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REMEMBERING SCRIPT-BASED TEXT

FRANCIS S. BELLEZZA and GORDON H. BOWER *

The role of scripts in the remembering of text was investigated focusing on the problem of how new information relevant to a particular script is organized and stored in memory. The results of three experiments are presented. It was shown that the typically ratings of script events were inadequate in predicting what information would be recalled. Both the unusualness of the information presented in a script-based passage and the level in the script hierarchy to which it belonged seemed to be important factors determining how the information was processed. As a possible explanation of the data, it was suggested that scripts be treated as cognitive cuing structures. In this approach instantiated script events can act as recall cues for the unusual information presented in the text. Also, the notion of the band width of a cuing structure indicates the range of information upon which the structure can operate. In addition, it was found that scripts do not cluster information during recall as do taxonomic categories. Finally, data was presented indicating that scripts act not only as scaffolds for new information but may also affect the allocation of attentional resources during text comprehension.

In recent years investigators in areas such as artificial intelligence, cognitive psychology, and social psychology have come to believe that organized knowledge structures in memory play an important, if not dominant, role in how people perceive, comprehend, and remember information. These knowledge structures can be thought of as generic concepts representing objects, persons, situations, events, sequences of events, actions, and sequences of actions. Furthermore, knowledge structures of this sort may have a role in motor activity (Schmidt 1975), in our response to visual art (Gombrich 1969), and in our interpretations of literature (Culler 1981; chap. 6). These different types of generic concepts have been labeled frames (Minsky 1975), memory schemata (Bobrow and Norman 1975; Rumelhart and Ortony 1977), beta structures (Moore and Newell

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Requests for reprints may be sent to either Francis S. Bellezza, Department of Psychology, Ohio University, Athens, OH 45701, USA, or to Gordon H. Bower, Department of Psychology, Stanford University, Stanford, CA 94305, USA.

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1973), scripts (Schank and Abelson 1977), macrosctructures (Kintsch and Van Dijk 1978), and memory organization packets (Schank 1980), to mention a few. There are, of course, differing views as to how these structures operate and interrelate, but still there seems to be a great deal in common among the proposals that have been made. In this paper we shall refer to these organized knowledge structures as memory schemata and limit our discussion to those attributes that seem to be characteristic of all the concepts proposed (Rumelhart 1980; Thorndyke and Yekovich 1980). Also, our discussion will be focused on a kind of memory schema called a script.

A script deals with a stereotyped series of events involving one or more actors (Abelson 1981; Cullingford 1978; Schank and Abelson 1977). A script not only enables us to comprehend a real or described situation, but also provides a blueprint for the behavior necessary in that situation. For example, in a written passage the restaurant script may be activated in memory by the sentence, "John was hungry so he entered a restaurant". The information in the passage that follows will tend to be interpreted in terms of the restaurant script. This *instantiation* of the restaurant script is encoded into memory and will consist of the particular information presented in the passage in addition to any inferences made from the generic script. If the sentence, "He sat down" is presented, the reader is likely to interpret the event as John sitting down at a table in the restaurant and preparing to order something to eat.

Scripts have subparts or components which represent stereotyped events connected with the script. These events can be grouped into scenes. In the restaurant script the patron typically enters, orders, eats, pays, and leaves. Each scene is made up of a series of events. When ordering the patron may look at the menu, signal to the waiter, give his order, and then give the menu back to the waiter. Also, scripts may have various tracks so that what is expected in a fast-food restaurant is different from what is expected in a fancy restaurant (Schank and Abelson 1977). Just as script scenes are made up of script events, script events are made up of roles, actions, and props. For example, John the patron (role) may be led (action) to a table (prop) by the hostess (role). Fig. 1 provides a schematic representation of a script, its script events, and the components of the event. Because we are concerned

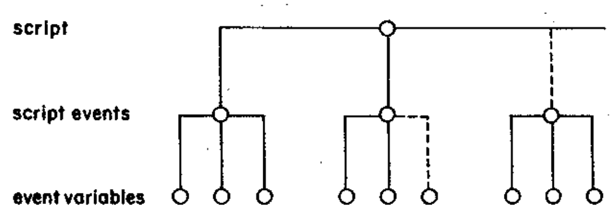

Fig. 1. Three levels of hierarchical components used for a script. The dotted lines represent atypical events (level 2) or atypical objects within a script event (level 3).

here primarily with script events, the level of the script hierarchy representing script scenes has been left out of fig. 1.

