

INSTITUTE OF COGNITIVE SCIENCE



*Technical Report*

University of Colorado, Boulder

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### Abstract

Subjects were given either of two variant texts, descriptions of a mythical town. One version (route) describes the town as a driver might encounter it, while the other (survey) describes the town using spatial referents. Each version is 25 sentences long, and is presented one sentence at a time in order to control the reading process.

In this study we examined the effects of multiple feedback presentations. For each text version, after reading the texts subjects were given 50 seconds to either read the entire text in paragraph form (text feedback) or see a map of the town (map feedback). They were then asked to recall as much of the text as possible and to verify the accuracy of inferential statements.

The subjects then read the same version again. Following the reading subjects were either given the same feedback type or the other. Recall and inferential reasoning protocols were obtained a second time. This led to one of four sequences: map-map, map-text, text-map, or text-text. The design was a 2 versions x 4 sequences x 2 trials. The recall protocols were scored for propositions, and the inferential reasoning was analyzed using a  $d$ -prime analysis.

ANOVA for recall yielded a doubling in the propositional levels from the first to the second reading. Although not statistically significant, the other trends confirmed previous findings. For the both text versions the recall patterns were the same. That is, the smallest increase came when the feedback provided was compatible and repeated with text version, while the largest gains were found with changes in feedback type.

ANOVA for inferential reasoning yielded several statistically significant findings: (1) there was a gain in  $d$ -prime scores between trials, (2) there was a significant interaction between text version and trial, with the survey group showing a much larger gain than the route version, and (3) a significant interaction between version, feedback type, and sequence with the survey version readers showing consistently better scores across all conditions. The route version data showed some interference between the first and second trials.

The results are described within the context of the memorial model of assisted comprehension which we are developing.

Our work concerning the contributions of instructional assistance to text comprehension, particularly feedback, represents a hybrid project (Langer & Keenan, 1984). Basically we are examining the basic relationships underlying the contributions of feedback to discourse processing. Instructional feedback is a significant problem in the educational research literature, while the study of basic mechanisms in discourse processing is more firmly entrenched in cognitive psychology.

Feedback is generally defined as some form of directed assistance subsequent to a response. Usually this takes the form of either affirmation regarding the adequacy of a response, or a negative evaluation which may include additional information designed to remediate an incomplete or inadequate answer. However, it may involve modifying covert responses, i.e., thoughts. Feedback represents a critical educational problem, since it is considered universally efficacious in just about every aspect of instruction. The general assumption among practitioners and researchers in education is that any assistance is better than no assistance (Berliner & Rosenshine, 1977). In fact, the extrapolated belief is that more assistance will lead to more of the sought outcome. This is, as we shall show, not always true, especially in the domain of text comprehension.

Indeed, our work would argue for some rather severe constraints regarding those axiomatic assumptions. Researchers in discourse processing have shown that there are just too many variables operating to assume a blanket instructional endorsement for some general kinds of assistance, much less determining the specific impact on text comprehension. For example, the processing of text appears to be a function of both text characteristics and prior knowledge of the individual reader (Frederiksen, 1977). Among the text properties investigated have been structure (Thorndyke, 1977), referential coherence (Kintsch, 1974), and argument overlap (Kintsch & van Dijk, 1978). Given this rather broad interactive state of affairs, appropriate help would not seem to be simply a matter of just introducing a general remedial panacea.

Still, our early research paradigms did follow prevailing beliefs and accepted a general positive effect for feedback on comprehension. Using the reconstruction of

scrambled text as our basic experimental model, we assumed that the scrambled text would encourage reader dependency and sensitivity to the assistance provided. Text reconstruction involved creating a sentence order which “made sense” to the reader; this we assumed would encourage deeper text processing. Our feedback procedures enabled the subject to ascertain the “appropriateness” of the developing sentence sequence. We also accepted the premise that the original text sentence order could be used as the standard for determining the adequacy of the developing sentence order in assisting comprehension (Langer, Keenan, & Culler, 1987). These rather naive assumptions were short-lived.

We found we were unable to consistently replicate experimental findings, and especially to derive significant comprehension-feedback interactions. This was due in part to the failure on our part to adequately recognize that we had three somewhat related problems: (1) how the text was being processed, which was based on text and learner characteristics, (2) a limited feedback process, and (3) a less than comprehensive set of memorial representations. We should add that these issues have not been adequately addressed together, especially in educational research dealing with reading processes. This deficiency represented both a challenge and a problem in terms of a starting conceptual model. Hence our efforts became focused on examining those critical issues which could be used to develop at least a preliminary model of memorial representations in assisted text comprehension.

Some recent changes in our program enabled us to address these major problem areas more systematically than in the past. We began by incorporating Kintsch's (1988) construction-integration paradigm of text processing. This model seemed to fit in with our prior work on text reconstruction. Additionally, a hierarchy of qualitatively differing levels of memorial representations (Kintsch, Welch, Schmalhofer, & Zimny, 1990) gave us the means for exploring a broader range of levels of comprehension outcomes. That is, Kintsch's work allowed us to examine when or at what stage in the

text processing assistance was most effective, while more sensitive and differentiated levels of memorial representation provided a more adequate set of outcome measures.

Kintsch's (1988) thesis was that the initial text propositions are formed directly from the text and then are subsequently modified by both prior reader knowledge and the subsequent text. Basically the micropropositions formed from the text are elaborated and combined into macropropositions. These macropropositions and prior knowledge help organize and elaborate subsequent text processing. Comprehension may be assessed at such levels as (1) surface representation, which is indexed by direct recall of the of verbatim text, (2) semantic meaning, defined in terms of propositional recall, and (3) a situation representation assessed by inferential reasoning. Surface and semantic memory are definitely text based. Situation memory, on the other hand, is conceived of as a mental model heavily derived from prior knowledge, and does not seem to be tied directly to the text as are surface and semantic memory (Kintsch, 1994). Although the levels appear hierarchical in terms of depth of processing and can be indexed separately, they may interact during text processing (Kintsch et al., 1990).

To incorporate these concepts into our research, we began use of a text derived from an original series of experiments by Perrig and Kintsch (1985). In their study they presented two descriptions of a mythical town called Baldwin. One version was presented as a set of sequential instructions for driving through the town (route version), while the other was presented in the context of spatial or geographic survey descriptions. The texts paralleled each other in that locations in the town are presented in the same sequence, but in the route version location was determined by references to streets and turns, while in the survey version the same place was assigned a geographical referent (e.g., east, west, etc.). As a consequence our research program underwent a number of transformations: (1) we shortly abandoned the scrambled text paradigm in order to compare our findings with Perrig and Kintsch, and (2) we began to utilize distinctively different types of feedback. The latter permitted us a better

opportunity to explore more closely possible systematic interactions between content and feedback, which were missing in our earlier data.

