SIGNALLING, SENTENCE ORDER AND TEXT COMPREHENSION

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Abstract

Subjects reconstructed one of two 26-sentence passages with the aid of signalling sentences which assisted in determining the original sequence. A third group of subjects read the scrambled discourse without reconstruction. Our major findings were: (1) recall of idea units was assisted by the use of signalling sentences, (2) recognition of original passages and paraphrases was also assisted by signalling, and (3) degree of concordance (tau) between reconstructed order and the original sentence sequence was a function of passage content. The contribution of targeting sentences as compared to feedback suggests that the amount of instructional assistance provided is not necessarily related to achievement. There appears to be a critical relationship between content and instructional assistance which needs to be examined further.

This study continues our efforts to examine the impact of instructional adjuncts on text comprehension. Previous research has examined the effects of such aids as objectives (Rothkopf & Kaplan, 1972), study questions (Semb, Hopkins, & Hursch, 1973; Webb & Schwartz, 1959), feedback (Barringer & Gholson, 1979; Anderson, Kulhavy, & Andre, 1971; Robin, 1976), and text signalling (Lorch & Chen, 1986). These areas have not systematically related to text comprehension processing in the past, with the result that traditionalists in the psychology of classroom learning have dogmatically attested to the general efficacy of instructional assistance (Berliner & Rosenshine, 1977; Gagné, 1985). Our own data, however, suggest that there are significant limitations with regard to the effectiveness of such assistance as feedback and signalling in synthesizing meaning from text (Langer, Keenan, & Culler, 1988).

In our previous studies subjects reconstructed scrambled passages with feedback as the primary form of assistance. Comprehension was assessed by comparison of the reconstructed text to the original sentence sequence, as well as more common retrieval measures such as idea recall and sentence recognition. Our choice of sentence order as a variable is based on the premise that reconstruction from scrambled text is a process, and therefore sensitive to instructional influences.

Interestingly this paradigm fits in with recent work by Kintsch (1988) who has postulated a bottom-up processing model. In this model the initial text propositions are formed directly from the text itself, but are then elaborated upon and subsequently integrated into a coherent text base by the knowledge base available. It is an iterative construction-integration process, and obviously both the knowledge and text bases

change as a result of the processing. The interaction between content and knowledge has been recognized by others, including Fredericksen (1977) and Meyer and Freedle (1984). While our work has not been interested in the mechanics of discourse processing, per se, it is equally true that the effectiveness of instructional assistance in any given situation requires some understanding of the cognitive mechanisms involved.

This knowledge of underlying mechanisms is critical to any understanding of the influences of assistance. Instructional adjuncts have been heavily influenced by behaviorism from their inception into instructional development (Langer, 1983). The underlying assumption among behaviorists is that the desired learning for a particular instructional sequence can be systematically shaped from the existing learner response repertoire through such processes as generalization and discrimination. Learning was conceived as occurring within a highly deterministic framework. The belief in a simplistic set of non-interactive additive connections may be difficult to defend in the light of current research in cognition (Bourne, Dominowski, Loftus, & Healy, 1986). For example, there is little evidence to suggest a straightforward linear relationship between amount and timing of feedback and concept acquisition (Getsie, Langer, & Glass, 1985).

Along with the issues of instructional management, the construction of the text itself represents a problem, since processing is obviously a function of sequence. Sequential order of constituents is a fundamental property of any language. We have presumed that there are optimal sentence sequences for any text and that comprehension will be better for this than for alternative sequences (Langer, Keenan, & Medosch-Schonbeck,

1986). While Reder (1980) argues for a significant relationship between text organization and comprehension, Irwin (1982) pointed out that over-all intersentential coherence does not seem to assist memory significantly.