Often, the components of the script events are variables. The patron may be Jane not John. The drink may be water, wine, beer, or milk. The food eaten also varies. Hence, a script has slots into which different variable values are bound, depending on the particulars of a text. What makes scripts and memory schemata important in comprehension is that much information not presented in the text may be inferred from the activated script. Even though nothing about a menu may have been mentioned in the text, the reader understands that John knows what to order from the waiter because John probably looked at a menu. Thus, the script events and variables may be inferred when they are not explicitly mentioned in the text.

The amount of research dealing with scripts is not large, but it is more extensive than the research on most types of memory schemata. Studies have shown that there is good agreement among people as to what events constitute a particular script (Bower et al. 1979; Graesser et al. 1979). Information that fits an activated script is comprehended faster than information that does not fit (Bellezza and Bower 1981; Den Uyl and van Oostendorp 1980). Information appropriate to a script is recalled better when the script is activated compared to when it is not activated (Anderson et al. 1978; Bransford and Johnson 1972). Also, information presented that fits an activated script is recalled better than information which does not fit (Graesser et al. 1980). And when intrusions occur during recall, they are likely to be inferences made from the activated script rather than other types of information (Bower et al. 1979).

Similarly, the results obtained with recognition tests can be understood using the notion of a generic script activated in memory. People have trouble discriminating between script information that has been presented in a text and information characteristic of the script that has not been presented (Bellezza and Bower 1981; Bower et al. 1979; Graesser et al. 1979, 1980). Once a script has been achieved, a "gap-filling" phenomenon takes place in which unspecified events, persons, and objects are inferred. Later the comprehender has difficulty deciding what information he or she was actually presented and what was inferred.

The purpose of the research presented here was to investigate the processes by which new information is instantiated or assimilated by a generic script in memory and to discover some of the characteristics of the resulting memory structure. To do this the type of information presented in script-based passages was manipulated. In experiments 1 and 2 the information presented was either typical or atypical of the script in which it was embedded. Also, the level of the atypical information was manipulated. The atypical information could be either the script events themselves or the types of objects or persons mentioned within each script event.

In experiment 3 all the information in a particular passage was typical of one of the four scripts upon which the passage was based. However, the arrangement of the script events within a passage was varied to determine whether the generic script would influence the organization of the new information in memory and whether the events associated with a particular script would be likely to be recalled together.

Scripts and slots

A characteristic of all forms of memory schemata is that they embed in one another (Rumelhart 1980). A narrative story, for example, may involve the activation of a number of scripts as subparts. As shown in fig. 1, a script itself is made up of a number of subschemata each describing script events. These script events, in turn, contain a number of constant and variable values representing actions, persons, places, and objects. One way to learn more about how scripts store information in memory is to experimentally manipulate the information in a text with regard to how well it fits the activated script, as we did in experiments 1 and 2. Previous research indicates that the events included in a text which do not fit the instantiated script will tend not to be recalled (Graesser et al. 1980). We did not expect an atypical event in a script-based text to be recalled very well because they would not be recognized by the reader as filling a *slot* in the script.

However, if atypical or unusual information is placed *within* a script event, that is, in a slot, then recall of this information may be better than otherwise expected. The reason is that the unusual information becomes part of a script event which can be instantiated during comprehension and will likely be reactivated again during testing. At recall both the typical and unusual components of the event will be

Table 1
A script-based passage from experiment 1 containing four atypical script events and four atypical script objects.

The student attends a lecture
The student entered the large lecture hall.
She stepped over someone asleep in the corner. (atypical event)
She finally was able to find a seat.
The student put down her pet bird. (atypical object – *pet bird* replaces *book bag*)
She then opened up her deck of cards. (atypical object – *deck of cards* replaces *notebook*)
She talked with some of the other plumbers. (atypical object – *plumbers* replaces *students*)
The student said hello to the entering professor.
She next took a drink from her bottle of whiskey. (atypical event)
She stuck her chewing gum behind her ear. (atypical event)
The student copied what the professor wrote on the window. (atypical object – *window* replaces *blackboard*)
She wrote down the assignment for the next class.
She cut up some paper at the end of the class. (atypical event)

Note. The words in parentheses were not presented to the subjects during the experiment.

remembered. In fig. 1 an atypical script event within a scipt is connected to the script structure by a dotted line as is the atypical variable value within a script event. This notion that recall of atypical information depends on the level in the script at which it occurs was tested in experiment 1.

