Sentence-Order Feedback in the Comprehension of Prose

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Abstract

Reconstruction of scrambled text was performed under varied sentence-order feedback conditions. The text was more sequentially constrained than those used in prior experiments in this series. Increasing availability of confirm-disconfirm messages (0, 5, 25) produced higher success in reproducing the original sentence order, better recall, and better sentence recognition. Recall of gist and a multiple-choice test of understanding were not sufficiently reliable to confirm facilitation with feedback. Reading the passage two times was equivalent to reconstruction without feedback. Implications for instruction were discussed.

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The extraction of meaning from ordinary language has long been a concern of scholars in many disciplines, e.g., education, cognitive psychology, linguistics, and artificial intelligence. In recent years, significant progress has been achieved through interdisciplinary investigations of several particular parts of the general study of language and meaning (cf. Anderson, 1976; Britton & Black, 1985; Just & Carpenter, 1987; Kintsch, 1974; Stein & Trabasso, 1981; van Dijk & Kintsch, 1983; Winograd, 1983). The present paper is concerned with the synthesis of meaning from text in an instructional context. It reports one of a series of experiments in which scrambled passages are reconstructed with feedback, and comprehension is indexed by approximation of reconstruction to the canonical order and by various retrieval measures.

Many aspects of text have been studied including structure and content (Thorndyke, 1977), causal relatedness and importance of events (Trabasso & Sperry, 1985), and referential coherence (Kintsch, 1974). The aspect we have chosen to investigate is sentence order, because text reconstruction from randomly ordered sentences is a <u>process</u>, and therefore amenable to instructional influences. The instructional device chosen is feedback, i.e., confirmation feedback during text reconstruction. The value of this research lies in the importance of sentence order in a given text and in the pervasiveness of feedback as an instructional strategy.

Sequential order of constituents is a fundamental property of any language. Collections of graphemes in conventional order are called "words," but in unconventional orders they are called "mistakes." Words in sentences must be ordered syntactically to prevent misunderstanding. The constraints of sequence are much looser at the level of sentences in paragraphs or in passages, but we have presumed that there are optimal sentence sequences for any text and that comprehension and retrieval will be better for this than for alternative sequences.

Sequential dependency of ideas in discourse is associated with a large number of its semantic and syntactic features. Associations in prose, as in memory, are thought to have hierarchical form with category nodes branching into specific instances of members, e.g., a mother is linked with her children. Ideas and things that are associated in time or space are often ordered in language as they are ordered in reality, e.g., the Wednesday meeting is considered before mentioning the Thursday schedule. Multiple causes are linked by their common effect, and a hierarchy of importance is implied by the expression, "first things first." Structural features of language that are involved in sequence include argument overlap for coherence (see Kintsch & van Dijk, 1978), and proximity of pronouns to their referents. Prose passages may vary on any of these, and other, features of sequential dependency, and the ordering of component sentences of a passage may be much more important in some passages than others.

Feedback is one of the most commonly recommended of all instructional practices, but there remains considerable confusion concerning its many forms and contexts. It may be intrinsic or extrinsic, motivational or informational. Berliner and Rosenshine (1977) recommend feedback in the forms of both praise and criticism when the context is the academic component of classroom teaching. Although their empirical support for this recommendation is a review of nearly fifty studies of teacher feedback and student achievement, with mixed positive and negative relationships, their conclusion is unequivocal, "The successful teacher...provides positive and negative feedback to students on academic matters." When the non-academic component of teaching (e.g., behavior management) was considered, praise and criticism were not consistently associated with success. Implicit in the choice of praise and criticism as objects to investigate is the assumption that feedback is equivalent to reinforcement. This implication of behavior theory is quite common in the study of

instruction, but the reinforcement aspects of praise and criticism should be separated from their information aspects.

