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Recognition of added and deleted details in scripts

RUTH H. MAKI
North Dakota State University, Fargo, North Dakota

Recognition of script actions that varied in specificity and expectancy of details was investigated. In Experiment 1, subjects indicated whether each action was the same or changed on an immediate or delayed yes/no recognition test. Changes that involved added details were recognized better than changes that involved deleted details. Unexpected added details were detected better than expected ones, but expectancy had no effect on deleted details. Experiment 2 tested whether the poor recognition of changes in actions with deleted details was due to a failure to retrieve those details. The recognition test was a forced-choice test with details present in the correct alternative, so their retrieval was not necessary for correct choices. Still, recognition of originally generic actions was better than recognition of originally detailed actions. Thus, a failure to retrieve details could not completely explain the results of Experiment 1. The subjects probably recognized originally generic actions better because they processed the material schematically so that the detailed actions subsumed the generic idea. Recognition decisions may then have been based either on the plausibility of the alternatives or on their familiarity within the experimental context.

Most studies of recognition memory have focused on subjects' abilities to recognize whether an item on a test has or has not been presented previously. However, recognition of whether an item on a test has previously been presented in the same form or whether it has been changed is also an important ability. The present experiments were focused on recognition of change, specifically changes involving the addition and deletion of details. In everyday life, we are frequently called upon to decide whether a present scene or object appears to be the same as its representation in memory or whether something has been added to it or deleted from it. For example, after a party, it might be important to observe that something has been added—that a guest left an article, for example—or that something has been deleted—that a guest took an article, for example. There has been relatively little research on this ability, but the experiments that have been conducted suggest that detecting additions is much easier than detecting deletions.

Agostinelli, Sherman, Fazio, and Hearst (1986) first presented to subjects line drawings of many objects and later asked the subjects to detect whether subsequent line drawings of those same objects had features added or deleted. For example, a bumper could have been added to or deleted from a line drawing of a car. Agostinelli et al. found that the subjects were better at detecting that objects had had features added than they were at detecting that they had had features deleted. With more exposures to the objects, the subjects became better at indicating "same" in response to old objects and "changed" in response to objects with added features; however, more exposures did not increase their ability to indicate "changed" for objects with features deleted. The latter performance remained at chance levels even after six exposures to the objects. Agostinelli et al. then conducted a second experiment in which they informed the subjects what the recognition test would involve, presented only one object, and tested them after a very short interval. They predicted that the subjects would use the presentation stimulus as the referent under these conditions; therefore, features in memory representations that were not in the test stimulus would be "added" and features that were absent from the memory representation but present in the test stimulus would be "deleted." Generally, the results supported this prediction: changes in objects presented with features were noticed more often than changes in objects presented without features. Thus, having the features present in the referent stimulus is important for good recognition, and the referent stimulus is the test stimulus in most recognition tasks.

Pezdek and her colleagues (Pezdek, 1987; Pezdek & Chen, 1982; Pezdek, Maki, Valencia-Laver, Whetstone, Stoeckert, & Dougherty, 1988) have reported some similar effects with respect to pictures. Line drawings of scenes that were either simple (without much elaborative detail) or complex (with more elaborative detail) were presented. These pictures were tested in either the same form or in changed form, with simple pictures being presented in their complex form on the test and complex pictures being presented in their simple form. The subjects' task was to indicate whether the test pictures were "same" or "changed." Essentially, a change from simple to complex

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involves the addition of details, whereas a change from complex to simple involves the deletion of details. Changes from simple to complex (additions) were recognized better than changes from complex to simple (deletions) under a number of different conditions. Generally, indicating "same" with respect to old pictures was not affected by whether the pictures were simple or complex.