Table 1 gives some examples of atypical events and atypical objects within typical events for the script-based passage "The Student Attends a Lecture". In table 1 the sentence "She stepped over someone asleep in a corner" is an atypical event. The sentence "She put down her pet bird" represents a typical script event that contains an atypical object. The student would be likely to put down a book bag as she sat down, but in this sentence the words "book bag" were replaced by the atypical "pet bird". Table 1 gives other examples of typical script events, atypical script events, and typical script events which contain atypical variable values. It was predicted that sentences in a script-based passage representing typical script events would be recalled best. Furthermore, because atypical variable values can fill slots in instantiated script events, it was expected that the sentences representing typical events with atypical variable values would be recalled next best. Finally, the atypical events would be recalled least well because they would not be instantiated as part of the script.

Experiment 1

Method

Eight script-based passages were used each made up of 12 events. Each passage was preceded by a descriptive title which was designed to activate the appropriate script in the memory of the reader. The titles were the salesman eats at a restaurant, the patient goes to the doctor, the wife goes to the department store, the student goes to a lecture, the banker takes an airplane trip, the secretary works in an office, the driver goes to a gas station, and the worker gets up in the morning. The scripts were formed from the normative data reported by Bower et al. (1979) and from additional data collected by the authors. Some of the script events were replaced by events atypical of the script. Also, some of the objects, persons, and places in a typical event were replaced by atypical values. More specifically: two of the passages remained unchanged. In two of the passages an object in in each of four of the typical events was replaced by an atypical object. In another two of the passages four of the typical script events were replaced by atypical events. In the final two passages four typical objects were replaced by atypical objects and four typical script events were replaced by atypical events. The passage shown in table 1 is an example of this last condition. Four different forms of the passages were used so that each set of two scripts occurred in each of the four conditions across subjects. This was done so that the effects of a particular script on memory performance was not confounded with the experimental factors of event typicality and object typicality.

Ten passages were arranged in a booklet with one passage printed on each page. The first and last passages were buffer passages and were not tested. The first passage was a warm-up passage and indicated to the subject the general nature of the material. The last passage imposed a short retention interval between the reading of the last passage to be tested and the beginning of recall. The title of each passage was printed on the top of the page containing the passage, and the 12 events appeared underneath. Each event was described by a sentence. Each of the 34 undergraduate subjects was tested on one of the four forms of the material. In reading the passage each subject used a large card with a slot cut in it so that only one line on a page could be read. Paced by the word "Next" from the experimenter, each subject moved his or her card down the page and studied each title and each sentence for 5 seconds. After presentation of the ten passages each subject was given a test booklet containing the titles of the eight experimental passages and was requested to write down the sentences presented with each title. For half the subjects recall took place immediately, and for the other half recall occurred one week later.

To determine which events were perceived as typical, after the recall test each subject rated each sentence in the study booklet as to how well it seemed to fit into the passage. Using a 6-point rating scale, a rating of 6 indicated that the event would be *very likely* to occur in this situation, and a rating of 1 indicated that the event would be *very unlikely* to occur. The other four values were also given appropriate verbal labels.

Results

Certain procedures in scoring and analysis used in experiment 1 were the same in all three experiments. A sentence was scored as correctly recalled if its meaning was correctly recalled. This means that synonyms of the original words were acceptable as were changes in phrasing and in word order. Also, in the analyses of variance used to test for differences among the mean scores, all tests of statistical significance were performed with the value of alpha set to 0.05.

