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ABSTRACT

A study examined the effect of amount of intervening text on the detection of semantic inconsistencies and use of strategic backtracking, by competent and less competent college readers. Data were elicited from 40 undergraduate students (selected on the basis of their high or low scores on a variety of instruments) enrolled in an introductory course in educational psychology. Subjects read and answered accompanying comprehension questions for six passages adapted from college-level psychology texts, four passages containing inconsistencies, and two normal passages as controls. Results indicated no difference in detection rate between competent and less competent with zero, two, and four intervening sentences. With eight intervening sentences, competent readers detected significantly more inconsistencies than less competent readers. Results also revealed similar levels of strategic backtracking by competent and less competent readers with zero intervening sentences, but competent readers made greater use of rereading with two, four, and eight intervening sentences. (Two figures and one table of data are included; 15 references are attached.) (Author/KEH)

# The Effect of Amount of Intervening Text on Detection of Semantic Inconsistencies by Competent and Less Competent College Readers

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## Abstract

The present study investigated the effect of amount of intervening text on the detection of semantic inconsistencies, and use of strategic backtracking, by competent and less competent college readers. It was hypothesized that increasing levels of text separation would be more disruptive to the detection of inconsistencies by less competent readers. Results indicated no difference in detection rate between competent and less competent with 0, 2, and 4 intervening sentences. With 8 intervening sentences, competent readers (M=.95) detected signicicantly more inconsistencies than less competent (M=.50) readers. These results are discussed in terms of differential criteria used for selection and retention of sentences in working memory during coherence testing. While competent and less competent readers displayed similar levels of strategic backtracking with 0 intervening sentences, competent readers made greater use of rereading with 2, 4, and 8 intervening sentences.

The mechanisms by which readers develop an understanding of expository text remain a critical area of study in education and psychology. Theories of comprehension such as those proposed by Kintsch (1979, 1984), Kintsch & van Dijk (1978), Rumelhart (1975, 1980), Rumelhart & Ortony (1977), and Schallert (1980) propose that comprehension involves construction of knowledge through interaction with text. This process of building a coherent text representation would involve the construction of a preliminary framework for representation of the text content, and successive elaboration of, and modification to, that representation. Differences in text comprehension between competent and less competent readers may relate not only to the nature of the representations that readers construct, but also to the mechanisms readers use to assess the adequacy and coherence of the emerging text representation.

One aspect of assessing the adequacy and coherence of a text representation would involve monitoring text for consistency. Kintsch (1979; Kintsch & van Dijk, 1978) has referred to this as testing for propositional coherence. Tests of propositional coherence would be a central facet of comprehension monitoring, specifically related to the evaluation component of the comprehension monitoring process. Figure 1 presents a schematic model for coherence testing based on Kintsch (1979) and Kintsch & van Dijk (1978). According to the model, tests of propositional coherence involve seeking overlap between new propositions and a subset of existing propositions that have been retained in a working memory buffer. The buffer is assumed to be a limited capacity store; hence only a limited number of propositions may be retained as a primary basis for coherence testing. The specific propositions that are retained are a matter of selection (or default) by the reader. While several factors may mediate which

propositions are selected for retention in the buffer, two important factors identified by Kintsch are propositional importance and recency.

Differences that have been observed in the ability of competent and less competent readers to detect inconsistencies in text suggest differences in the coherence testing processe (Baker, 1979; Garner, 1980; Garner & Kraus, 1981-1982; Hare & Borchardt, 1985; Reis & Spekman, 1983). Prior research on strategic reading differences between competent and less competent readers suggests that at least some of the difference is qualitative. Competent readers have been found to make greater use of text macrostructure in comprehension tasks, and to focus on information that is of high structural importance. Less competent readers, on the other hand, tend to process material in smaller bits, relying on foregrounded information to assess new material. Less competent readers have been characterized as more linear in their approach to text comprehension. To the extent that these characterizations of competent and less competent readers apply to the selection of propositions for retention in the buffer , they may influence the nature and effectiveness of coherence testing. Specifically, competent readers may be more likely to test new information for coherence against structurally relevant propositions from previously presented information, while less competent readers may rely more on tests of local coherence among successive, or recent, propositions. To the extent that inconsistent information occurs consecutively in text, tests based on local coherence or coherence with important propositions should be equally effective in detecting the problem. Local tests of coherence, however, may be insufficient when inconsistent information is separated by an appreciable amount of noncontradictory intervening text (text separation).