Pezdek et al. (1988) have presented a model for this type of recognition. They have hypothesized that subjects store a representation that captures the schema of each picture in memory. This representation should be similar for the simple and complex pictures. For complex pictures, the additional details are also stored but they are not very retrievable. Thus, when the same simple or complex pictures are tested, subjects can recognize the schematic representation for both types of pictures and they can also recognize the additional details for complex pictures. Hence, recognition of same pictures does not differ for the two types of pictures. For changed pictures, complex test pictures are recognized as being different from the simple pictures that were presented, because the added details are not in memory. However, simple test pictures that were originally complex are not recognized as different because the general schema of the test pictures matches the schematic representation in memory and the details that are also stored in memory are not retrieved. Therefore, subjects indicate "same" for these changed pictures. Thus, this model predicts that additions of details will be detected but deletions of details will not, and that is exactly what Pezdek (1987; Pezdek & Chen, 1982; Pezdek et al., 1988) has found under several different sets of conditions.

Both the Agostinelli et al. (1986) and the Pezdek (1987; Pezdek & Chen, 1982; Pezdek et al., 1988) experiments indicate that the detection of additions is easier than the detection of deletions with pictorial stimuli. However, the characteristics of the added and deleted features were not clearly defined in those experiments. The features that were added and deleted in the Agostinelli et al. (1986) experiments were not criterial features, but exactly how they related to the objects was not specified. The added and deleted features for the complex pictures in the Pezdek experiments included extra shading, details, and elaboration, but expectancy of the features was not manipulated. One purpose of the present experiment was to investigate the addition and deletion of expected or unexpected features.

A second purpose of the present experiment was to determine whether the earlier finding that additions to pictorial stimuli are easier to detect than deletions from them generalizes to verbal stimuli. The model proposed by Pezdek et al. (1988) should generalize to verbal stimuli that can be processed schematically. Bharucha, Olney, and Schnurr (1985) did investigate subjects' abilities to detect changes in prose materials. The subjects were first presented with pairs of sentences that were either coherent (e.g., "The waiter led Dave to a table; The menu was written in French") or anomalous (e.g., "The waiter led Dave to a table; The treaty was written in French"). On the subsequent test, the subjects were to indicate whether each pair of sentences was the same as at presentation or different. Changes were either from coherent to anomalous or from anomalous to coherent. The subjects were much better at recognizing changes from coherent to anomalous than from anomalous to coherent, but anomalous and coherent sentences did not differ in the same condition.

Bharucha et al. (1985) proposed two explanations for the asymmetric recognition of changes in anomalous and coherent sentences. First, they suggested an asymmetric matching process similar to the one proposed by Agostinelli et al. (1986)—that is, that subjects use the test stimulus as the referent, and that features deleted from it are not noticed. This explanation is similar to the retrieval aspect of the Pezdek et al. (1988) model in that subjects do not retrieve features that are missing from the test stimulus. The second aspect of Bharucha et al.'s (1985) explanation proposes that sentences activate schematic structures, and that changes that can be assimilated to the resulting schemas are not detected but changes that cannot be assimilated are detected. Thus, new anomalous sentences are detected but new coherent sentences are not. Bharucha et al.'s experiment showed that changes in semantic material were detected in an asymmetric manner, but it did not examine the addition and deletion of details. Whether or not a similar asymmetry would be found when details were added to or deleted from verbal materials was tested in the present experiments.

EXPERIMENT 1

Recognition of changes in script actions that either had details added or deleted was investigated. Scripts are stereotypical sets of actions that are carried out as part of routine activities (Schank & Abelson, 1977). A great deal of research on the recognition of script actions has been conducted; most of that research has asked subjects to indicate whether actions have or have not been presented. Graesser and his colleagues (Graesser, Gordon, & Sawyer, 1979; Graesser, Woll, Kowalski, & Smith, 1980) have shown that subjects are not able to indicate whether or not a highly typical, or relevant, script action (e.g., "Jack ordered his meal" in a restaurant script) has been presented; they make many false alarms to typical actions that have not been presented. However, subjects are fairly good at indicating whether or not atypical, or less relevant, actions (e.g., "Jack bought some mints") have been presented.

Graesser and Nakamura (1982) developed a schema-copy-plus-tag model to account for their data with scripts. This model proposes that subjects copy a subset of the information in a generic schema into a memory trace. In the case of scripts, the copied information is highly typical of the script. Other information that is included in a script passage is also included in the memory trace with specific tags. Both moderately typical and atypical information is tagged. The tagged information is much more discriminable than the copied information, and thus, subjects should perform better on the moderately typical and atypical information when it is tested on recognition tests, which is what Graesser et al. (1979, 1980) have found.