In experiment 1 the proportions of recalled typical script events, atypical script events, and typical script events containing atypical objects were computed for each subject. An analysis of variance was then performed with the two factors being retention interval (immediate recall versus delayed recall) and type of event (typical, atypical, and typical with atypical values). The recall results are shown in fig. 2. There was a significant effect of retention interval. As expected, in the immediate-recall condition 0.40 of all the sentences were correctly recalled compared to 0.15 in the delayed recall condition, $F(1, 32) = 17.98$. $MSe = 0.088$. In addition, the level of recall depended on the type of event, $F(2, 64) = 6.90$, $MSe = 6.90$, $MSe = 0.010$. Typical script events with typical values and typical script events containing atypical values were recalled better than the atypical events. This result was expected because there exist *slots* for persons, places, and things within a script event, but the events atypical of the script were not expected to be instantiated. There was no significant interaction between retention interval and type of event.

Corresponding to our expectations about recall performance, we thought that the role of memory schemata both in comprehending and in remembering new information. The comparison also illuminates the relation of comprehension to remembering. The imagery ratings and the recall results of experiment 2 taken together clearly show that the peg-word mnemonic can bind both script nouns and random nouns equally well using visual-imagery mediation. However, the restaurant script, when used as a cognitive cuing structure, could not bind the random nouns easily but did an excellent job in binding nouns fitting the script events. The success of this binding was indicated by both the rating and recall data.

In discussing these two types of cognitive cuing structures it may be useful to utilize the notion of *band width.* The peg-word mnemonic is a broad-band cuing structure. It can bind words which vary widely from one another in meaning. A script, however, is a cognitive cuing structure which has a narrow band width. It can bind only those variables which meet the constraints associated with each slot in the individual script events. The acceptable variable values are more constrained in their semantic range than are the values that can be bound to a peg-word mnemonic.

Of course, these constraints present in any script have a purpose, for they allow us to make inferences in a script-based passage when some events and some components of events are not explicitly stated (Minsky 1975). The narrow band width of a script relates to both the binding of values and the making of inferences. No inferences can be made when using a mnemonic device, just as no comprehension takes place when learning with a mnemonic device. On the other hand, script-based or schema-based comprehension occurs when a variable value is presented which fits the constraints of an available slot in the activated script.

The clustering of script events in recall

In the two experiments discussed so far our primary concern was how new information is processed and encoded using memory schemata. In experiment 3 the question addressed was somewhat different. Memory schemata such as scripts should be able to reorganize information if the information in a text is presented in some non-optimal manner. In the course of naturally comprehending and processing linguistic material the information instantiated by some type of memory schema may not be temporally and spatially arranged in the text in a manner that corresponds to the way that information exists in the schema. For example, scripts are often interrupted by other scripts. Also, scripts may be embedded in one another or be occurring simultaneously (Schank and Abelson 1977). Memory schemata should be able to process schema-based events even if they are not presented in the most appropriate arrangement.

A phenomena which is analogous to what may be expected from memory schemata and which has been widely studied by learning researchers is semantic clustering in free recall (Bousfield 1953). If a word list is presented for recall which contains items from the same taxonomic category spread throughout the list, then items from this category tend to be recalled together. It seems that as each category item is processed, the category concept is activated in memory, and the individual item becomes associated with it. During testing the category concept is first retrieved, and the items from each category are then recalled together regardless of their arrangement in the presented list (Bower 1972). Somewhat analogous results involving order information have been obtained using text material. Kintsch et al. (1977) found that people who read stories in which the events are scrambled tend to recall these stories in their correct order. Bower et al. (1979) presented a few script events out of order and found that these events tended to be recalled in their natural positions.

Memory schemata may organize information in somewhat the same manner as category concepts. Information separated during presentation but instantiated by a memory schema such as a script may be reorganized as it is processed. We have performed a number of experiments in which subjects read and recall passages made up of organized and unorganized script components. The experiment described here is representative both of the methods used and results obtained.

Experiment 3

Method

Three passages were written. They were titled "Mother's Busy Morning", "Father's Busy Afternoon", and "Sister's Busy Evening". Each passage was based on four scripts with each script containing six typical script events. Each event was represented by a different sentence or clause, all of which were approximately the same length. For the Mother passage the four scripts used were making coffee, feeding a baby, washing the laundry, and writing a letter. For the passage about Father, who was a grocer, the scripts used were washing a window, stocking shelves, changing a light bulb, and smoking a pipe. For the Sister passage the scripts were vacuuming the rug, decorating the party room, making party snacks, and getting dressed up. Within each passage the first script event of each script was introduced by a statement activating the script. An example is "Next Mother decided to write a letter to her sister. First, she took some paper from her desk".