We modified somewhat the original descriptions of the town, renaming the village Mapleton. There are still two versions, each 25 sentences long (see Appendices A & B). Again, one is a spatial or geographic description (survey version) while the other is a sequential presentation which guides the driver through the town (route version). It is important to emphasize again that critical town features in both versions occur exactly in the same order. For example, sentence #5 for the route version reads: "As the road swings left to go up the valley Mapleton can be seen on the other side of the creek, with wooded hills behind it." Sentence #5 in the survey version reads: "At the creek the road swings north to go up the valley where Mapleton can be seen on the east side of the creek, with wooded hills behind it."

In all our experiments, the stories are typed one sentence to a card and read aloud by the subject. This enables us to control the reading process. The feedback provided has been either an opportunity to (1) view during processing a schematic map of Mapleton, (2) review a sentence just previously read, or (3) read the complete text in paragraph form at the end of processing.

The new line of research began to uncover some differential effects for feedback on comprehension, particularly for situation memory. Our data showed more compatible and less compatible effects by feedback types (Langer, Keenan, & Cumbo, 1992; Langer, Keenan, and Bergman, 1993). A more compatible type was defined as assistance provided by a feedback type congruent with the text version. That is, the map is viewed as more compatible assistance during processing of the survey version, while sentence review theoretically provides a similar function for the route description. Less compatible or incongruent assistance, was defined in terms of map feedback for the route version or sentence review and complete text for the survey version.

We then began a set of studies designed to more fully develop a model of memorial representations. In the initial study, after reading the text one sentence at a



time, regardless of the assistance provided during processing, all subjects were given the complete text. Situation memory was enhanced by the additional reading (Langer, Keenan, & Bergman, 1993). We really could not tell, however, if this assistance was responsible for the enhancement of situation memory as compared to semantic memory, or that the addition of a single text reading was inadequate for a parallel change in semantic memory. However, we did have now some preliminary evidence that the amount of feedback available yielded differential results. In addition we were now curious to see if the effect might be a function of what memorial representation was assessed first.

In a second experiment (Langer, Keenan, & Schreiner, 1993), the complete text was not only provided again after processing under all feedback conditions, but once more before the first assessment of either semantic or situation memory. Moreover, since an issue might be the order in which comprehension was assessed, we dropped surface memory as one of our indices of text comprehension and counterbalanced for order of the semantic and situation memory tasks. By providing the additional assistance of a text reading before the initial assessment, we were attempting to see if we could get a more powerful effect, as well as determine if order of testing impacted on a particular level of comprehension.

The results were quite interesting. Under the experimental conditions provided there were no significant main effects for situation memory. The picture was quite different for semantic memory. Unlike previous studies, propositional recall was greater for the survey rather than the route version. There was also a main effect for order. When testing for situation memory first, propositional recall was greater than when semantic was assessed first. An interaction effect suggested that the difference was due to the extraordinarily high recall for the survey version as compared to the route.

Although statistically non-significant we continued to find those compatible feedback effects on situation memory. Map feedback provided more assistance for the

survey version, while sentence review was more efficacious for the route version. For semantic memory the three feedback conditions were superior for the survey version.

As a result of these studies we began an initial development of our memorial model. In the past we have remarked somewhat facetiously about the ability of our college subjects to recall text, without necessarily giving indication of any processing in depth. This recall at the expense of processing may explain why programmed instruction succeeded so often at reproduction of text at the expense of transfer, representing the distinction between learning and comprehension (Kintsch, 1994). In short, too much assistance may direct the learner away from the necessity of more elaborative processing in order to satisfy task demands which stress surface or perhaps semantic representation. On the other hand, a judicious choice of feedback based on content and level of memorial representation sought, could lead to a more complex text processing.

In a similar manner McNamara (1993) postulated that a less coherent text might encourage the reader to process at a level which would include the contributions of situation memory, as well as furthering the development of a more complete mental model. In contrast, the more coherent text could encourage memorial representations which were text-based, requiring less active higher-order processing. Indeed, in our earlier work, we found that subjects who simply read the scrambled text without any attempt at reconstruction or feedback could give us the gist of the material.

It is possible, therefore, when we gave help during reconstruction, the contributions of our assistance, especially early in the process were overwhelmed by processing strategies more dependent on the text itself. Thus the assistance provided probably was of little initial help, and by the time adequate use could be made of the assistance the readers were relying primarily on internally developed strategies. This is more likely to be the case for adult readers.

Still, in the past route version subjects always showed better propositional recall. Recall is essentially a verbal string, and it is not difficult to understand how sentence

review would enhance semantic or surface recall on the route version, which is a sequentially linked pattern of driver actions. Interestingly, protocol analyses showed that while the overall order of propositional recall for the route version was not necessarily congruent with the original, there was order within clusters of propositions relating to some common referent. On other hand, the propositional evidence for the survey version would suggest that the map assistance helped support development of a mental model rather than simply increasing text coherence. In a line of research similar to ours Ferguson and Hegarty (1994) argue for the development of "cognitive maps." Survey version subjects also seemed able to produce surface verbal strings in the recall task, but these were fewer in number and coherence, although syntactically correct. For the spatially oriented survey description, it would seem that map assistance directed development of a mental model at the possible initial expense of recall. The last study in this series, however, suggested another problem insofar as providing feedback is concerned.

In a subsequent experiment we increased our efforts to determine some of the parameters underlying the relationship between memorial representations of text and feedback types. This was done by providing a second reading just prior to assessment of comprehension. In the prior study, with only one text reading immediately available for all conditions, recall for the route version proved to be superior, but only marginally, to the survey version (Langer, Keenan, & Bergman, 1993). Surprisingly, in this experiment the survey propositional recall was significantly higher. However, in terms of absolute values the mean propositional recall for the survey version was not markedly different from the previous study (40.65 vs. 39.29). What we did get was a decrease for the route version as compared to the previous study (30.95 vs. 44.20). There are a number of possible explanations concerning our findings.

The failure to find differences between text versions in inferential reasoning in this study might have been in part due to gains for the route version. It may be that additional text presentations increase their facilitative effects on situation memory for

the route version. This would suggest a specific cumulative effect for feedback type on the route version.

The semantic memory findings represent a somewhat different picture. The second text reading at least maintained the level of semantic memory for the survey group, but seemingly had a negative transfer effect on recall for the route version. In fact, when semantic memory was accessed first, after the second reading, the mean recall for survey (32.36) was also greater than for route (26.89).

