Limitations of Feedback on Retrieval Using a Text Synthesis Paradigm

Abstract

This study explored a number of issues dealing with the use of a text synthesis paradigm and feedback. Subjects reconstructed a 26 sentence passage dealing with Watergate. The passage was presented in either scrambled form or in the original order of sentences. The major dependent variables were recall, recognition, and concordance (tau) between the subject-ordered sequence of sentences and the original order. Among the major findings were: (1) no differences in recall and recognition scores between limited and unlimited feedback, (2) tau increased with unlimited feedback, but had no significant impact on retrieval, (3) reconstruction assisted recognition as compared to simply reading the materials, and (4) there were no differences in recall or recognition as a function of whether the material was scrambled or in the original order. The results confirmed previous findings which suggest feedback may be subject and content specific.

Limitations of Feedback on Retrieval Using a Text Synthesis Approach

An axiomatic belief in instruction is that feedback in the form of assurance or guidance is conducive to improved achievement. Kulhavy (1977), for example, suggests that feedback should be prompt and frequent, while Frederiksen (1984) declares that appropriate feedback is an integral part of problem solving processes. Unfortunately, this reliance on the efficacy of feedback is not completely warranted, especially in the area of text processing (Langer, Keenan, & Medosch-Schonbeck, 1985a).

Support for instructional feedback has generalized from findings in such diverse areas as motor learning and cybernetics (Langer, 1983). Instructional developers faced with the task of preparing autotutorial materials have relied almost universally on some kind of feedback to reduce learner difficulties with content and sequencing (Langer, Keenan, & Medosch-Schonbeck, 1985a). However, the operational problems in using feedback to assist cognition have generally not been addressed by cognitive psychologists in any systematic fashion (Clark, 1982), other than to affirm in some vague manner that feedback as an additional source of information should contribute to measures of achievement.

This is especially disturbing in instruction which normally involves a high emphasis on text processing. While feedback is itself a multidimensional construct of uncertain properties (Holding, 1965), current text processing models are still preliminary in many respects (Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983; Meyer & Freedle, 1984). Although the major processing models seem to be moving from structural analyses to processes and the impact of real world knowledge (Britton & Black, 1985), there is a dearth of empirical evidence on how external intrusions such as feedback modify the on-going processing.

If research and theory in text processing have not included feedback, it is equally true that previous feedback research has generally ignored or attempted to minimize the issues concerned with text processing. The most typical feedback research paradigm employed has been to assess the impact of feedback upon the products of processing, such as a response to a specific question or a frame of programmed instruction (Keenan, Langer, & Medosch-Schonbeck, 1985a; Langer, Keenan, & Medosch-Schonbeck, 1985b). Unfortunately, feedback based upon a learning outcome is very difficult to validate since one has to assume that the student arrived at the answer using the logic upon which the available feedback was predicated (Winne, 1982; Bilodeau, 1969).

A second related issue deals with the organization of the discourse materials themselves. A basic assumption in most text processing is that text organization, either at the syntactical or conceptual level is critical for such common memory measures as recall and recognition (Reder, 1980). Not unexpectedly most instructional developers have taken this to mean that to facilitate learning they must provide through appropriate sentence and concept sequencing the most effective content organization, and to provide feedback which will guide the learner along a well-defined and predetermined instructional pathway (Langer, Keenan, & Medosch-Schonbeck, 1985b.

However, it is also generally accepted that information processing involves some idiosyncratic transformation of data. Indeed, Anderson and Reder (1979) argue that the learner schemata available may impact acquisition more than the logic of the discourse itself. Faced with subjective interpretation, researchers in feedback (and text processing to some extent) have attempted to minimize this dilemma by using tightly structured discourse of sufficient unfamiliarity so as to make the reader more dependent on the content provided than reliance on individual (and unknown) schemata (Keenan, Langer, & Medosch-Schonbeck, 1985b).

A third issue involves Clark's (1973) warnings concerning generalizability of content, per se. In a parallel manner van Dijk & Kintsch (1983) distinguished between narrative discourse which assists recall, as distinct from descriptive discourse which lends itself more to sentence recognition. In our efforts we have not only employed both narrative and descriptive passages, but have varied passage length and subject familiarity (Langer, Keenan, & Medosch-Schonbeck, 1985a; Keenan, Langer & Medosch-Schonbeck, 1985a; Langer, Keenan, & Medosch-Schonbeck, 1985b).