In the present experiments, script actions were generic without specific details (e.g., "Karen decided what time to eat") or they contained expected (e.g., "Karen decided to eat at about 6 p.m.") or unexpected (e.g., "Karen decided to eat at about 10 p.m.") details. On the test, half of the script actions were identical to those seen during the presentation sequence and half were changed either by adding details (e.g., "decided what time to eat" to "decided to eat at about 6 p.m.") or by deleting details (e.g., "decided to eat at about 6 p.m." to "decided what time to eat"). The subjects' task was to indicate whether each action was "same" or "changed."

According to the schema-copy-plus-tag model, details should be more likely to be tagged than the action itself, because details, such as what Jack ordered for his meal, are not part of the generic script. However, unexpected details should be more likely to be tagged, and thus discriminated in a recognition test, than should expected details. But whether or not this type of tagging would make the addition or deletion of such details more detectable is not clear from Graesser and Nakamura's (1982) model. The postulation of specific tags in memory would seem to lead to the prediction that subjects would be likely to retrieve tagged details; however, the model proposed by Pezdek et al. (1988) argues that deleted details are not retrieved. The schema-copy-plus-tag model also postulates that specific tags are forgotten faster than the copied schema, suggesting that details may be forgotten over time. To test this, half of the subjects were tested immediately and half were tested after 1 week. If details are stored differently from the schematic material, they might be more likely to be forgotten over the longer retention interval.

Method

Materials. Six different scripts with 24 actions each were used in the experiment. The scripts were as follows: "Going on Vacation by Car," "Going for a Bike Ride," "Preparing an Assignment for Class," "Making a Meal at Home," "Writing a Letter," and "Going to the Lakes." The actions were either *high*, *medium*, or *low* in relevance to the script. High-relevance actions were generated by at least 30% of a group of 12 to 16 subjects, and they were rated above 5.4 on a scale ranging from 1 ("Not at all important") to 7 ("Very important") in the average enactment of the activity. An example of a high-relevance action for "Making a Meal at Home" is contained in the statement "She prepared the food." Medium-relevance actions were generated by 1 or no subjects, and they were rated between 3.8 and 5.3 on the 7-point importance scale. An example of a medium-relevance action for the meal script occurs in the statement "She poured the beverages." Low-relevance actions were generated by 1 or no subjects and were rated 3.5 or lower on the 7-point importance scale. A low-relevance action from the meal script was as follows: "While the food was cooking, she munched on junk food." Details were identified for each script by asking other groups of 13 to 15 subjects to generate a detail for each generic action. For example, the subjects were asked to respond to the question "How?" with respect to the statement "She prepared the food" and "What?" with respect to the statement "She poured the beverages." Most of the details (46%) were given in response to the question "What?". Other details were given as responses to the questions "Where?" (15%), "Why?" (13%), "How?" (11%), "When?" (9%), and "Who?" (6%).

Another group of 24 subjects rated their expectancy of details that were generated. Given that an action occurred in the script, these subjects were to rate how much the answer to each question was expected on a scale ranging from 1 ("Not at all expected") to 7 ("Very expected"). Details were classified as *expected* if they were generated by at least 20% of the subjects and if they were rated at least one half of a standard deviation above the mean expectancy rating for the details in a script. Details were *unexpected* if they were generated by 1 or no subjects and if they were rated lower than one half of a standard deviation below the mean rating for the details in a script. Examples of actions with expected details occur in the statements "She prepared the food by cooking it" and "She poured the milk." The same actions with unexpected details are in the statements "She prepared the food by drying it" and "She poured the champagne."

Four different versions of each script were written. Each contained 24 actions, 8 at each relevance level. Each script contained the name of a character, and the actions were written with appropriate transitions, such as "Then" and "Next." Half of the actions were generic and did not contain details (e.g., "She prepared the food"), and half contained details that were either expected (e.g., "She prepared the food by cooking it") or unexpected (e.g., "She prepared the food by drying it"). Generic as opposed to detailed, and expected as opposed to unexpected actions were counterbalanced across the four versions of the script, so that each action appeared in each form equally often. Eight versions of each script were formed for the recognition test. Half of the actions that had been generic at presentation were the same at test, and half were changed to include details, half of which were expected and half of which were unexpected. Half of the actions with expected and unexpected details at presentation remained the same and half had the expected and unexpected details deleted. The half of the actions that were same and the half that were changed were counterbalanced across the script versions.