The need for information is more directly apparent in the use of two-choice decision tasks to study the discrimination of conceptual categories. Barringer and Gholson (1979) reviewed a large number of studies of feedback during conceptual learning by children. Most of the studies used a "...two-choice discrimination-learning paradigm...." (Note that the paradigm is a direct analog of that used to study the behavior of laboratory animals learning to discriminate, say, circles from triangles.) Overt choice and contingent reward or punishment were used in their various combinations, and the paradigm demands feedback because the subject is not instructed to jump (or point) to the circle except through information subsequent to each decision. These studies were, therefore, not about whether to provide feedback but about what kinds (verbal, symbolic, or tangible) and combinations (right-wrong, right-blank, or wrong-blank) of feedback. These reviewers concluded that learning was faster with verbal than tangible feedback, and that right-blank was the least effective combination. The studies dated from the 1950's and were probably motivated more by continuity theory than instructional theory, but the review was directed to educators. The results seem to support "informational interpretations" rather than "motivational-reinforcement explanations." The present study proposes that implications from this review should be limited to contexts in which decisions have no intrinsically apparent outcomes and therefore demand some extrinsic information feedback. A later, more systematic review of children's discrimination learning (Getsie, Langer, & Glass, 1985) provides similar conclusions and requires the same constraint on practical inference. Getsie et al. show that disconfirmation becomes increasingly helpful for older and brighter subjects, clearly emphasizing the informational value of the feedback, and suggesting that investigators in the many studies being reviewed were too optimistic in their recommendations of feedback for instruction.

In another context, Frederiksen (1984) reviews more than two hundred pieces on problem solving, including creativity. The subhead, "Provide practice with feedback," appears in the general problem solving part of the paper and again in the part on creativity. This subhead appears at first to be a prescription drawn from a critical review, but more careful reading reveals that it is merely a description of the recommendations given in some of the studies being reviewed. In many instances, feedback was merely an inherent part of an instructional method, e.g., self-corrective computer programs for arithmetic algorithms. In another instance, instruction focused on skill in obtaining feedback from the environment. The critical fact, here, is that in the studies reviewed by Frederiksen, feedback was not an explicit independent variable.

Yet another example is found in Gagne (1985) who has attempted to write a cognitive psychology for teaching in which the principal cognitive model is from Anderson (1983). Anderson claims that feedback is required for acquisition of procedural knowledge but not declarative knowledge. Gagne elaborates on both form and context, e.g., "...for proceduralization feedback about accuracy is more appropriate than feedback about speed. For composition feedback about speed is appropriate." The important point to be drawn is that the general exhortation to provide feedback during instruction is of little value without specification of the form and the context. The form may include reward, praise, acknowledgement, correction and redirection, or disconfirmation. The context may include concept formation, problem solving, strategy acquisition or reading expository prose. This criticism applies to all of the above sources. There is an urgent need for empirical mapping of feedback domains so that advice for instructional planning may be more direct, focused and specific.

Such a mapping has begun and the chosen domain is the synthesis of meaningful text from randomly ordered sentences (e.g., Keenan, Langer, & Medosch-Schonbeck, 1986). The feedback offered was confirmation or disconfirmation of sentence-placement decisions. Our expectations were that feedback would produce

agreement with original sequence, thereby enhancing comprehension and retrieval. We gave the randomly ordered sentences of prose passages to college students, with instructions to rearrange the sentences to reconstruct the original passage. Some subjects were given feedback on request as they moved sentences to new locations while others did the rearrangement without external assistance. The texts were taken from published prose as it occurs naturally so that effects would not be limited to texts specially created for particular linguistic purposes (e.g., Anderson & Pichert, 1978; Sulin & Dooling, 1974). Alternate selections were included for generalizability (Clark, 1973). It was assumed that feedback would assist reconstruction directly, i.e., increase Kendall's tau between subject's reconstruction order and the canonical order; and that tau would mediate better idea recall and sentence recognition.

In the earlier experiments our first assumption was supported generally, i.e., feedback enhanced reconstruction as indexed by Kendall's tau between subjects reconstruction order and the canonical order (Keenan, Langer, & Medosch-Schonbeck 1985; Langer, Keenan, & Medosch-Schonbeck, 1985, 1986a, 1986b). In two of four comparisons the difference in tau between feedback and no feedback was statistically reliable, and in one there was a reliable difference between limited (five tokens) and unlimited feedback. The extension of this reconstruction success to retrieval was even more tenuous; although tau increased with feedback in three of the four comparisons, percent of ideas recalled was not significantly higher for feedback conditions in any contrast, and percent of sentences in recognition was enhanced by feedback in only one of four contrasts. This failure to demonstrate memorial effects of feedback is not easily attributed to mere lack of power, for other effects showed quite definite statistical significance. Both recognition and recall were clearly better for shorter than for longer texts in the first two experiments, and for the more dense (or complex) text in the first experiment; and recognition scores were higher for the more familiar text in the third experiment. Delayed-retrieval groups were run in three

experiments and the immediate-retrieval groups did better in all retrieval contrasts. After four experiments with several variations, our data forced us to look at our assumptions about sentence-order feedback and the organization of semantic memory. In particular, the effects associated with differences of text compel us to seek a text domain, still within natural discourse, in which the sequential dependencies in a given passage ensure that information about the sequence of sentences is essential to comprehension. It also is apparent that reconstruction itself needs to be compared with ordinary reading as a processing task leading to comprehension.