This would raise several issues. The first is that the differences between what we call more compatible and less compatible may also reside in how much is provided. For example, more of the same previously positive assistance may begin to have a deleterious effect on one memorial representation at the expense of another. Second, this data represents to us less of a hierarchical model in levels of memorial representation. Parallel development would be a more consistent explanatory tool for both positive and negative feedback contributions.

At this point, we now assume that regardless of feedback and content type, all readers initially base their strategies on the surface representation. Subsequently semantic and situation memory emerge in a more parallel and interactive fashion. The nature of the development and interaction seems to be a function of both content and feedback type. We should emphasize that this model is based on assisted text comprehension. After all, we are adding to the internal text processing an externally directive influence. Kintsch's hierarchical model may well represent the case for unassisted expository discourse.

Going back to a point made previously, we began to wonder if through our various manipulations, which involved multiple feedback presentations, we were not dealing with a transfer problem. This study was designed to address the issue more directly. This required several changes.

First of all, instead of providing feedback during processing, the feedback was to be given after the text had been completed. Basically, all subjects received an equal

amount of feedback, which is not necessarily true when subjects select the amount of feedback given during processing. Second, because feedback was not given during the reading, sentence review as a feedback condition was not possible. Instead, the entire text or the map was given after processing.

### Method

Subjects were 56 General Psychology students at the University of Colorado. Texts for both versions (route and survey) were printed one sentence to a card. Two feedback conditions were provided: (1) in the map condition, subjects after reading all the sentences were allowed to look at a schematic map of Mapleton for 50 seconds, and (2) in the text condition, subjects after reading all the sentences could study the entire text up to 50 seconds. They then were given the semantic and situation memory tasks.

After completing the measures, the subjects were assigned to one of the following conditions. First, half the subjects were given the same text version a second time, with the same feedback condition. If they read the route version with text assistance, the process was repeated. The other half of the subjects were also given the same text version again, but the feedback conditions were changed. Thus if they had received the map feedback condition for the first text reading, they were given the text condition for the second reading. Similarly, those receiving the text feedback condition the first time used the map the second time. They were then tested again on the semantic and situation memory tasks. This gave us a 2 (text version: route or survey)  $\times$  4 (feedback sequence: text-text, map-map, map-text, text-map)  $\times$  2 tasks. Version and sequence are between subjects, while tasks is a repeated measure. All conditions were given within each set of eight replications.

To assess semantic memorial representation, subjects are asked to write down what they remembered about the town regardless of order. The recall protocol is scored for number of propositions (see Appendices C and D). The route version consists of 25 sentences, 489 words, and 215 atomic propositions. The survey version contains 25

sentences, 497 words, and 225 atomic propositions. The passages are comparable both in terms of word length and number of propositions.

Situation memory is assessed in terms of inferential reasoning (Langer, Keenan, & Bergman, 1993). In this instance all subjects are presented with a 32-card deck. The items consist of original sentences from both versions as well as new sentences. The latter are paraphrases written in either the route or survey style, and can be either true or false. Subjects read each sentence aloud, and decided whether the sentence was true or false. It follows that an original sentence from either version is by definition true, but paraphrases can be either true or false. In scoring for verification an original sentence from the route version would be a correct inference for a reader of the survey text, while an original sentence from the survey text is a correct inference for those reading the route version. Paraphrases were scored as correct or incorrect inferences for readers of either text, regardless of style. Conversely an original survey sentence for survey text readers (or route for route readers) may be considered "true," by the subjects, but these sentences represent surface rather than situation memory.

### Results

Recall was determined by the number of atomic propositions in the first and second protocols. ANOVA is given in Table 1.

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Insert Table 1 about here

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The statistically significant finding was that for tasks ( $F = 217.87$ ,  $df = 1,48$ ,  $p = .0001$ ). The mean for both groups on the first recall was 26.4, and 51.7 on the second. While there were no statistically significant interaction effects, a graphic analysis shows some consistent results.

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Insert Fig. 1 about here

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Insert Fig. 2 about here

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For both text versions the smallest gains were made under conditions where the feedback conditions provided were both more compatible and repeated. Thus, for the route version, under repeated text feedback the mean gain was 18.9, while for the survey version the smallest gain (20.6) was within the repeated map condition.

On the other hand the largest gains were not only found when the feedback condition was changed for the second trial, but when the change was from a less compatible to a more compatible type. When the route text subjects went from map to text, the gain in recall scores was 30.2, while for the survey text readers the mean gain of 30.3 was found within the text to map sequence.

As in previous studies, inferential reasoning was assessed using a  $d$ -prime analysis. Several statistically significant findings were obtained. There was a

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Insert Table 2 about here

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significant gain in  $d$ -prime scores ( $F = 9.18$ ,  $df = 1, 48$ ,  $p = .01$ ) from the first trial (1.29) to the second trial (1.60). There was moreover a significant interaction between trial and version ( $F = 6.59$ ,  $df = 1, 48$ ,  $p = .05$ ). The route version subjects showed practically no change between the two trials (1.27 to 1.30), while the survey subjects showed a large jump (1.31 to 1.87). Perhaps most critical was the significant triple interaction between version, trail, and sequence ( $F = 3.48$ ,  $df = 3, 48$ ,  $p = .05$ ). The means are presented in Table 3.

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Insert Table 3 about here

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The results can also be viewed graphically, paralleling the recall data. For the route version, map assistance yielded both the highest initial  $d$ -prime mean (1.68) and repeated measurement (1.71). However there were decreases in verification accuracy

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Insert Fig. 3 about here

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when the initial feedback was either map assistance (1.27) followed by text (1.15) or text (1.24) followed by map (1.15). When text feedback was repeated the mean increase in accuracy was from .90 to 1.25.

For the survey version in all cases the  $d$ -primes for the second testing were substantially higher both in absolute magnitude and increases from the first testing. The gains in the map-map (1.28-1.90), text-map (1.19-1.87), and text-text (1.33-1.99),

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Insert Fig. 4 about here

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conditions were about equal. Without exception the inferential means for the survey version were higher on both trials in each sequence.

#### Conclusion

The data trends follow previous research which suggest differential effects on memorial representations of text variants. Basically, situation memory for the survey version was most impacted. The data for recall while only suggestive, was interesting



in that the findings paralleled each other for both text versions. It appeared that supplying the same type of assistance twice resulted in the least gains, while moving from less compatible to more compatible assistance achieved the greatest gains. One possibility is that supplying a compatible alternative increased the amount of information available to the initial semantic memorial representation. For example, recalling the route version text may have been helped some by a map, but the complete text probably provided more detail. The net effect was interactive but positive.