Procedure. Script titles were presented first, followed by each action separately, on a monitor attached to an Apple II+ computer. The title of each script was presented in uppercase letters and the actions were presented in appropriate upper- and lowercase letters. The subjects pressed the space bar on the computer to erase each title or action and to present the next one. The reading time for each item was recorded by the computer. After one script was completed, the computer produced two beeps; then the title of the next script was presented. After the six scripts had been read in this manner, the subjects worked on a number-progression task for 10 min. This filler task involved rows of numbers that were arranged according to specific rules. The subjects' task was to fill in a final number that fit the rule. The subjects in the delay group were then excused and reminded to return 1 week later. The subjects in the immediate group were given the recognition test.

The recognition test for each script began with a 2-sec presentation of the script title followed by 24 actions. The subjects were instructed to indicate whether each action was the same as it had been at presentation or whether it had been changed. They were specifically informed that the changes would involve additions and deletions, and examples of such changes were given. The subjects were asked to press the slash key on the right of the keyboard if the action was the same as it had been at presentation and to press the "z" key on the left if it had been changed. These key instructions were printed at the bottom right and left on the screen along with each action. The scripts and their actions were tested in the same order as that in which they had been presented.

Subjects. A total of 32 subjects were tested, with 16 randomly assigned to the immediate group and 16 assigned to the delay group. The subjects were volunteers from introductory psychology courses at North Dakota State University who participated for extra credit toward their course grades.

Results and Discussion

Three dependent variables were entered into separate analyses of variance (ANOVAs). First, the proportion of correct "same" responses to same actions was analyzed. Second, the proportion of false alarms (defined as "same" responses to changed actions) was analyzed. Third, *d*-prime was calculated for each subject by using correct "same" responses as hits and "same" responses given to changed stimuli as false alarms. For example, if the generic action "She decided what time to eat" was presented at both study and test, responses of "same" would be counted as hits. If the generic action was presented at study but a detailed action, such as "She decided to eat at 6 p.m.," was presented at test, a "same" response would be considered a false alarm. All analyses used $p < .05$ as the criterion for the rejection of the null hypothesis.

Proportion hits. A 2 (delay) × 2 (detailed vs. generic action at presentation) × 2 (expectancy of details) × 3 (relevance) analysis of variance (ANOVA) was conducted on the proportion correct for *same* actions. Recognition was either immediate or delayed by 1 week, the actions were presented either with details or in their generic form, the details were either expected or unexpected, and the actions were of high, medium, or low relevance to the script.[1] The proportions of hits for same actions are presented on the left side of Table 1.

Overall, there was an interaction between delay and details [$F(1,30) = 11.68$, $MS_e = .030$]. On the immediate test, recognition of detailed and generic same actions did not differ (.74 vs. .74; $F < 1$), but generic actions were recognized better than detailed actions on the delayed test [.74 vs. .61; $F(1,30) = 23.37$, $MS_e = .012$]. Expectancy produced no significant effects or interactions ($Fs < 1$), which is somewhat surprising because expectancy was a dummy variable in the generic condition, but an actual variable in the detail condition. Apparently, indicating that an action was the same as what had been presented was not affected by the expectancy of its details.

As predicted by the Pezdek et al. (1988) model, there was no difference in the subjects' abilities to recognize same detailed and generic actions on an immediate test. With time, however, the recognition of same actions with details became poorer than the recognition of same generic actions. This suggests that the subjects initially stored the details so that they recognized them immediately, but that some of the details were forgotten over the 1-week retention interval.