The primary purpose of this research was to investigate the effect of text separation on detection of semantic inconsistencies in expository text by competent and less competent college readers. The ability of competent readers to detect text inconsistencies was predicted to be relatively unaffected by the degree of text separation between inconsistent sentences. While less competent readers were expected to detect incongruence between elements of information presented consecutively, their likelihood of detecting semantic inconsistencies was predicted to decrease relative to competent readers with increasing text separation of inconsistent sentences. The critical finding for the present hypotheses, therefore, would be a significant Reading Ability X Text Separation interaction on detection scores.

A secondary purpose of the present study to investigate whether compe .t and less competent readers displayed different pattern of strategic backtracking to reread previous portions of text following detection of inconsistencies.

## Method

Subjects: Subjects were 40 undergraduate students (8 male, 32 female) enrolled in an introductory course in educational psychology. These subjects were selected from a pool of 228 subjects who participated in a large group screening session. During the screening session, subjects were administered a variety of instruments including the Nelson-Denny Reading Test (Brown, Bennet, & Hanna, 1981). Subjects whose scores on the 36-item comprehension portion of the Nelson-Denny were among the 20 highest (M=34.05) and 20 lowest (M=18.94) were selected for participation. These scores represent the upper 5th percentile (competent readers) and lower 25th percentile (less competent readers[1]) on the

Nelson-Denny norms.

Materials: Experimental materials consisted of 6 expository passages (approximately 600 words each) adapted from college-level psychology texts. The passages dealt with topics related to material covered in the educational psychology course, but not specifically covered in the students' current program. Alternate versions of four of the passages were developed containing two sentences that were semantically inconsistent with each other. The inconsistent sentences could be placed in the sequence of the text with 0, 2, 4, or 8 intervening sentences. Although the intervening sentences were relevant to the overall passage, they were not specifically related to the contradictory information, nor did they interrupt the normal flow of the passage. In light of the research demonstrating the relatively poor performance of college students in detecting text-based semantic inconsistencies (Baker, 1979; Baker & Anderson, 1982; Clark, Forlizzi, Ward, & Brubaker, 1988), versions of these passages with the inconsistencies in consecutive sentences were subjected to multiple pilot tests to ensure that the 0-separation inconsistencies were readily detectable by competent readers. This precaution was taken to ensure sufficient "floor room" for any experimental effect to be observed.

Each passage was accompanied by three 4-choice multiple choice questions designed to assess comprehension of the main ideas in the passage. One of the questions asked specifically about the inconsistent information. Following the three comprehension questions, subjects were provided with a paraphrase of the inconsistent sentence, asked whether or not that sentence was consistent with (fit in with) everything else that they had read in the passage, and asked to provide a written example of how that information either fit in with, or was

inconsistent with, other portions of the text. This question served as a specific probe for detection of the inconsistency.

Procedures: Subjects read all six passages, the four passages containing inconsistencies, and two normal passages as controls. Passages were presented one sentence at a time on an IBM microcomputer. Subjects controlled reading time and movement through the text by pressing a predesignated key to move either to the next sentence in the passage or back to a previous sentence. For the experimental passages, records of exposure time and sequence of display of the sentences were maintained by the computer. All subjects read one of the two control passages first to become familiar with the experimental procedures. Order of the remaining five passages, and amount of intervening text between inconsistent sentences, were randomized with the constraint that all subjects received one problem passage under each level of text separation. After each passage, subjects answered the questions about the passage on an accompanying sheet before going on to the next passage.