The stories were always read by the subjects in the order Mother, Father, Sister. However, the script events were arranged differently in each passage. For one of the passages the six script events in each script were presented in order and contiguously. If the four scripts in a passage are denoted A, B, C, and D, then the presentation order within the passage was A_1, A_2, A_3, A_4, A_5, A_6, B_1, B_2, ..., D_5, D_6. This was the blocked condition. For another passage the script events were presented in order but interleaved with events from the other scripts. The order of presentation was something like A_1, B_1, C_1, D_1, B_2, D_2, A_2, C_2, ..., D_6, B_6, A_6, C_6. For the remaining passage the scripts events were partially blocked in the following way: for two of the scripts in the story the script events were arranged A_1, A_2, A_3,

Table 2
A partially blocked passage from experiment 2.

Mother's busy morning
Mother McGrady knew that she was going to have a busy and hectic morning. (I) She wanted to have a cup of coffee, (A_1) so she took coffee pot from the cupboard. (I) She also wanted to write a letter to her sister, (B_1) but she first had to get some paper from her desk. (B_2) When she finished writing the letter, (B_3) Mother next had to search around to find an envelope. (I) The laundry also had to be washed, (C_1) so Mother got the dirty laundry from the clothes hamper. (I) She then realized that she had to feed the baby, (D_1) so she started to warm up some baby food. (D_2) She then placed the baby in his high chair (D_3) and tied a bib around his neck. (B_4) Mother placed her letter in an envelope (D_4) before she placed the baby food in a bowl. (A_2) She then was able to pour some water in the coffee pot (C_2) and also started to sort the dirty laundry. (D_5) Mother then wiped off the baby's mouth (C_3) and placed the dirty laundry in the washing machine. (A_3) She also measured some coffee into the coffee pot (B_5) and found a postage stamp for her letter. (C_4) Mother took the laundry soap from the closet (C_5) and added soap to the washing machine. (C_6) She next took the clean laundry out of the washing machine. (A_4) She then got a chance to place the coffee pot on the stove (A_5) and let it perk for a few minutes. (A_6) She then took the coffee off the stove. (B_6) Mother next placed her letter in the mailbox (D_6) and was then able to lift the baby out of his chair. By the end of the morning Mother McGrady wanted to take a long rest.

Note: Letters in parentheses were not included when the passage was presented to subjects. (I) represents the activation of a script, (A_1) represents the first event in Script A, (A_2) the second event, and so on.

(A_4 A_5 A_6), and for the other two scripts the script events were arranged (B_1 B_2 B_3), B_4, B_5, B_6. Next, these four segments comprising each script were interleaved resulting in something like A_1, (B_1 B_2 B_3), C_1, (D_1 D_2 D_3), B_4, D_4, A_2, C_2, D_5, C_3, A_3, B_5, (C_4 C_5 C_6), (A_4 A_5 A_6), B_6, D_6. An example of the Mother passage under the partially blocked condition is shown in table 2. The (I) in the passage in table 2 represents the point at which a script is activated. To counterbalance the effects of specific passages on the measures of retention, each of the three passages appeared as blocked, partially blocked, and interleaved an equal number of times across subjects. The subjects read each passage for 2 minutes, and after reading all three passages the 36 undergraduates tested were asked to write down as much of each passage as they could remember. Recall was in the same order as presentation; that is, Mother, Father, and Sister.

Results

The proportion of sentences correctly recalled from each type of story were as follows: from the blocked stories, 0.54; from the partially blocked passages, 0.49; and from the interleaved passages, 0.44. These proportions are displayed in table 3. The difference among these means was significant, $F(2, 70) = 5.15$, $MSe = 0.015$. The recall results indicate that an increase in the degree of blocking during presenta-

Table 3
Performance means under the conditions of script organization used in experiment 3.