In our paradigm reconstruction of the scrambled text assumes some developing schemata of comprehension. However, an iterative reconstruction process is not in itself necessary for comprehension. With shorter and more familiar passages our subjects are able to determine meaning by reading the scrambled text (Langer, Keenan, & Medosch-Schoenbeck, 1986). Generally, retrieval for scrambled content has proved less effective than for organized text (Frase, 1970; Thorndyke, 1977). Except for work in our lab however, feedback has not been investigated in this context unless one includes a study by Schultz and Di Vesta (1972) in which assistance was inadvertently provided.

Our latest research has led us to speculate that the successful processing of scrambled discourse may be a function of Tulving's (1983) episodic-semantic distinction (Langer, Keenan, & Culler, 1987). Basically text which depends on semantic stores seems more sensitive to typical forms of assistance such as feedback and signalling (Langer, Keenan, & Culler, 1988). Of equal importance to instruction is that Tulving has expanded considerably upon his original episodic-semantic distinctions. While he considers the two to be separate, he acknowledges the possibilities of significant interactions resulting in semantic content embedded in episodic memory. Tulving still perceives the accessibility of episodic memory as a function of spatial-temporal references, while semantic content is more abstract.

This study is specifically an extension of a previous study dealing with the effects of signalling. Signalling is a form of text cueing. Since our model dealt with the role of sentence order in comprehension, we considered the findings of a study by Lorch and Chen (1986) relevant to our work. Their findings suggest that targeted sentences are not only better recalled but signalling assisted both the content and organization of recalled text as compared to nonsignalled passages. Similarly Glover, Dinnel, Halpain, McKee, Corkill, and Wise (1988) also found that forward or backward signalled materials were better recalled than non-signalled content. In our work we found that feedback and signalling enhanced text reorganization for semantic content, but signalling did not differentially effect recall or sentence recognition (Langer, Keenan, & Culler 1988). This absence of findings led to the second experiment, in which we utilized a signalling strategy without feedback on placement of nonsignalled sentences.

In addition to providing the targeted (i.e. signalled) sentences but no feedback, we also did not allow subjects to change the order of sentences once they were placed. In the past we allowed students to manipulate sentence order as freely as desired, but in this study subjects could insert a new sentence into the existing order, but could not change relative order. We speculated that this would lead to greater reliance on the internally developing text base. The signalling sentences were in the same position for each passage within each condition.

Method

Sixty Introductory Psychology students participated in the study. Two 26-sentence passages (Joan and Laura) were prepared on 3x5 index cards,

with one sentence to a card. The Joan passage, which has been used in previous research (Langer, Keenan, & Culler, 1988), was adapted from Brazelton (1974) (see Appendix A). This deals with the familial problems of a five-year old girl as her mother awaits the birth of a fifth child. The passage is 407 words long and has 90 idea units. The Laura passage is adopted from Bruch (1982) and concerns itself with the problems of a teen-ager who is suffering from anorexia. The passage is 477 words long and also has 90 idea units (see Appendix B). Both passages are classified as semantic since the passage concepts are familiar but are not likely to be indexed to spatial-temporal references.

To assist subjects in reconstructing the text, sentence ordering was assisted using a wooden board with 35 slots. When a signalling sentence was put on the board, it was placed in the correct slot for that sentence. For example, the Sentence 9 card was located in the ninth slot.

Each of the two passages were formed into two randomly ordered decks. The two decks were given alternately to subjects. In a previous experiment part of the data analysis consisted of dividing the 26 sentence passage into three clusters, consisting of sentences 1-9, 10-18, and 19-26 (Langer, Keenan, & Culler, 1988). Processing consisted of two signalling and one read-only conditions. In the first signalling condition (SC1) Sentences 9, 17, and 25 were chosen as the targeted sentences. The three sentences are located approximately at equal intervals, and were chosen for their approximately equidistant triad position in the 26-sentence passage. The same sentence positions were used for both the Laura and Joan passage.

In the second signalling condition (SC2), we used sentences 8, 13, and 20. Again, we used one sentence in each triad, but this selection was based on previous research (Langer, Keenan, and Culler, 1988). In the earlier study these were sentences in the Joan passage whose average assigned placement in the reconstructed text showed the least deviation from the original sequence. We used the same sentence positions for both the Joan and Laura passages. The third condition was read-only. In this condition subjects read both scrambled decks, which were presented in counterbalanced order.