## Results

Although performance on the passage comprehension test was not the central area of concern, total score across passages was analyzed to determine whether 1) subjects demonstrated sufficient attention to the comprehension task to render the data meaningful, and 2) performance within the experimental framework was consistent with the initial categorization of the readers into different reading ability levels. Overall performance of both competent (M=10.55) and less competent (M=9.40) readers was sufficiently high to warrant concluding that the subjects attended to the task of reading for understanding. An ANOVA of

Total Comprehension Scores indicated that the group difference was reliable ($F(1,38)=6.634$, $p=.014$).

The chief data of interest in this research were detection scores for the inconsistencies. Detection of inconsistencies was determined by subjects' responses to the specific probe on the question sheet. Subjects who indicated that the paraphrased sentence was inconsistent with other information presented in the text, and provided a concrete explanation of the nature of the inconsistency, were coded as having detected the problem. Those who indicated that the paraphrase was consistent with other information in the passage were coded as non-detectors. In three instances, subjects indicated that the paraphrase was inconsistent, but provided an explanation that was not related to the nature of the inconsistency. These were classified as instances of nondetection. All subjects provided easily categorizable explanations for their responses. Means and SD's of detection scores for competent and less competent readers for each level of text separation are presented in Table 1.

Detection scores were analyzed using a 2 X 4 (Reading Ability X Text Separation) mixed-factor analysis of variance. Reading Ability (competent vs. less competent readers) was a between subjects facors, while Text Separation (0, 2, 4, or 8 intervening sentences) was a within subjects factor. There was a significant main effect for Reading Ability ($F(1,38)=9.27$, $p<.005$), and a significant Reading Ability X Text Separation interaction ($F(3,114)=2.97$, $p<.05$). The interaction is presented in Figure 2. Since the main effect for Reading Ability is contained in the interaction, only the interaction will be discussed. Newman-Keuls contrasts indicated no difference in competent readers' detection scores across the four levels of text separation. There was no difference between competent and less

competent readers in detecting inconsistencies with 0, 2, or 4 intervening sentences, but less competent readers (M=.50) performed significantly worse than competent readers (M=.95) with 8 intervening sentences. Less competent readers' detection of inconsistencies with 8 intervening sentences was significantly lower than their detection scores at any of the other three levels of text separation.

A secondary purpose of the present investigation was to explore the use of strategic backtracking by competent and less competent readers in response to the text inconsistencies. Only those lookbacks which occurred at the inconsistent line were analyzed. These data were analyzed using a 2 X 4 (Reading Ability X Text Separation) mixed factor ANOVA. The analysis revealed a significant effect for Reading Ability ($F(1,38)=6.376$, $p=.016$) and a marginal effect for Text Separation ($F(3, 114)=2.540$, $p=.060$). Overall competent readers made greater use of backtracking, with a tendency for there to be less backtracking used with increasing levels of text separation. Perhaps more revealing are the conditional probabilities of backtracking given detection of the inconsistency by the two groups over the four levels of text separation. There was relatively little difference in the conditional probability of backtracking between competent ($p=.412$) and less competent ($p=.375$) readers when the inconsistent sentences occurred successively. For competent readers, the conditional probabilities declined somewhat slowly (.316, .278, and .267) with 2, 4 and 8 intervening sentences. For less competent readers, however, the conditional probabilities plumeted quickly (.071, .000, and .000) when the inconsistent sentences were not consecutive, with only 1 instance of backtracking at 2 intervening sentences and none at either 4 or 8 intervening sentences. These data should be treated with caution, however, in view of the

sparse use of backtracking by either group of readers.

## Discussion

The present research investigated the effect of text separation on the ability of competent and less competent readers to detect text-based semantic inconsistencies. It was hypothesized that the ability of competent readers to detect inconsistencies would be relatively unaffected by the amount of text separating the inconsistent sentences, but that less competent readers would show decreased detection of inconsistencies with increasing text separation. The present results indicate that competent readers were able to detect the inconsistencies readily at all levels of text separation investigated in the experimental paradigm. This finding is consistent with the view that the comprehension monitoring processes used by competent readers involve the tests of coherence between new information and relevant information from the text being read. The performance of the competent readers indicates that tests of propositional coherence involved in comprehension monitoring were used effectively, and that new information was compared to relevant aspects of the text representation rather than restricting comparison to recent or foregrounded information.