In a similar manner text assistance following the survey version may have initially helped semantic memory to some extent, but the map further enhanced general recall. Again we feel that the interactive and positive transfer was simply not present when the feedback condition was repeated. In fact, the repeated feedback type conditions may have represented practice effects.

The inferential reasoning results also follow previous data patterns, not only with respect to differential effects as contrasted with recall, but also the superiority of the survey text readers for situation memory. Thus we find that the highest achievement (1.68-1.71) for the route version was for those assisted within the map-map condition, while the largest absolute gains (although the mean levels were considerably lower: .90-1.25) were within the text-text condition. A change in feedback conditions for the route version resulted in a decrease in achievement, suggesting some type of interactive interference.

As in previous studies the survey text readers had overall a much better performance for inferential reasoning, with gains in across sequences. Reading the survey version insofar as inferential reasoning is concerned suggests general positive transfer with additional assistance. It is possible that once the construction of a mental model is initiated through text processing and some assistance, additional assistance may be helpful regardless of compatibility. That is, the memorial representation may be more flexible in the use of the feedback provided perhaps because it is more of a general

model. Obviously this is not quite true for the route version, which yields a more linear and tightly coherent representation.

In summary our data continue to support not only the differential effects of feedback type on text variants, but our model of parallel and interactive semantic-situation memorial representations seems to hold on this study.

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Table 1  
ANOVA: Recall

SOURCE	df	SS	MS	F	<i>p</i>
Subjects (Ss)	55	19,605.25			
Version (V)	1	558.03	558.03	1.48	
Sequence (Sq)	3	331.75	110.58	0.29	
VxSq	3	624.32	208.10	0.55	
Ss (VxSq)	48	18,092.15	376.91		
Trials (Tr)	1	17,952.89	17,952.89	217.87	.000
SqxTr	55	4,379.11			
VxTr	1	0.04	0.04	0.0004	
SxTr	3	254.46	84.82	1.02	
VxSxTr	3	169.04	56.34	0.68	
Ss(VxSq)xTr	48	3,955.57	82.40		

Table 2  
ANOVA: Inferences

SOURCE	df	SS	MS	F	<i>p</i>
Subjects (Ss)	55	51.41			
Version (V)	1	2.42	2.42	2.74	
Sequence (Sq)	3	1.51	.51	.57	
VxSq	3	5.14	1.71	1.94	
Ss (VxSq)	48	42.35	.88		
Tr (Trials)	1	2.66	2.66	9.18	.01
SqxTr	55	19.41			
VxTr	1	1.91	1.91	6.59	.05
SxTr	3	.56	.19	.64	
VxSxTr	3	3.01	1.01	3.48	.05
Ss(VxSq)xTr	48	13.93	.029		

Table 3

Means: Version x Trials x Sequence

Version

Feedback Sequence	Route		Survey	
	Trial 1	Trial 2	Trial 1	Trial 2
Text:Text	1.21	1.25	1.33	1.99
Text:Map	1.24	1.15	1.19	1.87
Map:Text	1.27	1.15	1.41	1.74
Map:Map	1.68	1.71	1.28	1.90