Prior to beginning the experiment, all students read a scrambled 11 sentence version of the "Golden Goose". Each sentence was typed on a separate card. They were then asked if the story made sense to them. All students performed the task successfully. The subjects then proceeded with the rest of the experiment.

In the two signalling conditions subjects first read one of the scrambled decks. Then the signalling sentences were taken out and placed in the appropriate slot. Subjects were told to reconstruct the text with the remaining cards, knowing that the three signalling sentences were placed in their proper positions. Unlike previous studies, subjects could not rearrange the sequence, but could insert a sentence between previously placed sentences. The target sentences could be and were moved to accomodate new sentences. However, some subjects just could not place a card when it came up the first time in the deck. The card was then placed in the back of the deck and not seen until it came up once again. This time the card was placed within the developing order. The

read-only subjects did not concern themselves with placement, but read the sentences in first one and then the other of the two random orders.

The design was a 2 (Joan-Laura) x 3 (SC1 [sentences 9, 17, 25], SC2 [sentences 8, 13, 20], and read-only). The dependent measures were proportion of idea units recalled, proportion of sentences recognized as new or original, and concordance (tau) with the original sentence sequence.

For recall, subjects wrote down as much as they could remember without regard for order. Idea units were categorized following Bovair and Kieras (1981). The recall score was the proportion of idea units recalled. Sentence recognition differed from previous studies in which the subject distinguished between pairs which included the original sentence and a paraphrase. In this study the subject was given 26 sentences, half of which were originals and half paraphrases, and asked to identify "old" and "new" sentences. The subject's score was the proportion of original and paraphrased sentences correctly identified as such. While the subjects took the retrieval measure, the final reconstructed sentence order was recorded by the experimenter to determine concordance with the original (i.e. tau).

Analysis

The dependent variables were proportion of idea units recalled, proportion of old and new sentences recognized, and tau (concordance of reconstructed text with original order). The independent variables were passage , and process.

ANOVA for proportion recall of idea units recalled yielded a main effect for signalling ($F_{(2,54)}$ = 5.38 p < .01). The read-only mean was .28,

compared to .38 for SCI (Sentences 9, 17, and 25) and .40 for SC2 (Sentences 8, 13, and 20). In addition, there was a statistically significant interaction between passage and signalling ($F_{(2,54)}$ = 8.35, p < .001). The Joan means for SC1, SC2, and read only were .47, .46, and .22 respectively, while the Laura means were .49, .41, and .35. The major difference appears to lie in the read-only condition, where recall for Laura was significantly higher (.35 to .22).

ANOVA for proportion of recognition scores for old and new sentences again yielded a statistically significant effect for signalling ($F_{(2,54)}$ = 4.01, p < .03). The mean for read-only was .67, compared to .74 for SCI and .73 for SC2. Unlike recall, there was no statistically significant interaction.

ANOVA for tau yielded a main effect for passage ($F_{(1,39)}$ = 17.704, p < .001). The mean tau for Joan was .69 compared to .45 for Laura. The correlation between tau and recall was statistically significant (.56, p < .001), but this was not the case for recognition. This correlation has been found in previous research, although it is not entirely consistent. There were no effects for the order of cards or the time spent for each passage. The means and standard deviations are given in Table 1.

Insert Table 1 about here

The effects for signalling and feedback were further analyzed using a qualitative procedure (Langer, Keenan, & Culler, 1988). As noted previously, we divided the passages into three clusters, consisting of sentences 1-9, 10-18, and 19-26 in the original order. For all groups the

maximum occurrence of the original first nine sentences in the first nine slots without respect to order within the cluster is 90 (9 sentences x 10 subjects). The second cluster also has a maximum occurrence of 90, while the third cluster is 80 (8 sentences x 10 subjects). This analysis permits us to examine general sentence agreement within clusters between and across conditions. The percentage of agreement between clusters is given in Table 2. Figure 1 displays the data graphically.