Measure	Condition		
	Interleaved	Partially blocked	Blocked
Proportion recalled	0.44	0.49	0.54
ARC scores	0.15	0.29	0.95
Input-output correlation	0.66	0.82	0.97
Recognition of targets	5.20	5.17	5.17
Recognition of distractors	3.51	3.17	3.36
Recognition of irrelevants	1.56	1.75	1.73

tion resulted in an increase in the level of recall performance.

A second measure, the adjusted ratio of clustering (ARC) score (Roenker et al. 1971) was computed from the recall of each subject for each passage. If the recalled events of a script were recalled adjacently, that is, perfectly clustered, then the ARC score would have a value of 1. If the recalled script events were recalled non-adjacently, randomly mingled with the events of other scripts and not clustered, then the ARC score would be 0. As can be seen in table 3, the ARC scores decreased as the blocking of the script activities decreased, $F(2, 70) = 31.70$, $MSe = 0.209$. The values of the ARC scores indicate that the separated script events in the partially blocked and interleaved conditions did not tend to be recalled together.

Inspection of the recall protocols indicated that subjects tended to recall the sentences of a passage in much the same order as they were presented. To test this hypothesis quantitatively, a Spearman rank correlation was computed between recalled sentences ranked first according to their presentation order and then by their order of recall. A correlation was computed for each of the three passages recalled by each subject. The mean correlations are also shown in table 3. Even in the interleaved condition a relatively high correlation value of 0.66 was obtained indicating that subjects did not cluster the sentences according to script but rather tended to recall the sentences in the same order as they were presented.

Discussion

It is unclear why clustering by scripts did not occur. The passages contained sentences designed to activate each of the four scripts. Also, the levels of recall of the three passages, though different, were all in the range of 0.44 to 0.54 of the sentences recalled. The rough equivalence of these recall levels is important because it indicates that under all three conditions the scripts were instantiated to approximately the same degree. If the memory schema appropriate for a particular passage is not activated, then the level of recall performance for that passage will be impaired (Anderson et al. 1978; Bransford and Johnson 1972). We have no reason to believe that the script events in the blocked passages were not instantiated, and since the recall levels were similar we would like to assume that the script events in the partially blocked and interleaved passages were instantiated. Nevertheless, clustering of sentences by script did not occur in recall in these latter two conditions. The analyses using ARC scores and input-output correlations indicated that subjects tended to recall script events in much the same order as they were presented. In another experiment in this same series no significant differences were found in the recall levels for the blocked and interleaved passages, and there was no clustering in recall of the interleaved passage.

There is additional evidence which indicates that the scripts were activated equally well for all three types of passage organization. Following the test of recall in experiment 3 the subjects were given a test of recognition for each of the three passages. The recognition test was comprised of 20 script events, and the subjects had to rate each event on a 6-point rating scale. A 6 meant that the subject was sure that the event had appeared in that passage and a rating of 1 meant that the subject was sure that the event had *not* appeared in the passage. To create the 20 events, two script events were sampled from each of the four scripts with the added condition that these same events had appeared in the passage. These eight events made up the target items. Also, two script events were sampled from each of the four scripts, but these events were not among those presented in the passage. These eight events made up the distractor items. Finally, four script events were presented which were drawn from scripts not presented in the three passages. These were labeled the irrelevant items.

The three types of items in the recognition test were given significantly different ratings, $F(2, 70) = 204.10$, $MSe = 1.58$. However, the important result was that there was no effect of passage organization on recognition performance. The mean ratings for each type of passage are displayed in table 3. This similarity of recognition performance across the different types of passage organization indicates that the degree of script activation in each passage was equivalent. If one of the three types of passage organization resulted in a lesser amount of script activation, then the ratings of the target items and the distractor items for that passage would have been generally lower (Graesser et al. 1979, 1980).

We may conclude from these results that the organization of information by memory schemata may take place, but this organization may be also affected by other factors. The theories concerning the operation of scripts such as those of Schank and Abelson (1977) and Graesser and his associates (Graesset et al. 1979, 1980) do not directly address the issue of how instantiated texts may be reorganized, but they imply that script clustering should take place in recall. However, in agreement with the results presented here Bellezza and Bower (1981) found that when subjects recalled texts based on a single script and an equal number of interleaved atypical events, clustering of script events in recall did not occur. The interleaved atypical events were recalled in the same relative positions they occupied in the passage.

