Bulletin of the Psychonomic Society
1992, 30 (5), 373-376

The effects of text version and feedback type on memorial representations

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Subjects read, sentence by sentence, one of two versions of a text describing a small town. The route version described the town as a driver might encounter it, and the survey version represented the town in spatial terms. Three feedback conditions were used. One group of readers had limited access to a map. The second group could reread a limited number of sentences. The third group read the entire version in paragraph form. There were no differences between conditions in semantic memory, defined as order and number of propositions recalled, or in surface memory, defined as recognition of old/new sentences. However, the sentence feedback proved superior for the route version in inferential (situation) memory, and text feedback was superior for the survey text. This suggests that feedback type that is congruent with the text version is more effective with regard to more complex memorial processes.

Within the field of instructional psychology, the belief that any assistance in the learning process is better than no assistance at all approaches the level of an axiomatic truth (Berliner & Rosenshine, 1977). Aid has been defined previously in such forms as learning objectives (Rothkopf & Kaplan, 1972), text cuing (Lorch & Chen, 1986), and, especially, feedback (Barringer & Gholson, 1979). Although the outcomes of these studies have not been systematically positive and uniform, the basic assumption has not been modified. The reasons for this consistently axiomatic viewpoint regarding the efficacy of instructional assistance are varied and complex. In general, they seem primarily to reflect basic principles underlying the associationist view of learning, with its emphasis on outcome assessment rather than process analysis. Within this model, assistance becomes part of a general systems approach to instructional management (Langer & Keenan, 1984).

This study is another in a series of experiments begun in 1984 to explore the effects of feedback on text processing. Feedback is perhaps the most common form of instructional assistance, usually defined as some type of help provided *subsequent* to a performance (Langer & Keenan, 1984). Whether the effects of feedback should be viewed in terms of controlling consequences or providing information is still a moot point (Anderson & Faust, 1973; Barringer & Gholson, 1979; Getsie, Langer, & Glass, 1985). Our project was initially conceived as a search for parameters in instructional assistance rather than discourse processing per se. The outcomes have been less than uniform, however, requiring us now to consider in a general way the interaction between mechanisms of text processing and assistance (Langer, Keenan, & Culler, 1987). Our data would suggest that there are indeed limitations regarding the impact of instructional assistance, especially in terms of the memorial processes underlying the synthesizing of meaning from text.

In addition to the conclusions we have drawn from our project data, other researchers have also argued that assistance might not necessarily have positive effects. Quite early, Battig (1966) insisted that learning that was initially facilitated might not be the most desirable instructional outcome. Gallagher (1981) showed that feedback could hinder subsequent learning, and Sternberg and Ketron (1982) argued that student-generated strategies might prove superior to instruction-derived strategies. Indeed, Kulhavy (1977) stated that the more complicated feedback programs may become learning tasks in themselves.

Previously our research program utilized a paradigm based on the reconstruction of scrambled text. The feedback provided either confirmed or disconfirmed the appropriateness of the sentence order developed during the reconstruction task. The passages were selected from regular texts and not especially constructed for the experiment (see, e.g., Bransford & Franks, 1971). Comprehension was indexed by comparing the order of the reconstructed text with the original (tau), as well as the more common retrieval measures of idea recall and sentence recognition. Our choice of this paradigm was based on the premise that the reconstruction of scrambled text is a process and therefore supposedly more amenable to the contributions of some form of instructional assistance. Although scrambled text has been used extensively in the past as a variable, comparatively little has been done recently (Langer & Keenan, 1984).

As noted, interpretation of data obtained from the reconstruction paradigm led us to consider closely the nature of text processing itself. Interestingly, our more recent

This article is based in part on a presentation at the 1991 meeting of the Psychonomic Society. Correspondence should be addressed to P. Langer, Department of Psychology, University of Colorado, Campus Box 345, Boulder, CO 80309-0345.

analysis fit in with a model developed by Kintsch (1974, 1988; van Dijk & Kintsch, 1983). Kintsch (1988) argued that the initial text propositions are formed directly from the text itself, but are then elaborated and integrated into a coherent text base representation, guided by the prior knowledge available. Comprehension is an iterative construction-integration process, and obviously both knowledge and text base change as a result of the processing. The model suggests that several layers of knowledge interact simultaneously with the task of understanding discourse. Evidence for the model may show a surface representation of verbatim text, a propositional representation of semantic meanings, and a situation representation of pragmatic interpretations. Kintsch, Welch, Schmalhofer, and Zimny (1990) went on to elaborate the model in terms of sentence memory. Linguistic elements and syntactic chunks (surface representation features) interact with propositions (semantic representations) and situation elements. These interact concomitantly and do not represent distinct phases as the term is commonly used (Shuell, 1991).