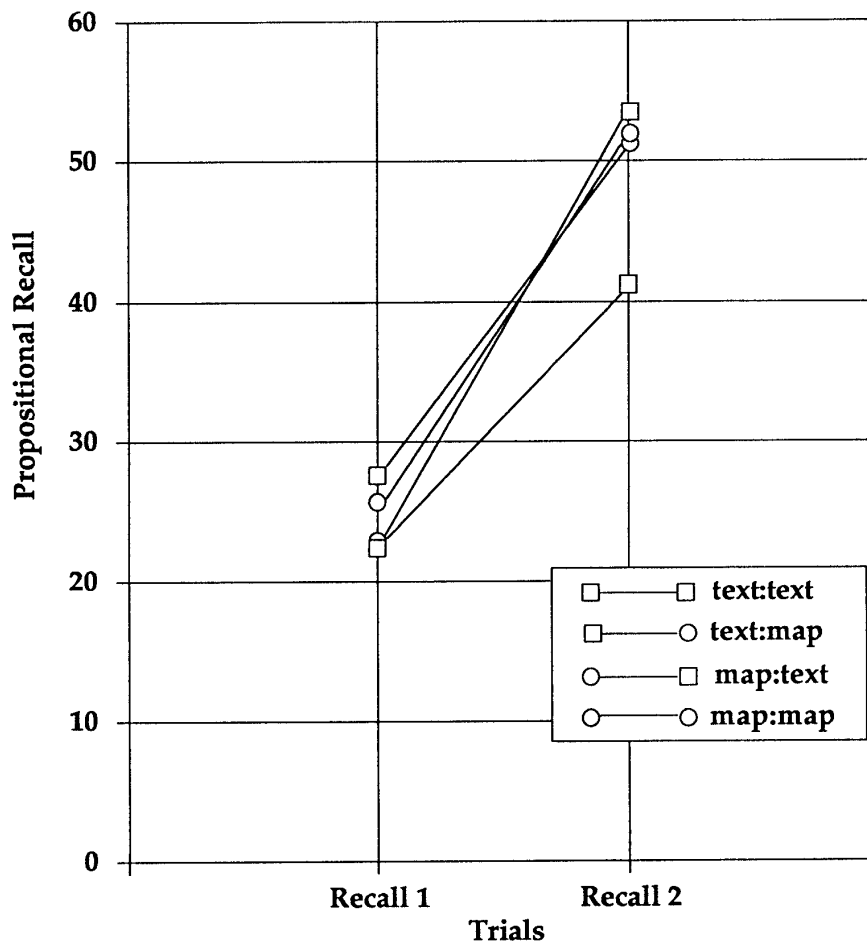


Figure 1. Sequence recall means: route version





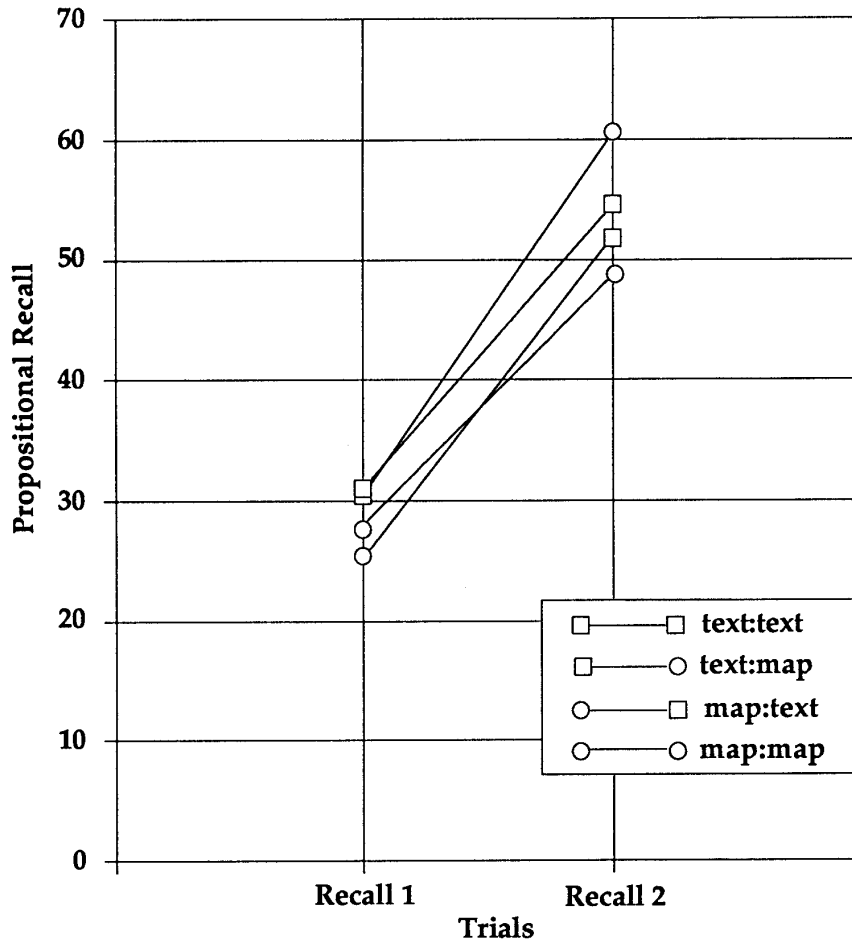


Figure 2. Sequence recall means: survey version

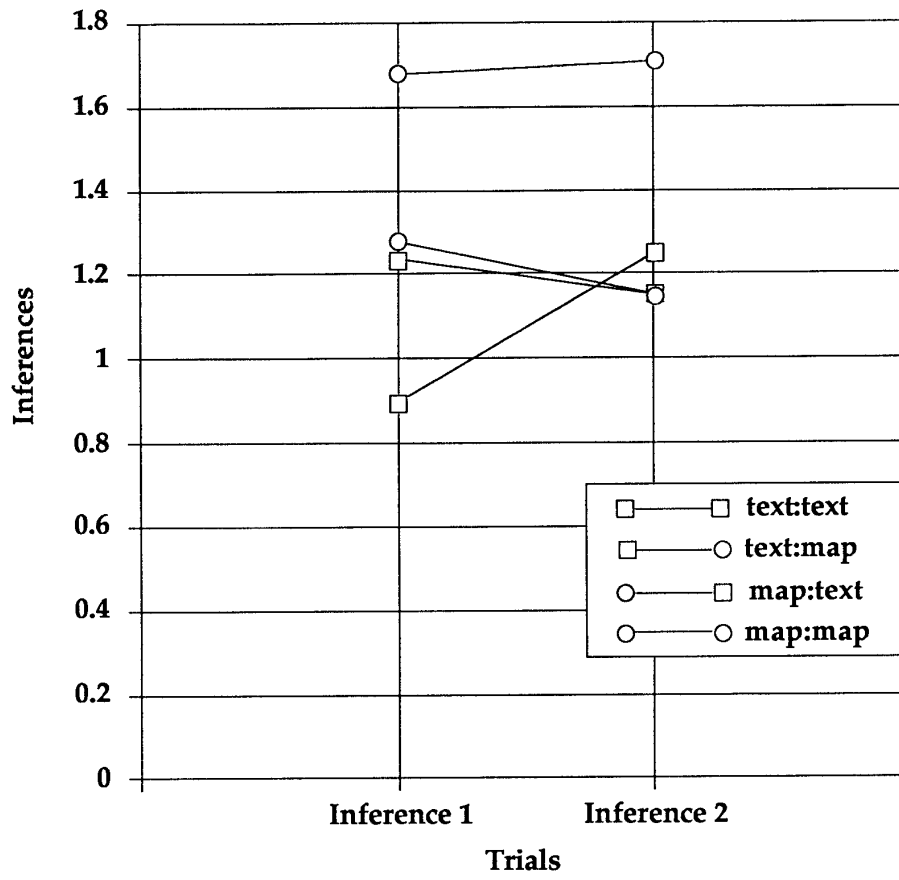


Figure 3. Sequence inference means: route version

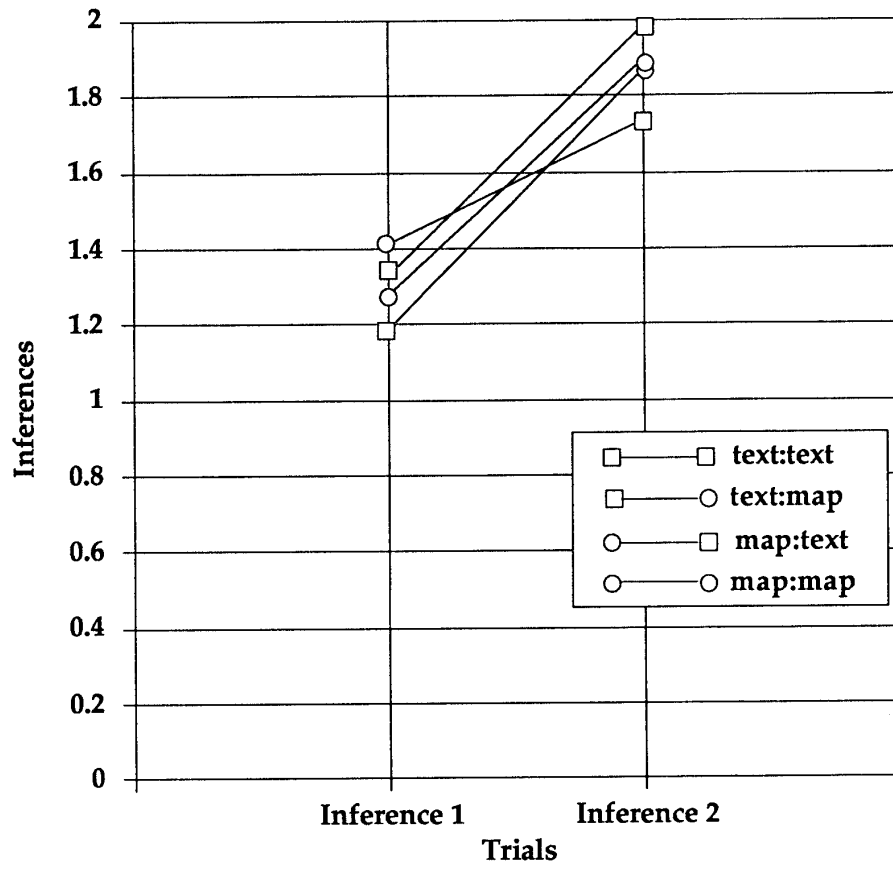


Figure 4. Sequence inference means: survey version

## APPENDIX A

NEW MAPLETON: BY SENTENCE  
Temporal (route) Version

1. Let me tell you about a town called Mapleton where I spent a week on vacation last year.
2. As you drive east toward Biggcity you cross Deer Creek and that is where you will find this little town.
3. The highway runs along the base of the hills before you get to the creek with pasture on the uphill side of the road.
4. On the right side are flat fields of corn and beans, and white barns with red roofs.
5. As the road swings left to go up the valley Mapleton can be seen on the other side of the creek, with wooded hills behind it.
6. Before you get to the bridge there are some small homes along the roadside and then you pass the highschool on your right.
7. Just past the highschool is a small gas station with the shop in the back.
8. At the bridge is an old general store where the young people hang out after school.
9. If you look upstream from the bridge to where the creek runs out of the hills, the Mapleton Inn is just visible on the far side.
10. I could fish up the stream from the Inn or hike in the woods behind it, or just lie around the pool and turn brown.
11. The Inn is old but kept in top condition, and the meals were superb.
12. Crossing the bridge you will see the Canyon Road that goes up to the Inn and disappears behind a bluff.
13. On the town side of the bridge the highway turns back down the creek with the town on your left.
14. There is a light at Main Street where you turn left to go into town.
15. A small business section extends about four blocks along both sides of the street with the newer shops farther from the creek.

16. Mapleton Park is on the left side of the street in the second block and on nice days oldtimers sit on benches watching the traffic.
17. The gray stone building on Main Street is Town Hall with the library upstairs and Police Department in back.
18. The tallest building in town is Holy Savior Lutheran Church which shows its steeple between Town Hall and the creek.
19. Just south across from Holy Savior is St. Catherine's Church, a small but solid red brick building.
20. On the hill behind Town Hall are the older homes, white frame houses shaded by big old silver maples.
21. Newer homes are across town and down toward the highway where it leaves the creek.
22. Main Street turns into a country road out of town and meets the highway again after a few miles.
23. I drove to the end of town once but there is nothing to see except corn fields.
24. If you just stay on the highway it goes down the valley past the town and turns away from the creek.
25. It is too bad that so many drivers pass through town without enjoying the leisure Mapleton offers.

## APPENDIX B

NEW MAPLETON: BY SENTENCE  
Spatial (survey) Version

1. Let me tell you about a town called Mapleton where I spent a week on vacation last year.
2. As you drive east toward Biggcity you cross Deer Creek and that is where you will find this little town.