Proportion of false alarms. The proportion of false alarms ("same" responses to changed actions) was analyzed next. The proportion of "same" responses to changed actions as a function of expectancy, details, and delay can be seen in the right half of Table 1. Generic actions at the time of presentation were changed to actions with expected or unexpected details on the test; hence, these changed generic actions have been given the label "Added." Actions with expected or unexpected details at presentation were changed to generic actions on the test; these changed detail actions have been given the label "Deleted." As can be seen in Table 1, changed actions with deleted details produced more "same" responses than changed actions with added details [$F(1,30) = 255.62$, $MS_e = .035$]. This detail effect interacted with delay [$F(1,30) = 13.35$, $MS_e = .035$], because the effect was larger after a week's delay (.66 vs. .28) than it was immediately (.39 vs. .15), but deleted details produced more "same" responses at both retention intervals [$Fs(1,15) \geq 51.05$]. In addition, there was an interaction between added or deleted details and expectancy [$F(1,30) = 16.27$, $MS_e = .034$]. Actions with added expected details were called "same" more often than actions with added unexpected details [$F(1,30) = 60.64$, $MS_e = .032$]. However, whether or not deleted details had been expected or unexpected did not influence the

Table 1
Proportion "Same" Responses on the Yes/No Test in Experiment 1 As a Function of Type of Action, Delay, Details at Presentation, and Expectancy

	Same (Hits)				Changed (False Alarms)			
	Generic		Details		Added		Deleted	
	Exp	Unexp	Exp	Unexp	Exp	Unexp	Exp	Unexp
Immediate	.76	.72	.72	.76	.22	.08	.40	.37
Delay	.73	.75	.63	.59	.41	.15	.68	.62
Mean	.75	.74	.68	.67	.32	.12	.54	.50

Note—Exp = expected, Unexp = unexpected.

number of "same" responses [$F(1,30) = 2.62$, $MS_e = .040$]. It might have been predicted that unexpected details are more retrievable than expected details, and, therefore, that their absence might be more easily noticed. However, this was not the case. The subjects were quite poor at noticing that details were missing and the expectancy of those details was unimportant. Yet the subjects were generally good at rejecting actions with added details, particularly if they were unexpected details that are not part of the typical script.

***D*-prime analysis**. The recognition of actions that were presented in their generic form (and had details added or not at test) versus actions that were presented in their detailed form (and had details deleted or not at test) was compared with *d*-prime. Again, "same" responses to same actions were considered hits, and "same" responses to changed actions were considered false alarms. The *d*-prime scores can be seen in Table 2. Overall, *d*-prime was higher in the immediate than in the delayed condition [$F(1,30) = 27.17$, $MS_e = 3.70$], and generic actions (with added details in the changed condition) were recognized better than actions with details (which were deleted in the changed condition) [$F(1,30) = 212.39$, $MS_e = .872$]. Details interacted with delay [$F(1,30) = 15.23$, $MS_e = 1.34$], because there was a larger detail effect on the delayed than on the immediate test. Unexpected details produced higher *d*-primes than expected details [$F(1,30) = 13.74$, $MS_e = 1.34$]; this effect interacted with generic versus detailed presentation [$F(1,30) = 10.72$, $MS_e = 1.127$]. The expectancy of the details was not significant in the detailed condition (when details were present at presentation) ($F < 1$), but unexpected details produced higher *d*-primes than expected details in the generic condition (when they were added at test) [$F(1,30) = 31.28$, $MS_e = .966$].

Generally, the *d*-prime analysis mirrored the analysis of changed actions. Overall, the generic actions that involved additions in their changed form were recognized better than detailed actions that involved deletions in their changed form. Expectancy had an effect in the condition in which changed actions involved additions, but it had no effect in the condition in which changes involved deletions. Following a delay of 1 week, the subjects' abilities to discriminate which of the actions that had been presented with details were same and which were changed was very poor; in fact, the mean *d*-primes in the delayed detail conditions were not significantly different from zero [$ts(15) < 1$]. In contrast, the *d*-primes in the delayed generic conditions were all significantly greater than zero [$ts(15) > 3.67$].

Table 2
Mean *D*-Primes on the Yes/No Test in Experiment 1 As a Function of Delay, Details at Presentation, and Expectancy

	Generic		Details	
	Exp	Unexp	Exp	Unexp
Immediate	2.05	2.52	1.21	1.32
Delay	1.07	2.19	−.16	−.10
Mean	1.56	2.36	.52	.61

Note—Exp = expected, Unexp = unexpected.