The situation representation was tested in a series of experiments by Perrig and Kintsch (1985). In that investigation, there were two descriptions of a mythical town called Baldwin. One was composed in terms of a sequential set of instructions for driving through the town, and the other in the context of a spatial or geographic layout. Surface representation was detected by recognition of verbatim sentences, text-based representation was detected by propositional recall, and situation representation was assessed by inferences.

This argument for distinctly discrete memorial representations leads directly to questions about thought processes in reading that are of vital concern to educational researchers and practitioners. In terms of our own feedback research, it is urgent that we know what kinds of intervention are most facilitative for the kinds of memorial representation postulated in this model. In turn, these are dictated by the instructional outcome specifically sought. This study, the third in a series, differs from previous work in that we do not use a reconstruction paradigm. We do, however, make a more exhaustive analysis of comprehension outcomes.

In the first study, we used a slightly modified version of the Perrig and Kintsch (1985) description of their mythical town (Langer, Keenan, & Nelson, 1991b). To acknowledge the changes, the town was renamed Mapleton. Each version was 25 sentences long; again, one was a spatial or survey description, and the other was a route version that guided the driver through town. The stories were typed one sentence to a card, and subjects read each sentence aloud as the card was turned over. Both sets of decks were presented in scrambled order. Subjects ordered the card placements using a slotted board.

One group of subjects reconstructed the scrambled passages, with assistance provided in the form of limited confirmation requests as to the correct order of sentence placement. A second group reconstructed the scrambled text without feedback. A third group simply read the scrambled passages twice. We assessed comprehension by indexing the order of the reconstructed text sentences to the original (tau), as well as the more usual measures of recall and recognition.

Recall scores, defined as the proportion of molecular propositions correctly remembered, were statistically greater for the route version across conditions, paralleling the Perrig and Kintsch (1985) findings. Recognition scores, defined as the correct identification of old sentences from paraphrases, were not different across versions. It may be that by using college students, we have subjects who, when called upon to read an unknown text, have developed to an art form memorial strategies to generate a valid surface representation. There was no feedback × text interaction, which we assumed might be present. As a stronger test for feedback effects, the next experiment provided both map and sentence assistance conditions. This permitted us to compare one type of feedback (map) against another (token).

We used the same two descriptions of Mapleton. Subjects were asked to rearrange the cards so the reconstructed order made sense to them. They were randomly assigned to the four treatment cells created by the two passages (route/survey) and two forms of assistance (tokens/map).

In the reconstruct/token confirmation condition, subjects were given 25 tokens. While arranging the cards, the subjects could use 1 token, up to a total of 25, to affirm the appropriateness of their order of reconstruction. In the reconstruct/map assistance condition, the subjects who reconstructed the text sequence had access to a map that could be used to modify their sentence order. They were given 5 tokens and could use a token to look at the map for up to 10 seconds.

As in the previous research, the major measures of comprehension were proposition recall, sentence recognition, and concordance (tau) of sentence order with the original passages. For recall, there were main effects for both version and feedback. The mean number of propositions recalled for the route version was significantly greater than for the survey. This paralleled the Perrig and Kintsch (1985) findings, even given the significantly different task of reconstructing scrambled text. The mean for map feedback was significantly greater than that for token assistance. There was no statistically significant interaction between version and feedback. There were no differences for recognition between old and new sentences. Additionally, recall was significantly related to tau (concordance), but recognition was not. These findings are not dissimilar to what we have observed in the past. Interestingly, concordance was not significantly related to feedback, confirming our previous arguments that the developing text structure, at least in terms of a plausible level of individual semantic representation, need not necessarily duplicate the original. Our subjects were able to achieve a satisfactory level of recall and recognition without an exact replication (Langer, Keenan, & Nelson, 1991a). Again, our results paralleled the Kintsch and Perrig findings, even with the critical difference of text reconstruction.

In this third study, we decided to continue our use of varied feedback conditions but to present the text to the subject in its original sentence order. This, we believed, would enable us to analyze comprehension outcomes in more detail. There were again two versions. The route version and survey version consisted of 25 sentences. The route version consisted of 487 words, yielding 214 propositions. The survey version consisted of 495 words and 224 propositions. In terms of key variables, the two versions are quite similar.