3. The highway runs along the south side of the hills west of the creek, with pasture on the hills to the north.
4. On the south side are flat fields of corn and beans, and white barns with red roofs.
5. At the creek the road swings north to go up the valley where Mapleton can be seen on the east side of the creek, with wooded hills behind it.
6. At the west end of town are some small homes along the roadside and closer to the creek is the school.
7. Just past the highschool is a small gas station with the shop in the back.
8. At the bridge is an old general store where the young people hang out after school.
9. If you look upstream from the bridge to where the creek runs south out of the hills, the Mapleton Inn is just visible on the east side.
10. I could fish the stream north from the Inn or hike in the woods behind it, or just lie around the pool and turn brown.
11. The Inn is old but kept in top condition, and the meals were superb.
12. East of the bridge is the Canyon Road that goes north to the Inn and disappears behind a bluff.
13. On the east side of the bridge the highway turns back south along the creek with the town further east.
14. There is a light at Main Street where you turn east to go into town.
15. A small business section extends east about four blocks along both sides of the street with the newer shops farther from the creek.

16. Mapleton Park is on the north side of the street in the second block east and on nice days oldtimers sit on benches watching the traffic.
17. The gray stone building on Main Street is Town Hall with the library upstairs and Police Department in back.
18. The tallest building in town is Holy Savior Lutheran Church which shows its steeple west of Town Hall toward the creek.
19. Just south across from Holy Savior is St. Catherine's Church, a small but solid red brick building.
20. On the hill north of Town Hall are the older homes, white frame houses shaded by big old silver maples.
21. Newer homes are south of Main down toward the highway where it turns , east from the creek.
22. Main Street turns into a country road east of town and then goes south to meet the highway again.
23. I drove out east once but there is nothing to see except corn fields.
24. The highway turns south to go back down the valley past the town and turns away from the creek toward the city to the east.
25. It is too bad that so many drivers pass through town without enjoying the leisure Mapleton offers.

APPENDIX C  
NEW MAPLETON: PROPOSITIONS

Conventions:

General Principles to ease scoring decisions

1. Approximate original words and sequence.
2. Minimize length, including predicate, "molecular."

Identification Number (first column)

3. Numbered within sentences e.g. 0210 = proposition 10, sentence 2.

Predicates (second column)

1. Verbs, modifiers, connectives, and some prepositions.
2. Some are two-word, hyphenated, e.g. verb-conjunction.
3. Brackets indicate [implicit predicate].

Arguments (third column)

1. Arguments are noun and pronoun phrases and other propositions.
2. Separated by commas, e.g. "loves George, bananas".
3. Brackets indicate [implicit argument] from within the same sentence.
4. Slash indicates proposition, usually by /predicate/ only.