One way of explaining this lack of clustering by scripts is to assume that there exists some form of narrative schema which biases the subject toward interpreting successive sentences as being linearly or sequentially related. A component of this narrative schema may be the tendency for people to look for causal chains or conceptual dependencies among sentences adjacent in the text (Schank 1972). In some texts, certainly, the order of events must be remembered for correct causal inferences to be later made.

Scripts, comprehension, and attention

The activation of a particular schema in memory means that an attempt will be made to fit incoming information into that schema. However, schema activation may also have effects on the allotment of processing resources; that is, on attention. We would like to discuss an additional analysis of the data of experiment 3 which seems to demonstrate both the subtlety of the mechanisms of comprehension following script activation and the need for care in designing experiments to investigate the functioning of any memory schemata. In this analysis only data from the partially blocked passages were used, and the script events from these passages were divided into four types. There were those which occurred in the first half of the script, such as A_1, A_2, and A_3, and those which occurred in the second half, such as A_4, A_5, and A_6. Also, the script events were divided into those appearing blocked, such as (B_1 B_2 B_3), and those appearing separately, such as C_1, C_2, and C_3. When

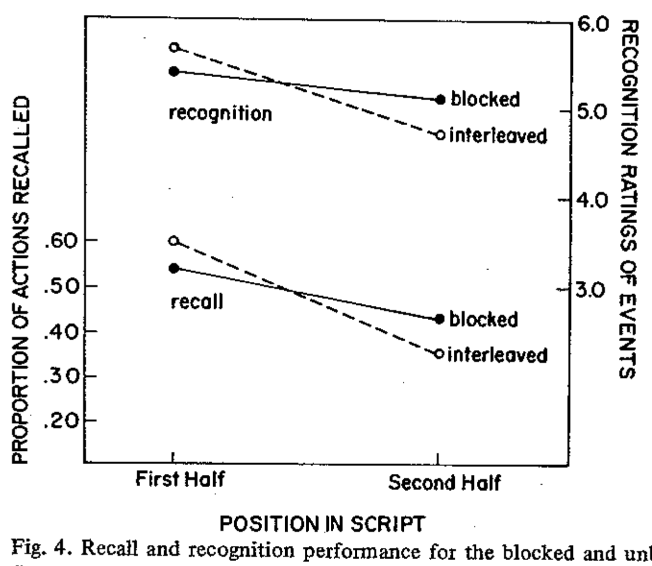

Fig. 4. Recall and recognition performance for the blocked and unblocked script events in the first and second halves of the scripts used in the partially blocked condition in experiment 3.

the recall of the partially blocked scripts was analyzed using these two factors, a Serial Position × Blocking Condition interaction resulted, $F(1,36) = 4.22, MSe = 0.028$. This interaction is shown in fig. 4. It is difficult to know for sure why this pattern of results occurred, but we will suggest one possible interpretation. If the early information of an instantiated script consisted of a number of separated script events, then as the subjects came across these separated events, they looked back and reread the earlier ones. This process resulted in better recall for these events. Also, the reading of the early separated script events meant less attention was paid to the later blocked events of the same script. However, if the early script information was blocked, this rereading did not take place. Thus, what may have happened here was that the arrangement of the script information in a text determined in part the degree of attention it received and the degree to which it was remembered. Fig. 4 also shows that the same pattern of remembering occurred when recognition performance was tested. The recognition results support the notion that this pattern results from differences in the amount of study time. It appears that scripts not only provide an ideational scaffolding for the storage of script information in memory, but also influence the allotment of attentional resources (Anderson 1978; Neisser 1976: chap. 9).

Activation of a particular script may influence not only what presented information is instantiated but may have an effect on the amount of attention types of information receive. The amount of attention received could depend upon (a) relevance of the information to the generic script, (b) how much of the script has been instantiated, and (c) the location of other script information in the passage. To assume that memory schemata influence attention does not seem unreasonable. People monitor their comprehension as they read and may spend more time looking at text difficult to understand; that is, information not subsumed by the currently active memory schemata.