Instead of assessing the contributions of feedback to the products of processing, we have attempted to correlate feedback more directly to the text processing itself. Based on our earlier findings we have come to view text processing as somewhat analogous to problem solving in which there are crucial decision points which may be highly idiosyncratic. In this model, the functionality of the available feedback will tend to be subject specific.

To test our very tentative assumptions, we decided on a text synthesis paradigm, in which subjects could manipulate the timing of limited amounts of feedback. Our original belief was that by using scrambled text in which the logic was not immediately discernible to the user, individual strategies and schemata would predominate and feedback needs would be more sensitive to the developing text logic. By using a limited feedback model, we hoped this would force the subjects to rely more heavily on their cognitive resources (i.e., strategies and available real world knowledge), and concomitantly utilize feedback more efficiently (Langer, Keenan, & Medosch-Schonbeck, 1985a).

The feedback provided was confirmation-disconfirmation with respect to the original order of sentences in the passage. That is, as the text was reconstructed subjects could determine if their order of sentence placement conformed to the original order (Keenan, Langer, & Medosch-Schonbeck, 1985b).

Additionally, subjects having only a limited amount of feedback available would probably not be able to completely reconstruct the original sequence. We could determine therefore just how crucial the original order was to achievement, something that has generally been assumed by instructional developers (Gagne & Briggs, 1979).

Scrambled text has been used in the past to compare achievement differences with connected discourse (Frase, 1961; Kulhavy, Schmid, & Walker, 1977; Taylor & Samuels, 1983; Thorndyke, 1977). With the exception of perhaps an inadvertent experimental manipulation (Schultz & Divesta, 1972), no independent confirmation sources (i.e., feedback) has been provided for the scrambled materials. As one might expect, the connected discourse led to higher achievement.

Cognitive processing research has also used scrambled text, and two studies are particularly relevant. Kintsch, Mandel, & Kozminsky (1977) investigated the processing of text scrambled at the paragraph level. Subjects were required to read two stories, one tightly structured and the other more loosely organized. Subjects read the stories either scrambled by paragraphs or in the original sequence. In comparing summaries written under conditions of unlimited time for processing, the researchers concluded that subjects could produce summaries based on the scrambled text which were equivalent to those for the ordered passages. Under conditions of restricted reading time, the scrambled text summaries suffered, particularly for the less structured stories. The researchers attributed the reconstruction process to the use of a formal story schema, with some input from general world knowledge.

Thorndyke (1977) also postulated a story schema for narrative discourse. He varied the expected structure and found that both recall and retrieval suffered with increasing disorganization. However, he presented the sentences one at a time either visually or auditorially and did not permit subjects to review previous sentences or anticipate new ones. Normally subjects do not read under these conditions (Miller & Kintsch, 1980), and one would expect that the lack of structure would reduce retrieval.

Critical to our paradigm is that a task of reconstructing scrambled sentences is well within the capabilities of our subjects. It should be noted that the passage lengths used by Kintsch et al. were considerably longer, making paragraph scrambling a more reasonable research option. The passage lengths used by Thorndyke (1977) are similar to ours, and he scrambled at the sentence level. Furthermore, Kintsch et al. argued that lexical cohesiveness is destroyed by scrambling at the sentence level, a finding replicated by Thorndyke (1977), but our data would suggest that this may not necessarily be true, especially where more general world knowledge and feedback are available.

As to be expected, our research has not been based upon a set of well documented theoretical assumptions. Our initial experiments have followed Sidman's (1969) "What if", or curiosity rationale. Nevertheless, in this fourth study we had identified three crucial empirical questions which we wanted to address directly: (1) What differences in achievement (recall or recognition) can be attributed to the frequency of feedback? Some of our colleagues have insisted that our failure to demonstrate the contributions of feedback have been due to the fact that we have compared limited to no feedback conditions; (2) What differences in achievement result from the reconstruction task as compared to simply reading the text; and (3) what differences in achievement result from the use of scrambled text as compared to the original text order.

Method

Subjects were 48 introductory psychology students at the University of Colorado. In order to answer our three questions, eight experimental groups were created. One group read the scrambled passage and reconstructed the text having limited (a maximum of five informational requests) feedback. A second group read and reconstructed the text with unlimited feedback. The third group of subjects read the scrambled discourse only, while a fourth group read the materials in the original order. Each of these groups was subdivided by giving the achievement measures either immediately or after one week's delay, yielding eight groups. All groups were balanced as to number of subjects.