Temporal (route) Version

0101	tell-about	me, you, town
0102	called	[town], Mapleton
0103	spend	I, week
0104	where	/spend/, [Mapleton]
0105	on	/spend/, vacation
0106	[when]	/spend/, /last/
0107	last	year
0201	as	/drive/, /cross/
0202	drive	you
0203	east	/drive/
0204	toward	/drive/, Biggcity
0205	cross	you, Creek
0206	Deer	[Creek]
0207	and	/cross/, /find/
0208	find	you, town
0209	little	[town]
0210	this	[town]



0301	runs-along	highway, base
0302	of	[base], hills
0303	on	/runs-along/, side
0304	this	[side]
0305	of	[side], creek
0306	with	/runs-along/, pasture
0307	on	[pasture], side
0308	uphill	[side]
0309	of	[side], road
0401	on	side
0402	right	[side]
0403	are	fields, /on/
0404	flat	[fields]
0405	of	[fields], /and/
0406	and	corn, beans
0407	and	[fields], [barns]
0408	white	barns
0409	with	[barns], roofs
0410	red	[roofs]
0501	as	/swings/, /can-be-seen/
0502	swings	road, left
0503	to-go-up	/swings/, valley
0504	can-be-seen	Mapleton
0505	on	/can-be-seen/, side
0506	other	[side]
0507	of	[side], creek
0508	with	[Mapleton], hills
0509	wooded	[hills]
0510	behind	[hills], it [Mapleton]
0601	before	/get/
0602	get	you, /to/
0603	to	bridge
0604	are	homes
0605	some	[homes]
0606	small	[homes]
0607	along	/are/, roadside
0608	and	/get/, /pass/
0609	pass	you, highschool
0610	then	/pass/
0611	on-right	[highschool]

0701	is	station
0702	small	[station]
0703	gas	[station]
0704	just-past	/is/, highschool
0705	with	/is station/, shop
0706	in-back	[shop]
0801	at	bridge
0802	is	store, /at/
0803	old	[store]
0804	general	[store]
0805	where	/is/, /hang-out/
0806	hang-out	people
0807	young	[people]
0808	after	/hang out/, school
0901	if	/look/, /is/
0902	look	you
0903	up-stream	/look/
0904	from	/look/, bridge
0905	to	/look/, /where/
0906	where	/runs/
0907	runs	creek
0908	out-of	/runs/, hills
0909	is	Mapleton Inn
0910	visible	/is/,
0911	on	/is/, side
0912	far	/side/
1001	could-fish	I
1002	up-stream	/could-fish/
1003	from	/up-stream/, Inn
1004	or1	/could-fish/, /(could) hike/
1005	[could] hike	[I]
1006	in	/[could] hike/, woods
1007	behind	[woods], it [Inn]
1008	or2	/or1/, /lie-around/
1009	lie-around	[I], pool
1010	and	/lie-around/, /turn/
1011	turn	brown

1101	is	Inn, old
1102	but	/is/, /is-kept/
1103	is-kept	[Inn]
1104	in	/is-kept/, condition
1105	top	[condition]
1106	and	/is-kept/, /were/
1107	were	meals, superb
1201	crossing	you, bridge
1202	will-see	[you], Canyon Road
1203	goes	[Canyon Road], /up-to/
1204	up-to	/goes/, Inn
1205	and	/goes/, /disappears/
1206	disappears	[Canyon Road]
1207	behind	/disappears/, bluff
1301	on	side
1302	town	[side]
1303	of	/town/, bridge
1304	turns	highway, /on/
1305	back	/turns/, /down/
1306	down	creek
1307	with	/turns/, town
1308	on	[town], left
1401	is	light
1402	at	/is/, Main Street
1403	where	/is/, /turn/
1404	turn	you, left
1405	to-go	/turn/, /into/
1406	into	/to-go/, town
1501	extends	business section
1502	small	[business section]
1503	about-four	/extends/, blocks
1504	along	/extends/, sides
1505	both	[sides]
1506	of	/both/, street
1507	with	[business section], shops
1508	newer	[shops]
1509	farther-from	/newer shops/, creek

1601	is	Park
1602	Mapleton	[park]
1603	on	/is/, side
1604	left	[side]
1605	of	/left/, street
1606	in	/is/, block
1607	second	[block]
1608	and	/is/, /sit/
1609	sit	oldtimers
1610	on	/sit/, days
1611	nice	[days]
1612	on	/sit/, benches
1613	watching	[oldtimers], traffic
1701	is	building, Town Hall
1702	stone	building
1703	gray	/stone/
1704	on	/is/, Main Street
1705	with	[Town Hall], /and/
1706	upstairs	library
1707	and	/upstairs/, /in-back/
1708	in-back	Police Department
1801	is	building, Church
1802	tallest	[building]
1803	in-town	/tallest/
1804	Lutheran	[Church]
1805	Holy Saviour	/Lutheran/
1806	shows	which [church], steeple
1807	between	/shows/, /and/
1808	and	Town Hall, creek
1901	across-from	/is/, Holy Savior
1902	south	/across-from/
1903	just	/south/
1904	is	Church
1905	St.Catherine's	[Church]
1906	small	/is/, building
1907	solid	[building]
1908	but	/small/, /solid/
1909	brick	[building]
1910	red	/brick/

2001	are	homes
2002	older	[homes]
2003	on	/are/, hill
2004	behind	[hill], Town Hall
2005	white	/are/, houses
2006	frame	[houses]
2007	shaded	[houses]
2008	by	/shaded/, maples
2009	big	[maples]
2010	old	[maples]
2011	silver	[maples]
2101	are	homes
2102	newer	[homes]
2103	across	/are/, town
2104	and	/across town/, /down-toward/
2105	down-toward	/are/, highway
2106	where	/are/, /leaves/
2107	leaves	it [highway], creek
2201	turns-into	Main Street, road
2202	country	[road]
2203	out-of	/turns-into/, town
2204	and	/turns-into/, /meets/
2205	meets	[Main Street], highway
2206	again	/meets/
2207	after	/meets/, miles
2208	few	[miles]
2301	drove	I
2302	once	/drove/
2303	to	/drove/, end
2304	of	[end], town
2305	but	/drove/, /is/
2306	is	nothing
2307	to-see	[nothing]
2308	except	[nothing], cornfields
2401	stay-on	you, highway
2402	if	/stay-on/, /goes/
2403	goes	it [highway]
2404	down	/goes/, valley
2405	past	/goes/, town
2406	and	/goes/, /turns/
2407	turns	[highway]
2408	away-from	/turns/, creek

2501	is	too-bad,
2502	that	/is/, /pass-through/
2503	pass-through	drivers, town
2504	so-many	[drivers]
2505	without	/pass-through/, /enjoying/
2506	enjoying	leisure
2507	offers	Mapleton, [leisure]