Although the performance of the less competent readers was comparable to that of the competent readers when the inconsistent sentences were in proximity in the text, they displayed greater difficulty in detecting inconsistencies as the distance between inconsistent sentences increased. With 8 intervening sentences, the difference was both significant and substantial. This finding is consistent with the view that less competent readers rely on more limited tests of local coherence in monitoring their comprehension. In the present data,

competent and less competent readers showed similar detection scores with 0, 2 and 4 intervening sentences. This suggests that, within the context of the experimental situation, local tests of coherence were sufficient up to at least 5 sentences. However the dramatic decrease in detection scores among less competent readers when there were 8 intervening sentences suggests that such levels of text separation exceeded the span of local coherence tests.

While these results are consistent with predictions made on the basis of hypothesized differences in the selection of propositions for use in coherence testing, a word of caution is in order. The coherence testing model allows for multiple passes through the testing process using alternative subsets of propositions when initial tests fail to find sufficient overlap. An alternate explanation based on similar initial selection of propositions by competent and less competent readers, but greater use of recursive followup tests by competent readers, could also account for the results. This explanation would imply additional time on the part of the competent readers attributable to the additional passes through the testing process. While the present investigation cannot rule out the alternate explanation, total reading time data argue against such an explanation. Competent readers (M=1185.35 ticks) took substantially less time than less competent readers (M=1460.45 ticks) at the critical 8-intervening sentence level. This, however, represents total reading time rather than time spent specifically at the inconsistent point. Additional study is warranted to clarify further the role of selection criteria in accounting for differences in detection among competent and less competent readers.

Results of the analysis of backtracking suggest that text separation influences not only

detection of inconsistencies, but also strategic repair. While both competent and less competent readers showed similar levels of backtracking with consecutive inconsistent sentences, less competent readers displayed almost no use of backtracking with non-consecutive inconsistent sentences despite some evidence of awareness of the presence of the inconsistencies. While, as noted earlier, these data should be treated with caution, they nonetheless suggest differences in the willingness of competent and less competent readers to initiate repair under more demanding repair conditions, even when there is recognition that such repair might be desirable.

## Notes

1. The terms "competent" and "less competent" are used here to describe the readers in recognition of the fact that all (?) college/university undergraduates are at least minimally competent in reading comprehension. At issue here is a comparison of groups that differ in reading ability rather than ones that represent real extremes on a comtinuum.

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Table 1

Means and SD's of Competent and Less Competent readers Detection Scores by Level of Text Separation

| | | Level of Text Separation (Number of Intervening Sentences) | | | |
|---|---|---|---|---|---|
| | | 0 | 2 | 4 | 8 |
| Competent Readers | Mean | .78 | .95 | .90 | .95 |
| | SD | .38 | .22 | .31 | .15 |
| Less Competent Readers | Mean | .80 | .70 | .75 | .50 |
| | SD | .41 | .47 | .44 | .49 |

Conditional Probabilities of Backtracking by Competent and Less Competent Readers by Level of Text Separation

| | Level of Text Separation (Number of Intervening Sentences) | | | |
|---|---|---|---|---|
| | 0 | 2 | 4 | 8 |
| Competent Readers | .412 | .316 | .278 | .263 |
| Less Competent Readers | .375 | .071 | .000 | .000 |