Deletions were detected less often than additions. Thus, the findings of Agostinelli et al. (1986) and Pezdek (1987; Pezdek & Chen, 1982; Pezdek et al., 1988) generalize to schematic verbal material. The results generally support the model proposed by Pezdek et al. (1988). The subjects were good at indicating that details had been added probably because the new details were not stored in memory, but they were poor at recognizing that details had been deleted. Some of those details were still in memory on the immediate test, because the subjects recognized same detailed items as well as same generic items. However, the Pezdek et al. model suggests that the subjects did not retrieve those details; as a result, the subjects indicated that the actions were "same" although details were deleted. The recognition of deletions became poorer with time. In part, this may have been due to the forgetting of some details. Other details may have still been available in memory but they were not retrieved. The data also support the asymmetric matching hypothesis proposed by Bharucha et al. (1985) and the similar explanation offered by Agostinelli et al. (1986). Both sets of previous investigators assumed that subjects use the test stimulus as the referent, and that new details added to the referent are noticed but details deleted from it are not.

All of these explanations assume that one test stimulus serves as a referent at the time of the test. Each explanation implies that subjects would recognize the old details if they were present, as indeed was the case for same detailed actions, at least on the immediate test. Both the retrieval-failure explanation and the asymmetric matching hypothesis predict that any effects of adding versus deleting details should disappear on a forced-choice test. If the original action was generic, then subjects should easily be able to reject an alternative with details and choose the generic alternative on a forced-choice test. Likewise, if the original action contained details, then subjects should be able to reject the generic alternative in favor of the one with details because there is no need to retrieve the details in this case; they are present in one of the test alternatives.

EXPERIMENT 2

Experiment 2 was designed to investigate the plausibility of the retrieval and asymmetric matching explanations for the differential recognition of changed actions with added and deleted details. The presentation procedures were identical to those in Experiment 1, but the test was a forced-choice test involving the generic and detailed forms of each action. If failure to retrieve deleted details was the primary reason for poor recognition of deletions on the immediate test, then the forced-choice procedure was expected to eliminate the difference. There was also some evidence in Experiment 1 that details were forgotten over time because recognition of same detailed actions was poorer than recognition of same generic actions following the 1-week delay. If details are actually forgotten, then performance should be poor on a forced-choice test. Thus, the retrieval explanation predicts no difference between generic and detailed items on the immediate forced-choice test. However, if some details are forgotten after the 1-week delay, then generic actions should be recognized better than detailed actions on the delayed test. The asymmetric matching hypothesis also predicts that the generic-detail difference will be eliminated because the detailed test stimulus could serve as the referent whether or not a detailed or generic action was originally presented.

Method

The scripts that were presented were identical to those used in Experiment 1. The forced-choice test consisted of script actions arranged in the order in which they had previously been presented. The generic form and a detailed form of each action were presented side by side on the computer monitor. For original actions that had been generic, the incorrect alternative contained an expected detail half of the time and an unexpected detail the other half of the time. For original actions that had contained either expected or unexpected details, the correct alternative was the old detailed action and the incorrect alternative was the generic version of the action. Whether original actions were generic or had expected or unexpected details and whether new actions had expected or unexpected details were counterbalanced across subjects.

As in Experiment 1, the subjects saw six scripts, each of which had 24 actions. Generic actions, actions with expected details, and actions with unexpected details were mixed within each script. The scripts were presented on the Apple computer monitor and the reading of each action was self-paced. For 10 min after the six scripts had been read, the subjects worked on the same number-progression task as had been used in Experiment 1. Delay subjects were then excused and reminded to come back 1 week later. Immediate subjects were given the forced-choice test. The subjects were instructed to read each alternative on the forced-choice test and decide which one was exactly like an action that had previously been presented. They were instructed to press the "z" key on the computer keyboard if the alternative on the left was the same as an action that had been presented and to press the "slash" key if the action on the right was the same as a previously presented action.

A total of 32 volunteer subjects from introductory psychology classes at North Dakota State University participated in the experiment. One half of these subjects were randomly assigned to the immediate condition and one half was assigned to the delay condition, so that there were 16 subjects in each group.