## APPENDIX D

NEW MAPLETON  
Spatial (survey) Version

0101	tell-about	me, you, town
0102	called	[town], Mapleton
0103	spend	I, week
0104	where	/spend/, [Mapleton]
0105	on	/spend/, vacation
0106	[when]	/spend/, /last/
0107	last	year
0201	as	/drive/, /cross/
0202	drive	you,
0203	east	/drive/
0204	toward	/drive/, Biggcity
0205	cross	you, Creek
0206	Deer	[Creek]
0207	and	/cross/, /find/
0208	find	you, town
0209	little	[town]
0210	this	[town]
0301	runs-along	highway, side
0302	south	[side]
0303	of	[side], hills
0304	on	/runs along/, side
0305	west	[side]
0306	of	[side], creek
0307	with	/runs-along/, pasture
0308	on	[pasture], hills
0309	to	[hills], north
0401	on	side
0402	south	[side]
0403	are	fields, /on/
0404	flat	[fields]
0405	of	[fields], /and/
0406	and	corn, beans
0407	and	[fields], [barns]
0408	white	barns
0409	with	[barns], roofs
0410	red	[roofs]

0501	at	creek
0502	swings	/at/, road
0503	north	/swings/
0504	to go up	/north/, valley
0505	where	/can-be-seen/, [valley]
0506	can-be-seen	Mapleton, /on/
0507	on	side
0508	east	[side]
0509	of	[side], creek
0510	with	/can-be-seen/, hills
0511	wooded	[hills]
0512	behind	[hills], it[Mapleton]
0601	at	/are/, end
0602	west	[end]
0603	of	/west/, town
0604	are	homes
0605	small	[homes]
0606	along	/are/, roadside
0607	and	/are/, /is/
0608	is	school
0609	closer-to	/is/, creek
0701	is	station
0702	small	/is/
0703	gas	/is/
0704	just-past	/is/, highschool
0705	with	/is/, shop
0706	in-back	[shop]
0801	at	bridge
0802	is	store, /at/
0803	old	[store]
0804	general	[store]
0805	where	/is/, /hang-out/
0806	hang-out	people
0807	young	[people]
0808	after	/hang out/, school



0901	if	/look/, /is/
0902	look	you
0903	upstream	/look/
0904	from	/look/, bridge
0905	to	/look/, /where/
0906	where	/runs/
0907	runs	creek
0908	south	/runs/, /out-of/
0909	out-of	hills
0910	is	Mapleton Inn
0911	visible	/is/
0912	just	/visible/
0913	on	/is/, side
0914	east	[side]
1001	could-fish	I
1002	up-stream	/could-fish/
1003	from	/up-stream/, Inn
1004	or 1	/could-fish/, /[could] hike/
1005	[could] hike	[I]
1006	in	/[could] hike/, woods
1007	behind	[woods], it [Inn]
1008	or 2	/or 1/, /lie-around/
1009	lie-around	[I], pool
1010	and	/lie-around/, /turn/
1011	turn	brown
1101	is	Inn, old
1102	but	/is/, /is-kept/
1103	is-kept	[Inn]
1104	in	/is-kept/, condition
1105	top	[condition]
1106	and	/is-kept/, /were/
1107	were	meals, superb
1201	east-of	bridge
1202	is	Canyon Road, /east-of/
1203	goes	[Canyon Road], north
1204	to	/goes/, Inn
1205	and	/goes/, /disappears/
1206	disappears	[Canyon Road]
1207	behind	/disappears/, bluff

1301	on	side
1302	east	[side]
1303	of	/east/, bridge
1304	turns	highway, /on/
1305	back	/turns/, south
1306	along	/turns/, creek
1307	with	[highway], town
1308	further	/with/, east
1401	is	light
1402	at	/is/, Main Street
1403	where	/is/, /turn/
1404	turn	you, east
1406	to-go	/turn/, /into/
1407	into	/to-go/, town
1501	extends	business section
1502	small	[business section]
1503	east	/extends/
1504	four	/extends/, blocks
1505	about	/four/
1506	along	/extends/, sides
1507	both	[sides]
1508	of	/both/, street
1509	with	[business section], shops
1510	newer	[shops]
1511	farther-from	/newer/, creek
1601	is	Park
1602	Mapleton	[Park]
1603	on	/is/, side
1604	north	[side]
1605	of	[side], street
1606	in	/is/, block
1607	second	[block]
1608	east	/second/
1609	and	/is/, /sit/
1610	sit	oldtimers
1611	on	/sit/, days
1612	nice	[days]
1613	on	/sit/, benches
1614	watching	[oldtimers], traffic

1701	is	building, Town Hall
1702	stone	building
1703	gray	/stone/
1704	on	/is/, Main Street
1705	with	[Town Hall], /and/
1706	upstairs	library
1707	and	/upstairs/, /in-back/
1708	in-back	Police Department
1801	is	building, church
1802	tallest	[building]
1803	in-town	/tallest/
1804	Lutheran	[Church]
1805	Holy Savior	/Lutheran/
1806	shows	which [Church], steeple
1807	west-of	/shows/, Town Hall
1808	toward	/shows/, creek
1901	across-from	/is/, Holy Savior
1902	south	/across-from/
1903	just	/south/
1904	is	Church
1905	St. Catherine's	[Church]
1906	small	/is/, building
1907	solid	[building]
1908	but	/small/, /solid/
1909	brick	[building]
1910	red	/brick/
2001	are	homes
2002	older	[homes]
2003	on	/are/, hill
2004	north-of	[hill], town
2005	white	/are/, houses
2006	frame	[houses]
2007	shaded	[houses]
2008	by	/shaded/, maples
2009	big	[maples]
2010	old	[maples]
2011	silver	[maples]

2101	are	homes
2102	newer	[homes]
2103	south-of	/are/, Main
2104	down-toward	/are/, highway
2105	where	[highway], /turns/
2106	turns	it [highway]
2107	east	/turns/
2108	from	/east/, creek
2201	turns-into	Main Street, road
2202	country	[road]
2203	east-of	/turns-into/, town
2204	and	/turns-into/, /goes/
2205	goes	[Main Street], south
2206	to-meet	/goes/, highway
2007	again	/to-meet/
2301	drove-out	I
2302	east	/drove-out/
2303	once	/drove out/
2304	but	/drove-out/, /is/
2305	is	nothing
2306	to-see	[nothing]
2307	except	[nothing], cornfields
2401	turns	highway, south
2402	to-go	/turns/, down
2403	back	[down]
2404	down	/to-go/, valley
2405	past	/to-go/, town
2406	and	/turns/, /turns-away]
2407	turns-away	[highway]
2408	from	/turns-away/, creek
2409	toward	/turns-away/, city
2410	east	[city]
2501	is	too-bad,
2502	that	/is/, /pass-through/
2503	pass-through	drivers, town
2504	so-many	[drivers]
2505	without	/pass-through/, /enjoying/
2506	enjoying	leisure
2507	offers	Mapleton, [leisure]



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