Insert Table 2 about here

Compared to our previous study in which we used both signalling and feedback (Langer, Keenan, & Culler, 1988) the magnitude of cluster agreements are lower. The percentages for the Joan passage in the previous study where feedback and signalling were both provided, and subjects could move the sentences about as often as needed, averaged 91% for Cluster 1, 81% for Cluster 2, and 86% for Cluster 3. However in this same study where just signalling was provided and subjects were more restricted in sentence placement, the percentages were 89% for Cluster 1, 77% for Cluster 2, and 74% for Cluster 3. The difference probably lies more in the removal of feedback as compared to the restricted sentence placement.

Insert Figure 1 about here

While there were differences in magnitude, there were also similarities in findings. In both studies the highest agreements were for

the first cluster, and the differences between the second and third clusters were relatively small. This finding supports our premise that signalling seems to be most critical for concordance within the last two clusters.

Discussion

Clark's (1973) warning about treating content as a fixed variable still holds true. Although the Joan and Laura passages were relatively similar clinical discussions of familial problems, comparable in length, and with equal numbers of idea units, there were significant differences between them concerning the effects of signalling.

The tau coefficients were higher for the Joan than the Laura passage. These differences may be a function of the highly sequential nature of the Joan passage, semantically as well as structurally (see Keenan, Langer, & Culler, 1987).

Our findings seem to be converging with van Dijk and Kintsch (1983) and Kintsch's latest model (Kintsch, 1988). Basically, our subjects are able to group and retain the surface representation of segments of discourse, without necessarily extracting meaning through deeper processing. However this material is organized and stored in long-term memory, it is clear that our subjects can recall significant amounts of fragmented ideas. In short, non-organized content can be stored and retrieved, but the processes elude us.

In another sense these findings raise some significant issues regarding both types and amount of instructional assistance. The use of signalling sentences alone did not lower retrieval in any dramatic fashion, as compared to the combined contributions of signalling and feedback. This

challenges any instructional researcher as to whether or not they may be engaging in overkill insofar as assistance is concerned. Matching between types of content and types of assistance has not generally been taken seriously enough, since the usual assumption has been that aids such as feedback are generally functional and proportionally increase achievement (Langer, 1983). This assumption may now be seriously questioned.

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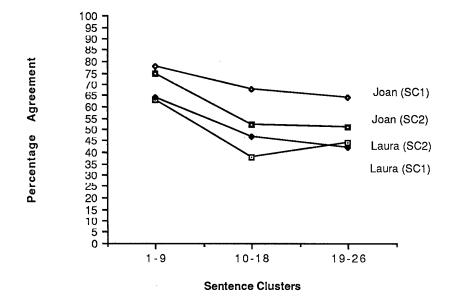
Table 1: Means and Standard Deviations

	Passage				Condition					
	Joan		Laura		SC1		SC2		Read-Only	
	X	SD	X	SD	X	SD	X	SD	X	SD
Recall	.38	.14	.33	.15	.38	.14	.40	.14	.28	.14
Recognition	.69	.09	.73	.98	.74	.06	.73	.79	.67	.11
Tau	.69	.16	.45	.19	.61	.21	.51.	.25	--	--

Table 2: Percentage of Agreement Between Clusters

Condition	Cluster		
	1-9	10-18	19-26
Joan SC1	78	68	64
Joan SC2	75	52	51
Laura SC1	64	38	44
Laura SC2	63	47	42

Figure 1: Percentage of correct cluster placement for Joan and Laura passages

Joan (SC1)

Joan (SC2)

Laura (SC2)

Laura (SC1)

Sentence Clusters

Appendix A

Joan Passage

1. The first year of Joan's life was a happy one for everybody.

2. Joan had been a gay, laughing baby.

3. She was round, chubby-faced, and dimpled.

4. Everyone enjoyed being around her.

5. Her mother, father and grandmother carried her around frequently, and her brothers played with her as if she were a doll.