METHOD

Our subjects were 69 general psychology students. As in the past, the sentences were printed one to a card, and the subjects read each card aloud. Unlike in previous studies, the sentences were in appropriate order. Three feedback conditions were provided as follows: (1) In the map condition, the subjects, after reading a sentence, were allowed to see a schematic map of Mapleton for up to 10 sec. They could make five such requests, totaling 50 sec. (2) In the sentence condition, the subjects, after reading a sentence, could study the sentence on the card they had just read for an additional 10 sec. They could make five such requests, totaling 50 sec. (3) In the text condition, after reading the 25 cards, the subjects had the complete text made available, which they could study for 50 sec. This gave us a six-group comparison, based on a two (route/survey) × three (map/sentence/text) design.

To assess semantic representation, after reading the cards the subjects were first asked to write down what they remembered. This recall protocol was scored for both number of propositions and order. Upon completion of the protocol, the subjects were presented with a 32-card deck, consisting of either old or new sentences covering both text versions. The new sentences, which were paraphrases, were either true or false inferences.

Situation memory was determined as follows: The subjects read each sentence aloud and determined whether the sentence was "true" or "false." True and false cards were placed in separate piles. Inferential reasoning is generally considered a valid index of situation memory.

To assess surface representation, the subjects then went through the "true" pile and indicated which were "old" sentences. This recognition measure constituted our index of surface memory. Obviously, a new sentence could be a true inference, but it could not appropriately be classified as old.

RESULTS

Again, following Perrig and Kintsch's (1985) previous work, we measured three dimensions of memory: semantic, surface, and situation. Semantic memory was assessed by total number of propositions recalled, as well as the agreement of recall order with original order (tau). Discrimination between old and new sentences measured surface memory, and situation memory was assessed by inferential reasoning. The d' statistic was used throughout our analyses of recognition and verification.

In terms of semantic memory, there were no statistically significant differences between groups. An analysis of variance for number of propositions recalled shows only a marginally superior performance for the route version. Surface memory, as noted previously, was determined by recognition based on the "true" pile. After the subjects had separated the sentences into "true" and "false" piles, they then went back to the "true" pile and indicated which sentences were old and new. A "hit" was correctly identifying an "old" sentence as part of the original text read, and a "false alarm" was identifying as old any new sentence. The route-version subjects were only marginally superior.

For situation memory, we utilized each subject's "true" pile to arrive at our d' analysis. The scoring for either version was the same. For those reading the route version, a "hit" was based on having assigned a new or an old sentence, from either version, that was indeed true. A "false alarm" resulted from assigning a new sentence, written in either route or survey language, but that was not a true inference. By definition, an original route or survey sentence is a true appropriate inference. Likewise, for the survey-version subjects, a "hit" was defined as assigning a new or old sentence, from either version, that was true. A "false alarm" occurred by categorizing as "true" a new sentence written in route or survey language that was not a true inference. Again, by definition, an original route or survey sentence is a true inference for this group.

There were no main effects for version or feedback, although the route version was marginally superior. However, there was a statistically significant interaction between version and feedback [$F(2.63) = 3.44, p < .05$]. For the route version, sentence feedback (.90) was clearly superior to map (.44) and text (−.24). For the survey version, text (.37) was much more effective than either sentence (−.22) or map (−.02).

CONCLUSIONS

Some of the results parallel both the Perrig and Kintsch (1985) study, as well as our previous work. The absence of differences in surface and semantic memory was not entirely unexpected; what was more gratifying was to find an interaction between version and feedback with respect to situation memory. One might assume that inferential reasoning would be more demanding in terms of appropriate assistance, as compared to other memorial representations. For the route version, the superiority of the sentence condition seems logical, with map assistance secondary. The evidence for text feedback superiority for the survey condition seems more difficult to explain. One would expect the map to be more helpful, but it may be that the map we provided, which was basically schematic, was inadequate for the more dependent survey text. In future experiments, we intend to make the map more explicit, by labeling some critical locations such as the school, churches, and so forth. Nonetheless, a finding for differential feedback effects is crucial to our arguments.

There is now some evidence, from both Kintsch's work and our own, that the analysis of memorial representation in text processing is vital to any consideration of text assistance. For example, the assumption that processing in depth requires aid that is congruent with the memorial demands makes the task of the instructional developer quite complex. We believe that those directly involved in instructional design must begin to recognize the difficulty of the problem. Basically, there must be an expansion of types of assistance derived solely from an associationist model.

It is simply indefensible any longer for educators to attempt to manipulate the outcomes of text processing without a more precise characterization of the memorial representations under which outcomes are subsumed. Process and outcome are interactive events, with all the ramifications of that assumption.

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(Manuscript received March 25, 1992.)