In sum, the literature on instruction contains many exhortations to provide feedback, without specifications of the tasks and times for which it may be beneficial. Our attempt to specify a particular task, text reconstruction, reveals a further demand for texts of a particular kind. The purpose of the present investigation was to use the text-synthesis paradigm with a text having high sequential dependency and with various amounts of feedback.

METHOD

The passage used in this experiment was more tightly sequential than passages used in four previous experiments on text synthesis with sentence-order feedback. The expectations were that the agreement of reconstruction order with the original (tau) would be higher than with the other passages and would be a function of the amount of sentence-order feedback. The experiment asked also if retrieval of the text would be a function of feedback during reconstruction, and how reading the text as compared with reconstruction, would support retrieval.

Materials

The passage was about a little girl, Joan, and her family, and the stress they experience as her mother goes through pregnancy with a fifth child (see Appendix A). It was taken from a piece by Brazelton (1974), adapted to make a coherent expository statement in 26 sentences, matching the length of passages used in prior experiments.

We had previously used texts from a biography of Fermi and a selection from an account of Nixon reacting to the Watergate hearings. In contrast, the Joan text is not about a historic incident which subjects may have encountered in various linguistic communications, but about a familiar (family) context. Subjects all know something fairly conventional about babies and pregnancies and smiling and crying; but they probably did not know, before the experiment, about the specific events of this text. Feedback should be helpful in giving meaning to this particular set of events, of which any single event is familiar. Other aspects of the passage which should make it more likely to be influenced by sentence-order feedback are its inherent series of temporal elements and its use of many personal pronouns. The temporal nature of early childhood and of pregnancy both contribute to a kind of deterministic chain of cause-effect links. The use of pronouns is exemplified in the many instances of she (20) and her (24) referring alternately to Joan, her mother, or her grandmother. There are 74 idea units in the passage.

Other materials were the cards and slot-board, the practice task and the tests. In all the text-synthesis experiments, the sentences appear typed on 3 in. by 5 in. cards, one sentence per card, and the reconstruction is accomplished by placing and rearranging cards in the 35 slots in a board. The practice-task was an 11-sentence version of the tale of "The Goose that Laid the Golden Egg," also on cards. One of the retrieval tasks was a forced-choice recognition test in which each sentence appeared with a paraphrase. Original and paraphrase were in random positions for each sentence, and the same test was used for all subjects. Another task was a 10-item, 4-choice multiple choice test of comprehension of the passage.

Subjects and Procedures

Subjects were 48 volunteers from Introductory Psychology classes who received credit for their participation. They were assigned to the four treatment conditions in random order as they appeared individually at the lab. The conditions

were: 1) read only, 2) reconstruct, no feedback, 3) reconstruct, 5 tokens, and 4) reconstruct, 25 tokens. Each subject was told that the purpose of the experiment was to learn how people make meaning from what they read, particularly how meaning is constructed from the sentences that comprise a complete text. The condition-appropriate instructions were then given, and practiced with the story about the goose. Following successful performance on the practice task, the subject processed the Joan passage and completed, in order, a short statement of gist and written recall , a 10-item multiple-choice test (Appendix B), and a forced-choice sentence-recognition test (Appendix C).

In the read-only condition, subjects were given a deck of randomly-ordered sentence cards to read aloud one at a time placing them in the board, then asked to read them another time in the same way, and then a third time from the board. Reconstruction subjects were given the same decks and the slot-board, and told to read each card and place it in a slot in the board, to reorder the sentences to make the text as meaningful as possible, and to signal when finished. They were allowed any number of moves as long as they moved only one card at a time.

For the feedback conditions, subjects who received tokens received either five or twenty-five, and were told they could have feedback on any move by giving a token. The feedback was "right" if the move placed a card in the slot following the sentence it followed in the canonical order, e.g., sentence #12 in the original placed to follow sentence #11 in the original. The five-token condition was used in early experiments and seemed sometimes to be helpful. In one experiment a group was given unlimited feedback and the mean number used was 35 so we used 25 as a number likely to be about as helpful as any. After hearing instructions and performing the practice task, all subjects follow the procedures satisfactorily.

The experimenter recorded starting and stopping times for all conditions and numbers of moves for reconstruction subjects. For feedback conditions the numbers of

tokens were also recorded. The order of sentences in reconstruction was recorded while the subject performed the retrieval tasks.