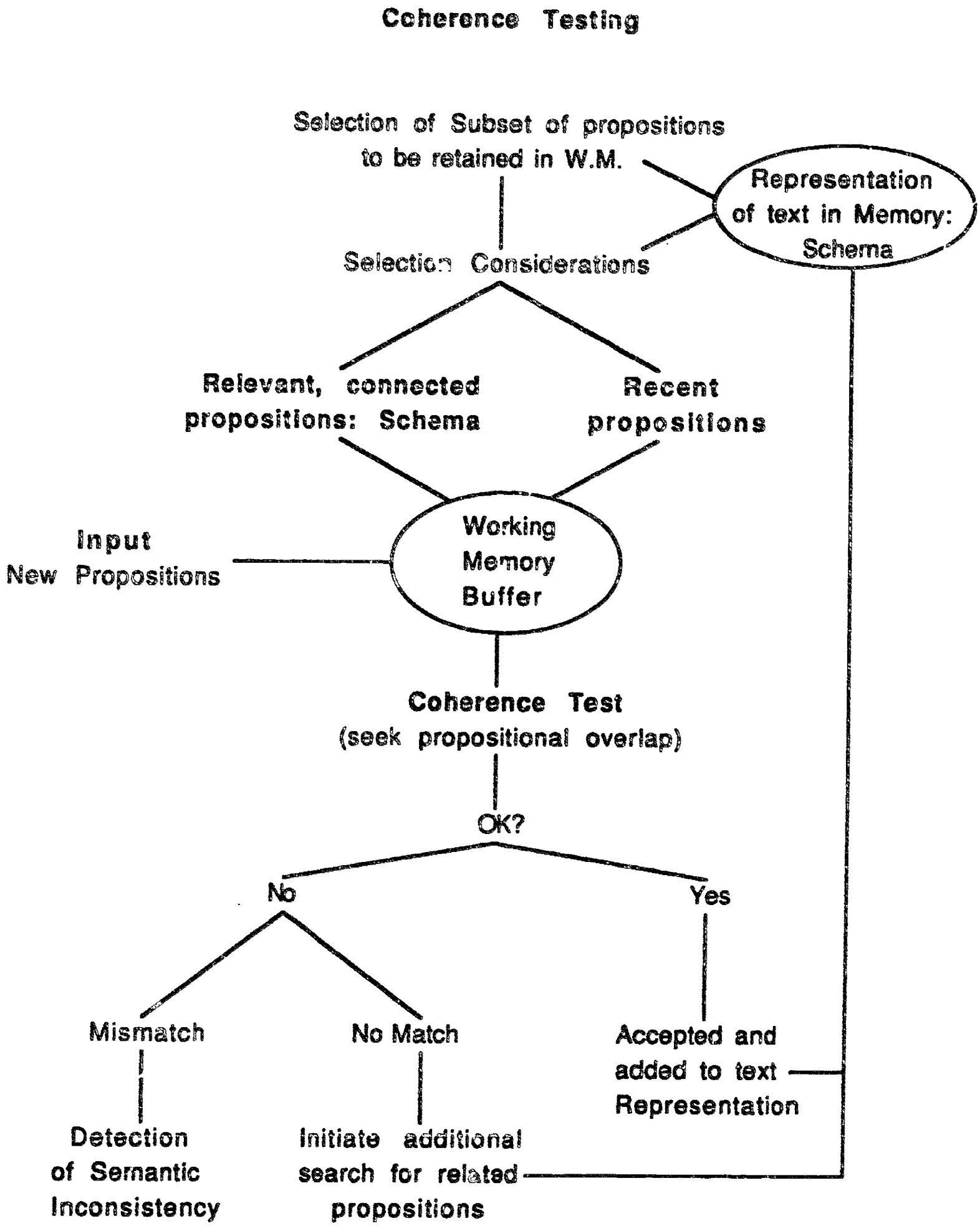
Coherence Testing
Selection of Subset of propositions to be retained in W.M.
Representation of text in Memory: Schema
Selection Considerations
Relevant, connected propositions: Schema
Recent propositions
Input New Propositions
Working Memory Buffer
Coherence Test
(seek propositional overlap)
OK?
No
Yes
Mismatch
No Match
Accepted and added to text Representation
Detection of Semantic Inconsistency
Initiate additional search for related propositions