6. The family was excited when she was learning to walk and say words, and cheered her on.

7. She developed quickly with all this positive attention, saying many words at a year, walking and even running.

8. When Joan was a year old, Mrs. Gary found out she was pregnant with the fifth child.

9. She became depressed and spent much of her time in bed.

10. When she was up and around, she was angry and quick with the children.

11. By the time Joan was 18 months old, Mrs. Gary was beginning to feel awkward and uncomfortable.

12. She resented the amount of care Joan required.

13. She couldn't hide her feelings, and when Joan made an advance or a request, she either wept openly or refused Joan with an abrupt, angry answer.

14. Since Joan had not met with anything like this before, she was stunned but not daunted at first.

15. She turned to her grandmother or her father or her brothers, who tried to make up for the mother's withdrawal.

16. As the months wore on, everyone in the household began to reflect the tension, and Joan's world began to crumble.

17. Her father and brothers became quieter around the house, and didn't play as much with Joan.

18. Her grandmother was so concerned about her daughter-in-law's state of mind that she, too, left Joan more and more to herself.

19. Joan reacted with a combination of quiet sadness and a kind of showing off when others were around.

20. She didn't dare express herself in the loud, gay voice she had used when she was smaller, for everyone called out "ssh."

21. On one occasion, when she was tired at night, she began to cry and lay down on the floor to kick her feet.

22. Her mother's eyes flashed, and she picked Joan up by one arm angrily and threw her still crying into bed.

23. No one came to see her.

24. The next day her right arm seem to be hurting her.

25. The family decided to have her arm x-rayed, and found she had a dislocated elbow.

26. The doctor recommended they find some help to relieve the strain on the family.

Appendix B

Laura

1. The parents of anorexics will speak with pride of having given a happy and harmonious home to their children.

2. But this may not be what the anorexic girl herself has experienced.

3. She may have been the one who was aware of the strain and felt it to be her obligation to make up to the parents for what was lacking in their relationship.

4. As an example I give the story of Laura, the second daughter of parents of prominent status in a northwestern state.

5. The older sister had been considered emotionally unstable, rather troublesome.

6. There was a younger sister who went quietly about her business.

7. Laura had lived her whole life as "the shadow" of her older sister imitating her in every possible way except in causing trouble.

8. The sister was often cruel and aggressive toward Laura.

9. To some extent the mother was aware of this, but she didn't interfere because she dreaded the temper tantrums of the older girl.

10. Since her sister had done so, Laura also decided to spend the last year of high school in France.

11. She was acutely unhappy and returned home before the end of the term.

12. She had lost a considerable amount of weight and continued to lose.

13. Until then she had been always close to her mother.

14. In contrast to the demands the older sister made, she had tried to be a "comfort" to her mother.

15. Now she became annoyed about certain mannerisms of her mother; her indecisiveness, her difficulty with being anywhere on time.

16. Then she became critical of both her parents, though she continued to admire her father as the "most perfect" man she knew.

17. The father was a successful financier who was involved in several important enterprises and also took an active part in the cultural development of his city.

18. In a way he had adjusted to his position of being the only man in an four-woman family by seeking satisfaction outside the home.

19. In spite of all her admiration for him, Laura felt he was emotionally detached.

20. There was never any criticism from him; on the contrary, he was lavish with praise and encouragement.

21. But Laura was convinced this meant nothing, that her father never showed his true feelings.

22. She felt that he was patient and considerate because that was her father's job.

23. She was desperately anxious that she could never know what he really felt.

24. As the anorexia persisted, she also expressed concern about the quality of her parents' marital relationship.

25. She felt her mother maintained what only looked like harmony by being always conforming and obedient to what her father wanted.

26. Now she was impatient with her mother because she saw in her what she dreaded would be her own fate--to be a nothing, to be devoted to a husband, to be devoted to her children, but without a life of her own.