RESULTS

The principal goal sought by this research was to show that sentence-rearrangement decisions would enhance reconstruction success immediately, and would thereby improve understanding of the meaning of the interrelated sentences comprising the whole passage, and ultimately lead to better retrieval. The measures used to indicate the links in this chain were: Kendall's tau for agreement of reconstruction with canonical order, proportion of the 74 ideas of the text in written recall, and proportion of the 26 sentences recognized against paraphrase lures. Other indices of comprehension were a statement of "a sentence or two" to convey the gist of the passage scored 0-5, and a 10-item multiple-choice test reported in proportions. A second goal was the comparison of reconstruction with reading as a processing task.

The mean (and standard deviation) scores on all the dependent variates are shown, for all four processing tasks, in Table 1. Inspection of the first two rows shows that reconstruction without feedback does not produce better retrieval than the read-only condition, even though it occupied more processing time. No statistical analysis was performed for this comparison. Apparently the text synthesis activity costs something in terms of resources available for encoding text-relevant information.

Insert Table 1 about here

The primary results are the tau coefficients and the retrieval measures for the three reconstruction conditions. Mean scores on all of these measures show the relationships we had expected, with the one exception of the multiple-choice scores for the two feedback conditions. A one way ANOVA, however, did not show significance for any variable except recognition so tests were performed for the

apparent linear trends. There were linear trends for tau, $F(1,33)=5.64$, $p<.05$; for recall, $F(1,33)=6.30$, $p<.05$; and for recognition, $F(1,33)=11.50$, $p<.01$; but not for gist or multiple-choice, p's$>.05$.

DISCUSSION

Our previous work on feedback in text synthesis has produced very little consistency of results to support the ubiquitous recommendation for feedback during instruction. The most consistent outcome in this series has been that reconstruction success and retrieval success were dependent more on the differences between passages than any differences of instruction. The present experiment has pursued this point of specificity of the relation of feedback information to the process and the material. Theoretical models of discourse have wisely, in some cases, restricted their domains to particular styles of text structure, e.g., Kintsch and van Dijk (1978) develop their model for scientific reports. This specification permitted extraordinary explication of premises, purposes and processes and led to success in simulation. Similarly, Mandler and Johnson (1977) gave us a grammar for children's stories. The taxonomy of discourse structures that is needed, we leave to others (e.g., Britton & Black, 1985), but a message for educational and instructional psychologists seems clear and unequivocal. The new cognitive psychology offers great promise, but every theoretical principle generalized from empirical laboratory experiments will require careful exploration of its generalization to practical contexts, procedures and materials. A crucial component of this exploration is the elaboration of the text-structure problem with respect to feedback during text synthesis.

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Appendix A

Joan Passage

The first year of Joan's life was a happy one for everybody. Joan had been a gay, laughing baby. She was round, chubby-faced, and dimpled. Everyone enjoyed being around her. Her mother, father and grandmother carried her around frequently, and her brothers played with her as if she were a doll. The family was excited when she was learning to walk and say words, and cheered her on. She developed quickly with all this positive attention, saying many words at a year, walking and even running.

When Joan was a year old, Mrs. Gary found out she was pregnant with the fifth child. She became depressed and spent much of her time in bed. When she was up and around, she was angry and quick with the children. By the time Joan was 18 months old, Mrs. Gary was beginning to feel awkward and uncomfortable. She resented the amount of care Joan required. 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.

Since Joan had not met with anything like this before, she was stunned but not daunted at first. She turned to her grandmother or her father or her brothers, who tried to make up for the mother's withdrawal. As the months wore on, everyone in the household began to reflect the tension, and Joan's world began to crumble. Her father and brothers became quieter around the house, and didn't play as much with Joan. Her grandmother was so concerned about her daughter-in-law's state of mind that she, too, left Joan more and more to herself. Joan reacted with a combination of quiet sadness and a kind of showing off when others were around. She didn't dare express herself in the loud, gay voice she had used when she was smaller, for everyone called out "ssh."

On one occasion, when she was tired at night, she began to cry and lay down on the floor to kick her feet. Her mother's eyes flashed, and she picked Joan up by one arm angrily and threw her still crying into bed. No one came to see her. The next day her right arm seem to be hurting her. The family decided to have her arm x-rayed, and found she had a dislocated elbow. The doctor recommended they find some help to relieve the strain on the family.

