"Action Schemata in Story Comprehension and Memory"

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My group at Stanford has been studying how people understand and remember narrative stories. I think the study of text understanding and memory is the next logical topic for those of us investigating language and memory. Text processing can be investigated at several different levels. One approach we've adopted supposes that people can understand a narrative if they can identify and understand the goals and plans of the major characters and can see how their actions relate sensibly to their plans. And the way we understand the actions of storybook characters is probably much like the way we understand people's actions in real life. Our knowledge on this topic is general in some respects and specific in others. That is, as story-readers, we all have general knowledge about people's motives and goals, about how people plan and execute actions in order to bring about their goals. If an action plan for a given situation is used repeatedly, it may become a stereotyped routine. We know many stereotyped routines (such as eating in a restaurant or attending a concert, and we use this specific knowledge to help us understand any part of a story that refers to such activities. When texts refer to such activities, they typically do so in an abbreviated, elliptical way, nonetheless, we can fill in the missing details from our knowledge base. An example is shown in Table 1: "John went to a fancy restaurant. He ordered roast beef. Later, he paid and left."

It is easy to show that people's conception of this scene contains much more detail than what is explicitly stated. The gap-fillings can be illustrated by asking simple questions like "Did John eat? What did he eat? Did he read a menu?" People answer readily, "Yes, of course he read a menu, talked to a waitress and ate roast beef." But none of that was stated in the text; it is all filled in by our knowkledge of the standard restaurant scene. There are thousands of examples of this sort.

Narrative texts typically mention only occasional signposts or highlights of the complete activities that are taking place. Because the writer and reader share cultural stereotypes, the writer can conjure up an entire scenario by mentioning explicitly only a few parts of the scene, leaving out the boring redundant details, and the reader obliges by filling in when necessary from his memory the details and connections that the text omits.

Roger Schank and Bob Abelson use the term "script" to refer to the memory structure a person has that represents his knowledge about one of these stereotyped activities. We have all learned hundreds of scripts or recipes for conventional activities such as attending a theater, getting a car repaired, cashing a check, visiting a doctor, eating in a restaurant, and so on.

Each script is a memory structure containing several parts; an example, the Restaurant Script, is shown in Table 2 of your handout. There are standard roles to be played; there are props; there are usual conditions for entering upon the activity, a standard sequence of actions where one action enables the next action to occur, and there are normal results from performing the script.

We believe that such memory structures are used in understanding new instances of the activity, such as a new restaurant scene. Whenever a text mentions two or three lines that match parts of the memory script, the reader can instantiate the script by filling in its slots or variables according to the details mentioned. Thus, in our earlier example, John would be assigned the role of the customer and roast beef would be the food ordered and eaten, and so on. By using the abbreviated text to instantiate the full script from memory, a reader can then understand references to unmentioned props or can draw connections between events not mentioned in the text.

The memory-script idea implies that we can communicate a standard scenario to a reader by mentioning any of a subset of ordered actions. This is schematized at the top of page 2 for say, the Restaurant Script, represented along the top of the table. The subset of statements used in Texts #1 and #2 are shown as pluses in the two rows. These are narrative paraphrases: That is, either sequence supposedly tells the same standard story, arouses equivalent interpretations, and they should be highly confused with one another. We may suppose that as a given line of text is read, that action becomes associated to that particular character, but nearby actions of that script are also activated and thought about.

A significant implication is that if we wait for awhile to allow literal surface memories to fade away, then ask the person to remember what was said, he will be confused between exactly what was said versus unmentioned actions that are close in the memory script to things that were said. So that's the first prediction we tested in our experiment.

Second, we predicted that we could increase the subject's belief that an unmentioned action had occurred in a given text by having him read related stories in which the parallel action was explicitly mentioned. Table 4 on page 2 of your handout illustrates the kind of parallel stories we used, one for John visiting a doctor, the other for Bill visiting a dentist. Think of these as different instances of an abstract script for visiting a health-professional.

Focus on the Doctor story on your left. Let's call it a Target story. Each Target story was about 8 lines long. Each subject read 9 Target stories on different topics mixed in with 9 confuser stories, all in one 10-minute block. Three of his Target stories had 2 confuser texts; three had one confuser text; and three had no confusers. The Dentist script in Table 4 is an example of a confuser story. The Target Doctor story consisted of lines 1, 2 and 4 and later ones, whereas lines 3

and 5 were left as gaps. The Confuser story explicitly presented the counterpart actions left out of the Target. These gaps were later tested for recognition memory.

We tested 45 Stanford students. The target texts and the gaps were varied and rotated in a counterbalanced fashion across the subjects.

We expected that if the subject read confuser texts, he would be more likely to confuse those in memory with the corresponding target text, and hence believe falsely that the gap filler was explicitly mentioned in the target text.

A half hour after reading these 18 stories, our subjects took a recognition memory test. This consisted of some verbatim sentences like 2 and 4 in Table 4 some gap-fillers like 3 and 5, and some plausible but false statements which mixed up actors and actions from different stories. The subject rated on a 7-point scale his belief that exactly that statement had been in the stories he had read.

