u> supports the hypothesis that the first letter is <u>c</u> over the hypothesis that the first letter is <u>a</u>. Use of such knowledge is one of the factors that are part of skilled reading and can, in fact, lead to higher basic word identification rates.

<u>Reading Skill and Sensitivity to Discourse Context</u>

The preceding discussion has emphasized the possibility that basic processing rates and not use of context are the main factor distinguishing skilled from less skilled readers. Moreover, less skilled readers are more dependent on context as a means of compensating for low rates of word identification (see also Stanovich, 1981). However, this should not imply that use of context is something less skilled readers are especially good at. In fact they are not as able as skilled readers to predict words from context. In connection with the experiments described above, children of different reading ability were asked to predict words occurring at the end of two sentence texts. The right columns of Table 1 show the success of these subjects in the prediction task. There are interesting results in the boundary conditions of textual constraint and in the normal textual constraint conditions. By boundary conditions, I mean those texts that completely constrain the final word and those that provide practically no constraint. In the former case less skilled readers as well as skilled readers can predict the target. In the latter case neither can predict it. However, in texts of moderate constraint, significant differences emerge. Skilled readers can predict the target better than less skilled readers. This is unsurprising when we consider that the skill groups are defined by their scores on comprehension tests. However, explanations are another matter. In our task, the texts were very short and required no special knowledge. One, for example, was the following: When I got home from work, I wanted to eat a fruit. I went to the refrigerator and got a pear. Pear is more often predicted within the 15 second interval by skilled readers than by less skilled readers. Notice that the semantic constraint is very general -- a fruit.

Refrigerator is an additional constraint. It was characteristic of less skilled readers that they often ignored the fruit constraint and named only something that would be found in a refrigerator, e.g., milk, cake. Whether such subjects forgot the fruit constraint or whether they knew fewer fruit examples to name, or something else, is not clear. It is quite possible that the explanation will involve a tendency for semantic constraints from sentences before the one being processed to be forgotten or, at least, not honored. It is not possible yet to fully describe the source of this context difference. In any case it's clear that less skilled readers face problems of context as well as problems of decoding.

Summary

In this paper, I have described a model of interactive processing that is useful for describing word identification processes in discourse context. It is an example of what I called the weakly interactive type, as opposed to the strongly interactive type. It does not assume that context directly alters basic identification processes but rather that it accelerates the rate of word activation given lower-level data. While more powerful models (e.g., Rumelhart & McClelland, 1981) may prove necessary, the weakly interactive model allows a systematic account for several facts concerning reading ability. Those are that skilled readers identify words more quickly, are less affected by context, and less affected by stimulus degrading compared with less skilled readers. Finally, while less skilled readers are more dependent on context to compensate for less efficient word identification skills, they are also less able to use context to predict words. These factors obviously put less skilled readers at a double disadvantage.

References

(1) Collins, A. M. and Loftus, E. F., A spreading-activation theory of semantic processing, Psychological Review 82 (1975) 407-428.

(2) Massaro, D. W., Phonological constraints in speech perception, Psychonomic Society (1980).

(3) McClelland, J. L., On the time relations of mental processes: An examination of systems of processes in cascade, Psychological Review 86 (1979) 287-330.

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

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

(6) Perfetti, C. A., and Hogaboam, T. W., The relationship between single word decoding and reading comprehension skill, Journal of Educational Psychology 67 (1975) 461-469.

(7) Perfetti, C. A., and Roth, S., Some of the interactive processes in reading and their role in reading skill, in: Lesgold, A. M., and Perfetti, C. A. (eds.), Interactive Processes in Reading (Lawrence Erlbaum Associates, Hillsdale, 1981).

(8) Posner, M. I., and Snyder, C. R. R., Facilitation and inhibition in the processing of signals, in: Rabbitt, P. M. A., and Dornic, S.(eds.), Attention and Performance V (Academic Press, New York, 1975).

(9) Rumelhart, D., Toward an interactive model of reading, in: Dornic, S. (ed.), Attention and Performance VI (Lawrence Erlbaum Associates, Hillsdale, 1977).

(10) Rumelhart, D. E., and McClelland, J. L., Interactive processing through spreading activation, in: Lesgold, A. M.,and Perfetti, C. A. (eds.), Interactive Processes in Reading (Lawrence Erlbaum Associates, Hillsdale, 1981).

(11) Stanovich, K. E., Attentional and automatic context effects in reading, in: Lesgold, A. M.,and Perfetti, C. A. (eds.), Interactive Processes in Reading (Lawrence Erlbaum Associates, Hillsdale, 1981).

(12) Stanovich, K. E. and West, R. F., Mechanisms of sentence context effects in reading: Automatic activation and conscious attention, Memory & Cognition 7 (1979) 77-85.