In this experiment the scrambled passage, 26 sentences in length, was drawn from "The Final Days" (Woodward & Bernstein, 1976) and dealt with Nixon ordering his aides to stonewall inquiries into their knowledge of Watergate. The passage would be characterized as descriptive (van Dijk & Kintsch, 1983). The materials have been used in a previous study (Langer, Keenan, & Medosch-Schonbeck, 1985b), and provided some additional baseline data with which to evaluate our experimental conditions.

The sentences were presented on a set of randomly ordered cards, with one sentence to a card. Subjects were informed that the purpose of the experiment was to determine how meaning is constructed. For those subjects who reconstructed the text as opposed to merely reading it, sentence ordering was assisted using a wooden board with 35 slots. Subjects picked up one card at a time, read, and placed it in a slot. Cards could be rearranged freely, but always one at a time.

A move was recorded when a subject changed the position of a card relative to others. The feedback provided was either a "right" or "wrong", depending on whether a sentence was correctly placed with respect to the sentence immediately preceding it as determined from the original text. If the subjects were given limited feedback, they proceeded with five tokens which could be used to request feedback. In the unlimited feedback condition, subjects were able to obtain as much confirmation as they desired. The subjects in both feedback conditions were first given a practice task under either the limited or unlimited feedback conditions, depending on the experimental treatment to which they were subsequently assigned. The training task was to reconstruct 11 scrambled sentences comprising the fairy tale "The Goose that Laid the Golden Egg." For the read-only conditions, the scrambled or unscrambled deck was placed before the subject who picked up one card at a time and read the sentence. The decks were read twice.

The independent variables were feedback (limited vs. unlimited), task (reconstruction vs. read only), and order (scrambled vs. unscrambled). The critical dependent measures were recall, recognition, and concordance. For recall, subjects wrote down as much as they could remember, without regard to order. Scoring was assessed as number of idea units presented. Recognition was measured by having subjects select from pairs of sentences the original sentence, as distinguished from a paraphrase. Concordance was determined by correlating final subject order with the original order (Kendall's Tau). Other dependent measures included time to completion, number of rearrangement moves, and number of tokens.

Analyses

Data are presented in terms of our three basic questions. The first question dealt with the differences in recall and recognition, as between limited and unlimited feedback. Recall scores were based on the percentage of idea units, following Bovair and Kieras (1981). There were 90 idea units in the 26 sentence passage (Langer, Keenan, & Medosch-Schonbeck, 1985a). As discussed earlier, one of the criticisms levelled by colleagues of our previous research has been that we were using a limited-no feedback paradigm, which may have resulted in the lack of clear cut effects of feedback on achievement. To evaluate this argument, we compared limited to unlimited feedback. The latter condition provided a baseline from previous research (Langer, Keenan, & Medosch-Schonbeck, 1985b).

In this study, subjects given unlimited feedback used an average of 35 tokens as compared to the 3.5 tokens in the limited feedback condition. Using the Kintsch et al. research as a guide we continued to analyze the data using time as a covariate. In all our previous research subjects using feedback took more time to complete the task. In this study unlimited feedback subjects took more time (36.83 minutes) than limited feedback subjects (31.67 minutes). Table 1 presents the analysis of percentage recall scores with time as covariate.

Insert Table 1 about here

The only statistically significant finding is for the timing of the recall measures. Although the group which took the memory measures one week later spent more time processing the passage (10.75 minutes vs. 13.50 minutes for the immediate group), the recall percentages for the immediate group were higher (16.50% vs. 7.46% for the delayed group). We can only assume at this point that this finding may be a sampling error; i.e., the delay group was poorer at the task. Interestingly, if time is not treated as a covariate, ANOVA yields no statistically significant findings for either feedback or timing. For recall, unlimited feedback makes no difference, suggesting that our earlier findings were not an artifact of the amount of feedback available.

ANOVA for percentage recognition scores is given in Table 2.

Insert Table 2 about here

Although there were no statistically significant differences, the percentage recall score mean for the unlimited feedback group was 80.75 as compared to 80.08 for the limited feedback group. The higher scores associated with unlimited feedback as compared to the limited feedback condition follows a trend observed earlier between limited and no feedback (Langer, Keenan, & Medosch-Schonbeck, 1985b). While feedback seems to have some effect on recognition, the character of the relationship is not clear.

In our previous studies we have found that tau (concordance with the original order of sentence) increased with feedback. This study was no exception. Table 3 presents ANOVA for tau, with time as a covariate.