Data from other experiments also support the notion that memory schemata can influence the types of information attended to. Bellezza and Bower (1981) measured decision times for sentences describing events typical and atypical of an activated script. They found that subjects spent 50% more time judging events that were atypical. However, both typical and atypical script events were recalled equally well. In this particular experiment it seems that the advantage typical script events had in ease of storage was offset by the greater amount of processing that the atypical events received.

It might also be noted from fig. 4 that script events from the first half of the script were better recognized and recalled than were script events from the second half. This was also true for the blocked and interleaved passages. Bellezza and Bower (1981) obtained similar results for passages based on only one script. It is not clear why this occurs, but it could be that subjects reading any passage have to keep in mind earlier parts of the text to better understand later parts. This "keeping in mind" is a rehearsal process which may enhance recall performance (Atkinson and Shiffrin 1968).

Conclusions

We have presented some data concerning the operation of script-type memory schemata in connection with the comprehension and remembering of text. Also, we have made a number of proposals as to how these data may be interpreted. Of course, we consider these proposals as suggestions to promote further research and not as definitive answers to the questions that have been raised. Research on memory schemata has not reached the point where many definite conclusions can be drawn. There are many methodological problems to be overcome when experimenting on memory schemata, as attested to by the sometimes complex design of the experiments presented here. Furthermore, adequate experimental design may be complicated by the fact that memory schemata may not only act as a framework for storing new information, but also subtly influence attentional processes.

Another consideration in interpreting our results is that scripts may be a special type of memory schemata, and it may be that other forms of memory schemata differ from scripts in ways not now recognized by memory investigators. Consequently, some of the results presented here characteristic of scripts may not be true of these other forms.

In spite of these reservations some of the proposals that we have made here warrant further consideration. Scripts, like most other forms of memory schemata, are hierarchical structures, and it seems that lower level components activated in the script result in more specific inferences than do higher-level components. The more specific the contextual conditions a person perceives, the more specific his or her expectations will likely to be of what will occur next in the text. Therefore, the activation of a specific script event may result in more precise predictions than the activation of the generic script or a script scene.

The presence of slots seems to be based on the presence of well-defined inferences. When a script is activated and some script event is instantiated, strong expectations arise for a well-specified type of information to occur in the text. These specific expectations may be considered as the restrictions being placed on the information that can be bound into these slots. Another result of the generation of specific expectations following event instantiation is that persons, places, and things inferred from the activated script may become associated with the unexpected information appearing in the presented text. The script then can act as a cognitive cuing structure because these script components are likely to occur both during comprehension and later during recall. In this way these components act as cues and aid in remembering unusual information. This process is in agreement with the principle of encoding specificity (Tulving and Thomson 1973). Also, the script generated cues representing person, places, and things involve the retrieval from memory of sensory-perceptual information and thus may be especially effective because this learning involves visual-imagery mediation (Paivio 1971).

Scripts are cognitive cuing structures with narrow band widths, so there are constraints on the types of information presented in a passage that can be instantiated by the script. Experiment 2 demonstrated that including atypical objects as values in script events resulted in both low comprehension and in low levels of recall. In contrast, the peg-word mnemonic represents a cognitive cuing structure from which few inferences can be drawn and therefore it was able to bind a broader range of information.

Scripts do not seem to organize information during recall in the same manner as do other concepts such as taxonomic categories. The spreading out of script events in some passages in experiment 3 did not result in the clustering of these events in recall, even though the appropriate scripts seemed to be activated. Other knowledge structures, in this case a narrative schema, may possibly be operating so that the script may not be the sole schema affecting the organization of the information in memory.

Although the notions of memory frames and memory schemata seem to be necessary to adequately understand comprehension and memory on any level, experimentation in this area is fraught with methodological difficulties. If experimentation is to proceed, better defined and more easily testable models of memory schemata must be developed (Thorndyke and Yekovich 1980). Progress may be slow, but the reward of a better understanding of understanding itself is a great one.

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Francis S. Bellezza received his Ph.D. from the University of Minnesota and is now Professor and Director of Experimental Training at Ohio University. His research interests are in human memory and cognition.

Gordon H. Bower is currently Professor and Chairman of the Department of Psychology at Stanford University. He has many publications on learning and memory. He received many honors for his research, including election in 1973 to the American National Academy of Sciences.