**Figure 1**

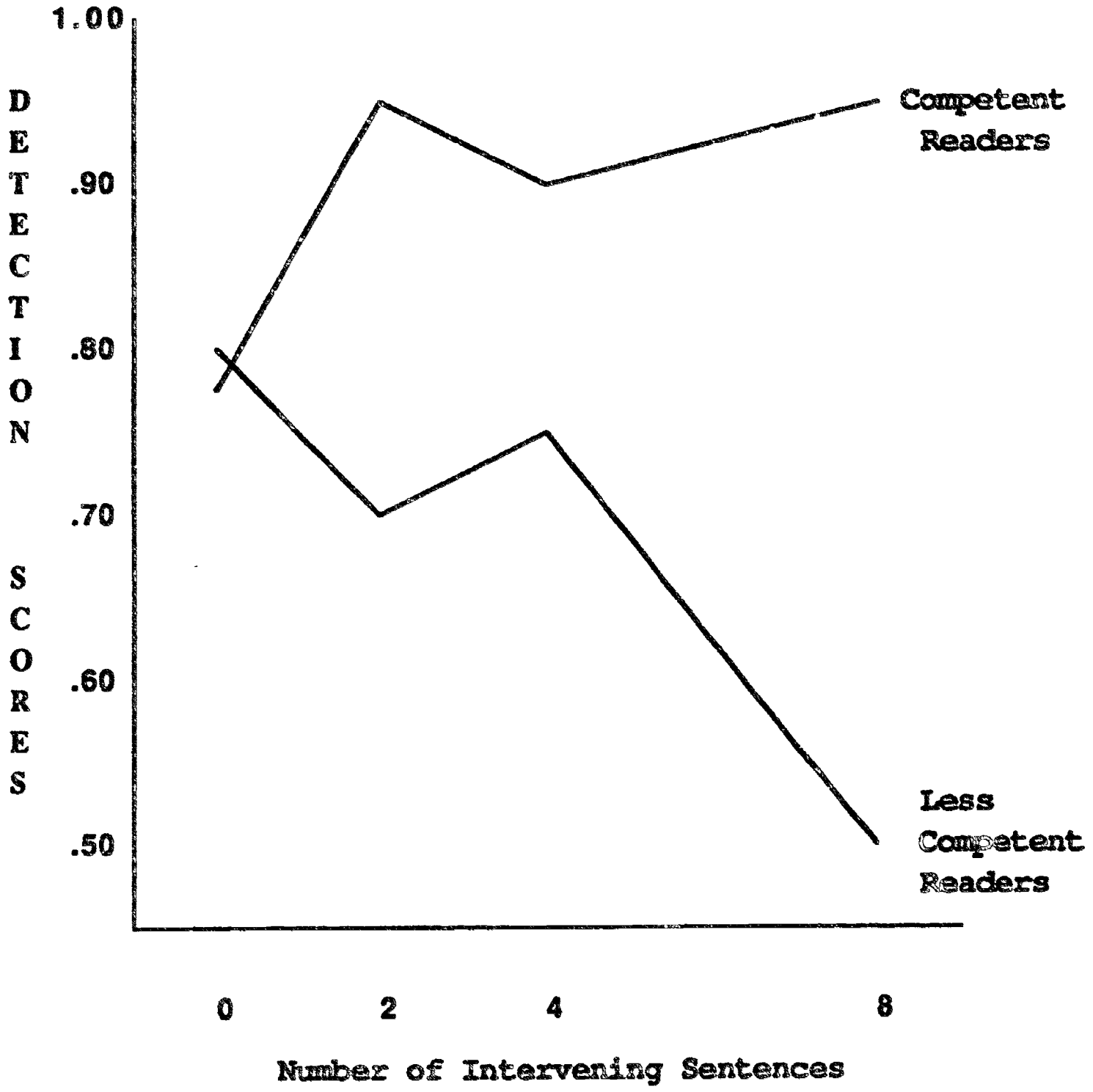
1.00
.90
.80
.70
.60
.50
DETECTION SCORES
Competent Readers
Less Competent Readers
0
2
4
8
Number of Intervening Sentences

Figure 2