Insert Table 3 about here

Feedback generally increases concordance with the original order. It would follow that increased feedback should improve concordance. This is indeed the case. Tau was significant for feedback $F(1,19)=5.14$, $p<.04$. The mean for the unlimited feedback group was .57 as compared to .29 for the limited feedback. The effect for timing $F(1,19)=6.29$, $p<.02$ is again a sampling problem. The delayed testing group mean tau was .31, compared to .12 for the immediate group. While one can speculate on differences in recall and recognition as a result of delay, there should be none regarding tau and time of testing, as this was unknown to subjects prior to the actual presentation of the achievement measures.

The Pearson r's between tau and recall (r=.001, n.s.) and recognition (r=.28, p<.02) follows previous findings (Langer, Keenan, Medosch-Schonbeck, 1985a; Keenan, Langer, & Medosch-Schonbeck, 1985a). These results serve to reinforce our belief that processing tends to be idiosyncratic, with a more consistent effect for feedback on recognition than recall. Finally, the number of moves was higher for the unlimited feedback group (49.50 vs. 26.58), but this is clearly an artifact of the experimental paradigm.

The second question dealt with task, that is the effects of reconstructing the text as compared to simply reading it. ANOVA for percentage recall score is presented in Table 4.

Insert Table 4 about here

There was no statistically significant difference in recall between reading scrambled text and reconstruction. The finding replicates previous studies which have generally yielded little evidence of recall augmented by reconstruction as compared to reading scrambled text (Keenan, Langer, & Medosch-Schonbeck, 1985a), and also reaffirms previous data which suggest that non-feedback subjects can organize scrambled text in some meaningful manner, probably using local cues and syntax. There was an effect for delay F(1,44)=4.93, p<.03. The recall mean for the immediate group was 16.50 as compared to 7.46 for the delay condition. This has been a rather consistent finding (Langer, Keenan, & Medosch-Schonbeck, 1985b).

For recognition the results are somewhat different. ANOVA is given in Table 5.

Insert Table 5 about here

Recognition was enhanced by reconstruction $F(1,44)=7.60$, $p<.01$. The mean for the reconstruction subjects was 83.92 vs. 75.33 for read only. For delay there was a statistically significant advantage for the immediate group $F(1,44)=7.75$, $p<.01$. The mean for the immediate group was 83.96 compared to 75.29 for the read only. As we have hypothesized, the reconstruction process assists sentence discrimination as compared to recall. The advantage of the immediate condition has also been a consistent finding (Langer, Keenan, & Medosch-Schonbeck, 1985a).

Question three dealt with the effects of reading scrambled vs. unscrambled text. ANOVA yielded no statistically significant findings for either recall or recognition. For recognition, therefore, enhanced achievement appears to be a function of both the reconstruction process and availability of feedback. Recall seems to be somewhat independent of both our experimental treatments.

Discussion

Over a decade ago, Clark (1973) warned about generalizing findings from specific content. If anything, our reconstruction paradigm has emphasized that point; our studies have reflected sensitivity (perhaps too much sensitivity) to differences in passage content and length.

By using content which was not expressly devised for the experiment, we have uncovered a whole new set of variables. The typical approach has been to use content which forced the reader to rely on external cues (i.e., the content provided) rather than previously acquired knowledge (e.g., Bransford & Franks, 1971). Our use of natural expository texts and subject control of feedback do permit and indeed encourage subjects to rely on previously held knowledge and strategies. The results have been at variance from commonly held assumptions regarding the impact of feedback. That is, the assimilation of text to existing individual schemata and strategies appears to be more pervasive than instructional developers would like to believe. As yet we are unable to determine if it is a question of differing end products resulting from the intersection of common strategies and different knowledge levels, or differing strategies resulting from and interacting with unique knowledge bases (Langer, 1983).

The continued dependency on artificial texts represents a real problem in feedback research. While experimental control is necessary (Sidman, 1960), there comes a time when a procedure which once served a useful function has to be abandoned, in order to probe further into the complexities of a given problem. The alternative is to fall into the trap of accepting an artificial constraint as equivalent to a real world phenomenon (Herrnstein, 1977). Briefly, subjects do not usually process texts which are so carefully organized and delineated as to prior knowledge.

Previously retained knowledge is functional when the reader interprets new data in the light of what has been previously learned (Britton & Black, 1985). Several decades ago the first author conducted an experiment in which students in a general psychology course were administered a personality test, but were returned interpretations taken from an astrology book with zodiac references omitted (Langer, 1967). Overwhelmingly students accepted the description as accurate, although the so-called interpretations had absolutely nothing to do with the test results themselves. Aside from some profound insights on how purveyors of astrology have survived, we found that there were enough familiar phrases in the personality descriptions provided to convince our subjects of their validity. It became increasingly apparent that certain expectations had been aroused by our testing procedures and the personality descriptions provided.