Results and Discussion

The recognition data were analyzed both in terms of proportion correct and *d*-prime. For each, the analysis was a 2 (delay) × 2 (detailed vs. generic action at presentation) × 2 (expectancy) × 3 (relevance) ANOVA. Each subject's proportion correct in each condition was converted to *d*-prime for that analysis. A response was considered a hit when the subject selected a presented action and a false alarm when the subject selected a changed action. Both the proportions correct and the *d*-primes are shown in Table 3. Because the statistical analyses of the data yielded similar patterns, only the *d*-prime analyses will be reported.

Table 3
Proportion Correct and *D*-Prime on the Forced-Choice Test As a Function of Delay, Details at Presentation, and Expectancy

	Immediate				Delay			
	Generic		Details		Generic		Details	
	Exp	Unexp	Exp	Unexp	Exp	Unexp	Exp	Unexp
p(Correct)	.88	.95	.76	.85	.71	.84	.52	.55
d-prime	1.66	2.32	1.00	1.47	.78	1.40	.07	.18

Note—Exp = expected, Unexp = unexpected.

D-prime was higher on the immediate than on the delayed test [$F(1,30) = 53.35$, $MS_e = 2.155$]. Generic actions were recognized better than detailed actions [$F(1,30) = 64.99$, $MS_e = 1.569$], but this effect interacted with the expectancy of the details [$F(1,30) = 11.65$, $MS_e = .453$]. There was also some suggestion that this two-way interaction entered into a three-way interaction with delay. With the *d*-prime data, the three-way interaction among details, expectancy, and delay was short of significance [$F(1,30) = 3.61$, $MS_e = .453$, $p = .067$]; however, this three-way interaction was significant in the proportion correct data [$F(1,30) = 6.57$, $MS_e = .013$]. Therefore, the *d*-prime data were analyzed separately at each delay.

In the immediate condition, actions that were generic at presentation were recognized better than actions that had details at presentation [$F(1,15) = 66.58$, $MS_e = .531$]. Overall, unexpected details were recognized better than expected details [$F(1,15) = 31.78$, $MS_e = .578$]. When actions had been generic at presentation, the unexpected or expected details were contained in the incorrect alternative on the forced-choice test, but when actions had details at presentation, the unexpected or expected details were contained in the correct alternative. Although the expectancy variable was operationalized differently for actions presented in generic and detailed form, these two variables did not interact in the immediate condition ($F < 1$).

In the delay condition, details at presentation and detail expectancy interacted [$F(1,15) = 19.34$, $MS_e = .331$]. As can be seen in Table 3, the presence of unexpected details in the incorrect alternative for the originally generic actions produced better recognition than the presence of expected details in the incorrect alternative [$F(1,15) = 36.90$, $MS_e = .485$]. However, actions that were originally presented with unexpected details were not recognized better than actions that were originally presented with expected details ($F < 1$). This suggests that the details, both expected and unexpected, had been forgotten following the 1-week retention interval. Indeed, the *d*-primes for both expected and unexpected details in this condition did not differ from zero when tested with single-sample *t* tests; $t(15) = 1.20$ for expected and 1.91 for unexpected details.

Comparison of Experiments 1 and 2

One purpose of Experiment 2 was to test the idea that actions with deleted details were not recognized as changed in Experiment 1 because the subjects used the test stimulus as the referent and they did not retrieve the deleted details. If this is true, then performance should have been much higher on these actions in Experiment 2 (where the old details were present on the test) than in Experiment 1 (where the deleted details were not present in changed actions on the test). In order to compare the relative sizes of the generic–detail difference in the two experiments, an ANOVA was conducted on the *d*-prime scores for the two experiments combined. The analysis was a 2 (experiment) × 2 (delay) × 2 (details at presentation) × 2 (expectancy) × 3 (relevance) mixed ANOVA. Interactions with experiment were of particular interest. The only interaction effect involving experiment was the details at presentation × experiment interaction [$F(1,60) = 5.05$, $MS_e = 1.22$]. In the first (yes/no) experiment, the *d*-prime for actions presented with details was .56 whereas the *d*-prime for generic actions was 1.96; thus the difference was 1.40. This difference was larger than in the second (forced-choice) experiment, where actions presented with details yielded a *d*-prime of .79 and generic actions yielded a *d*-prime of 1.82, producing a difference of 1.03. A larger *d*-prime effect was predicted with the yes/no procedure by the asymmetric matching and retrieval models of the addition–deletion effect. Thus, some of the difference between generic and detailed actions observed in Experiment 1 may have been due to the use of the test stimulus as the referent and a failure to retrieve the deleted details. However, generic actions were recognized better than detailed actions in both experiments, and the asymmetric matching and retrieval explanations predicted no difference with the forced-choice procedure, at least in the immediate condition. Therefore, these data cast doubt on these explanations as being primary for Experiment 1.