The data are shown in Table 5, on the third page of your handout; this reports mean recognition ratings for test sentences that were stated, for unstated gap-fillers, and for false sentences. The results for a single story, read without a confuser text, are shown in the left column; the right-hand column shows ratings for target stories read in the presence of one or two confusers; the results for one and two confusers were combined since they differed only slightly. Any difference in this table of more than half a scale point is statistically significant.

The first conclusion is that gap-fillers call forth higher recognition ratings than do false lures but not as much as actually stated actions of the text. Perhaps this difference between stated and implied actions would diminish over time as surface memories fade.

Second, as shown in the second line, the gap-fillers of the target text attracted more false recognitions when that text had been studied in the presence

of confusers. That is, the 4.70 rating significantly exceeds the 3.92 rating. This means that presentation of a given event in, say, the Dentist text becomes somewhat confused in memory with its counterpart in the Doctor script, so that the subject believes that the counterpart action had been explicitly stated in the Doctor text.

If you look at the GAP items in Table 4, you can see roughly two types of action confusions--those like line 3 where you simply mix up whether John waited in the Doctor's reception or Bill waited in the Dentist's lounge; and those like line 5 where the similarity results from a role-function carried out in the abstract script--the assistant performing a preliminary test, in one case X-raying teeth, in another taking bloodpressure. In checking our data, we found the recognition ratings for <u>both</u> these types of gap-fillers in the target text to be elevated by the confuser texts. That is, the similarity and confusion of the two texts seems to be at the abstract level of corresponding actions in parallel scenarios.

The parallel scenarios may be viewed as different instances of one abstract script called "Visiting a Health Professional." The parallelism is diagrammed in Table 6. Think of the script as a column of interassociated slots in memory waiting to be filled by particular details of a story. The sentences mentioned in the Doctor and Dentist texts are indicated by pluses in their respective columns. When a given action is mentioned in the text, we may think of that as injecting some activation into that node in memory representing that action in the script-network. Imagine that this activation flows like electricity through the associative pathways connected to the excited node; this causes activation to spread to the superordinate node, to adjacent superordinate nodes, and to coordinate nodes at the same level. Imagine that the activation diminishes

the farther it spreads from its point of injection, and that activation dampens out over time to some low, background level. Assume that at a later memory test, the person says he remembers a given action segment as having been stated if the activation or strength of its node in memory exceeds a criterion amount.

We may think of the spreading activation as the mechanism for unconscious expectations wherein mention of one event in a script leads us to expect neighboring actions of that script.

This spreading activation theory explains our results. First, of course, there will be forgetting of specific text statements as the specific activation fades away. Second, unmentioned actions that are close to stated actions of a text will elicit false recognitions to an extent varying with their node-distance in the underlying memory structure. Third, the model explains how false recognition of a gap-filler will increase when a counterpart action is mentioned in a parallel, related script.

At present, this theory is largely speculative and not secured by very many experimental observations. However, it has helped guide some of our later research on scripts.

Let me conclude by repeating our main point: we think that memory scripts play an important role in helping people understand and remember not only the stories they read but also most real-life events they witness. Scripts are like blueprints for building images of reality. Having so concluded, the script for my talk is now finished. (Thank you.)

Handout for APA Talk

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TABLE 1. Examples of an eliptical text

STORY: John went to a fancy restaurant. He ordered roast beef. Later, he paid and left.

QUESTIONS: Did John eat? What? Did he read a menu? Talk to a waitress? Receive a bill?

TABLE 2. The "Fancy Restaurant" Script.

ROLES: Customer, Waitress, Cook, Cashier

PROPS: Tables, Chair, Kitchen, Menu, Food, Bill, Money, ...

ENTRY CONDITIONS: Customer is hungry, is near, has money.

SCENES:

1. Entering
2. Sit down
3. Read menu
4. Order from waitress
5. Get food
6. Eat it
7. Receive check
8. Pay check and tip
9. Leave

} Each event enables the text

RESULTS: Customer has less hunger, less money. Cashier has customer's money.

TABLE 3. Two Texts Telling Equivalent Scenes

Steps of Abstract Script in memory	ENTER →	SIT →	MENU →	ORDER →	EAT →	PAY →	LEAVE
Text 1:	+		+		+		+
Text 2:	+	+		+		+	

TABLE 4. Sample Texts Used: GAP Sentence Was Presented Only During Test

	Target Text "The Doctor"	Confuser-Text "The Dentist"
1.	John went to the doctor's office.	1. Bill went to the dentist's office.
2.	John checked in with the receptionist.	- - - - - - - - - - - - - - - - -
GAP 3.	John waited in the doctor's reception lounge.	3. Bill waited in the dentist's reception room.
4.	The nurse took John to an examining room.	- - - - - - - - - - - - - - - - -
GAP 5.	The nurse measured John's blood pressure.	5. The dental assistant x-rayed Bill's teeth.
	. . .	. . .

TABLE 5. Recognition Rating (7=Old) for Different Sentences of Target Script.

Type of Test Sentence	Standard; No Confuser	In Presence of Confuser Story
Actually Stated	5.43	5.48
Gap Fillers	3.92	4.70
False Lures	1.69	1.90

TABLE 6. Memory Structures Established by Two Texts