Appendix B

Multiple-Choice Test (Joan)

1. The family's last name was: a. Cory b. Mills c. Gary d. Cull
2. Joan's arm was: a. sprained b. broken c. dislocated d. bruised
3. Joan's mother became pregnant again when Joan was how many months old?

   a. 9 b. 12 c. 15 d. 18
4. Joan's mother started to get uncomfortable when Joan was how many months old?

   a. 12 b. 15 c. 18 c. 20
5. As time wore on, Joan's mother: a. had morning sickness. b. yelled frequently. c. resented the care Joan required. d. All of the above.
6. Who played with Joan as if she were a doll? a. her mother b. her father c. her grandmother d. her brothers
7. What caused the family's stress? a. her father got a new job causing him to be absent often. b. her grandmother moved in. c. the mother's tolerance decreased with the pregnancy. d. Joan's brothers teased her.
8. How did the family react to the stress: a. The grandmother left Joan more to herself. b. Some members tried to compensate for the mother. c. The family became quieter. d. All of the above.
9. How would you describe Joan in her first year?

   a. happy b. withdrawn c. hyperactive d. spoiled
10. How would you describe Joan in her second year?

    a. happy b. withdrawn c. hyperactive d. spoiled

Appendix C

Recognition Test (Joan)

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

   _____ The first year after Joan was born everybody was happy.

2. _____ Joan had been a bubbly, smiley baby.

   _____ Joan had been a gay, laughing baby.

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

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

4. _____ The whole family loved being around her.

   _____ 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.

   _____ Her father, mother and grandmother carried her often, and her brothers played with her like a doll.

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

   _____ The family was delighted at her attempts to walk and say words, and cheered.

7. _____ With all this attention her development was early, saying may words at a year, walking and even running.

   _____ 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.

   _____ Mrs. Gary discovered her fifth pregnancy when Joan was a year old.

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

   _____ During much of the pregnancy she was depressed and in bed.

10. _____ She was irritable with the children when she was up and around.

    _____ 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.

    _____ When Joan was 1-1/2, her mother started feeling awkward and uncomfortable.

12. _____ She resented the amount of care Joan required.

    _____ Mrs. Gary began to resent the care Joan required.

13. _____ When Joan made a demand from her mother, she couldn't hide her feelings, and either cried or refused Joan with a quick, angry answer.

    _____ 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. _____ Joan was stunned, but not daunted at first, since she hadn't met with anything like this before.

    _____ 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.

    _____ Joan turned to her grandmother, father or brothers, who all tried to compensate for the mother's withdrawal.

16. _____ As the months went on, the whole household reflected the tension, and Joan's world began to crumble.

    _____ 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.

    _____ Joan's brothers and father were less willing to play with her, and were quieter around the house.

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.

_____ Even Joan's grandmother left Joan more to herself, being worried about her daughter-in-law's state of mind.

19. _____ Joan reacted by alternating between a kind of sadness and showing off when others were around.

_____ 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."

_____ She became hesitant to use the loud, gay voice she had used before, 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.

_____ One night, when she was tired, she started crying and lay down on the floor and kicked.

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

_____ Her mother flared-up, and picked Joan up angrily by one arm, throwing her still crying into her bed.

23. _____ None of the family went to see how she was.

_____ No one came to see her.

24. _____ The following day Joan's right arm seemed to be bothering her.

_____ The next day her right arm seemed to be hurting her.

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

_____ They thought they should have it x-rayed, and were told it was injured.

26. _____ The physician said he thought they should find some ways to relieve the family's stress.

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

Table 1. Means (and Standard Deviations) For All DependentVariables by Processing Condition.

Processing Tasks	Kendall's Tau	Idea Recall Proportion	Sentence Recognition Proportion	Tokens Used	Time (min.)	Moves	Gist	M-C
Read only	---	.376 (.179)	.864 (.902)	---	7.42 (1.68)	---	1.50 (1.38)	8.00 (1.13)
Reconstruct no feedback	.697 (.162)	.353 (.133)	.835 (.370)	---	14.75 (5.85)	18.33 (10.28)	1.17 (0.58)	7.92 (1.62)
Reconstruct 5-tokens	.732 (.174)	.454 (.249)	.895 (.518)	2.83 (2.04)	30.00 (15.33)	28.92 (26.19)	1.58 (0.90)	8.92 (0.90)
Reconstruct	.848 (.126)	.493 (.216)	.899 (.489)	13.08 (11.06)	29.08 (8.55)	24.67 (9.83)	1.92 (1.16)	8.42 (1.51)