In a similar manner, even though the text provided is not in an initially logical order, our subjects assume that it eventually will make sense. What is interesting is that concordance with the original order is not directly related to achievement. For example, in the unlimited feedback condition, only one subject correctly reproduced the original order. Moreover, subjects in the unlimited feedback condition who had perfect recognition scores reconstructed final sentence sequences at some variance with both the original order and with each other. This may suggest that sentence ordering while similar on the surface may have different internal representations. Certainly further research is needed.

If the reconstruction strategies are unique, so then is feedback usage. In the unlimited feedback condition subjects requests for assistance ranged from zero to 124. The Pearson r's between tokens used and recall (.02) and recognition (.20) are not significant, which is not surprising.

In summary, the reconstruction paradigm assists sentence recognition with feedback making a modest, if uneven contribution. Both the Kintsch et al. study and our findings concur in that recall may be a different problem. It is possible that the dependency on internal data (i.e., story schema or real world knowledge) may overwhelm the contributions of feedback or other external cues. We have much more to uncover as to how the impact of feedback can be increased, and recall assisted along with recognition. Our findings clearly suggest that feedback is beset by more variables than can be encapsulated by simple incentive or information theorems.

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Table 1.

ANOVA: Percent recall scores.

Source	SS	Df	MS	F	Sig
Covariates	4.88	1	4.88	.113	.74
Time (TM)	4.88	1	4.88	.113	.74
Main Effects	348.03	2	174.02	4.01	.04
Feedback-No Feedback (FB)	168.01	1	168.01	3.88	.06
Immediate-Delayed Testing (D)	217.83	1	217.83	5.02	.04
2-way Interaction	70.20	1	70.20	1.62	.22
FB x D	70.20	1	70.20	1.62	.22
Explained	423.12	4	105.78	2.44	.08
Residual	823.84	19	43.36		
Total	1246.96	23	54.22		

Table 2

ANOVA: Percent recognition scores.

Source	SS	Df	MS	F	Sig
Covariates	5.06	1	5.06	.053	.82
Time (TM)	5.06	1	5.06	.053	.82
Main Effects	508.67	2	254.34	2.65	.10
Feedback-No Feedback (FB)	329.59	1	329.59	3.44	.08
Immediate-Delayed Testing (D)	127.88	1	127.88	1.33	.26
2-way Interaction	257.18	1	257.18	2.68	.12
FB x D	257.18	1	257.18	2.68	.12
Explained	770.91	4	192.73	2.01	.13
Residual	1822.92	19	95.94		
Total	2593.83	23	112.78		

Table 3

ANOVA: TAU

Source	SS	Df	MS	F	Sig
Covariates	.62	1	.62	8.05	.01
Time (TM)	.62	1	.62	8.05	.01
Main Effects	.79	2	.40	5.14	.02
Feedback-No Feedback (FB)	.39	1	.40	5.10	.04
Immediate-Delayed Testing (D)	.49	1	.49	6.29	.02
2-way Interaction	.16	1	.16	2.03	.17
FB x D	.16	1	.16	2.03	.17
Explained	1.57	4	.39	5.09	.01
Residual	1.47	19	.08		
Total	3.03	23	.13		

Table 4

ANOVA: Percent recall scores as a function of task.

Source	SS	Df	MS	F	Sig
Main Effects	1006.54	2	503.27	9.00	.001
Reconstruction-Read (Tsk)	25.52	1	25.52	.46	.50
Immediate-Delayed Testing (D)	981.02	1	981.02	17.54	.001
2-way Interaction	275.52	1	275.52	4.93	.03
Tsk x D	275.52	1	275.52	4.93	.03
Explained	1282.06	3	427.35	7.64	.001
Residual	2460.92	44	55.93		
Total	3742.98	47	79.64		

Table 5

ANOVA: Percent recognition scores as a function of task.

Source	SS	Df	MS	F	Sig
Main Effects	1785.42	2	892.71	7.68	.001
Reconstruction-Read (Tsk)	884.09	1	884.08	7.60	.01
Immediate-Delayed Testing (D)	901.33	1	901.33	7.75	.01
2-way Interaction	147.00	1	147.00	1.26	.27
Tsk x D	147.00	1	147.00	1.26	.27
Explained	1932.42	3	644.14	5.54	.003
Residual	5116.83	44	116.29		
Total	7049.25	47	149.98		