GENERAL DISCUSSION

These experiments produced two main findings. First, the subjects recognized actions that were originally generic better than they recognized actions that were originally presented with details. Second, the subjects forgot many of the details during the 1-week delay. Evidence for detail forgetting was found in the delay condition of Experiment 1: the subjects responded "same" to same detailed actions less often than they responded "same" to same generic actions. In addition, the expectancy of the original details had no effect after the 1-week delay either with the yes/no or the forced-choice test procedure.

In Experiment 1, deletions were detected less often than additions. This asymmetric recognition effect indicates that the findings of Agostinelli et al. (1986) and Pezdek (1987; Pezdek & Chen, 1982; Pezdek et al., 1988) generalized to schematic verbal material. However, the results do not support the retrieval model proposed by Pezdek et al. (1988). That model explained the poor recognition of changes in actions with deleted details by proposing that subjects did not retrieve the details. However, with a forced-choice test, no retrieval was necessary. The correct alternative contained the details while the incorrect alternative did not. With a forced-choice test, subjects needed only to recognize the details in the correct alternative; they did not need to retrieve them. Similarly, the asymmetric matching explanation proposed by both Agostinelli et al. (1986) and Bharucha et al. (1985) cannot account for the results of the forced-choice experiment. This explanation proposes that subjects compare the test stimulus to the memory representation and that features missing from the test stimulus are not noticed. Although these models may account for some of the asymmetrical effect observed for changed generic and detailed actions in Experiment 1, there must be some other explanation for better recognition of generic actions in Experiment 2, because both alternatives were available to serve as referents on the forced-choice test.

Such an alternative explanation must include mechanisms for storage of these script materials in memory and also mechanisms that explain the subjects' choices at the time of the test. Storage must involve the activation of schemas from long-term memory and integration of the presented material with those schemas. Both Pezdek et al. (1988) and Bharucha et al. (1985) proposed such an explanation for their results. Pezdek et al. (1988) suggested that the main theme (or schema) of their pictures was abstracted and stored, along with some of the details. Bharucha et al. (1985) suggested that their sentence pairs were stored in the context of activated schemas, along with any unusual details, such as those in the anomalous sentences. Both explanations contain components of Graesser and Nakamura's (1982) schema-copy-plus-tag model. As applied to the present procedures, subjects would activate the appropriate script and copy most of the main actions of the script into a memory representation for the presented materials. Thus, the high-relevance actions and possibly the medium-relevance actions would be part of this schema copy. Low-relevance actions, however, would be stored separately with distinctive tags. Because the schema that is copied contains generic actions, each presented action would be stored in generic form whether expected or unexpected details were included. Expected details may be inferred during storage and, if so, those would be part of the schema copy; if not, they would be stored separately with tags. Certainly, unexpected details would be stored with distinctive tags.

A complete model of the present data must not only describe how the script materials are stored in memory but also what decision processes the subject uses on the test. Two alternative views of subjects' decision processes that can account for the observed data will be presented. The first possibility is that subjects use the activated script schema to judge the truth of test sentences. The presented action (with or without details) is judged to be certainly true; that is what was presented. Generic test actions are implicitly true if the original action contained a detail. That is, if a specific detail such as "decided to eat at 6 p.m." is presented, the generic version "decided what time to eat" is true also. It would not matter whether the expected or unexpected detail had been presented; the generic version is true. The subjects indicated "same" to such generic actions following presentation of the details in the yes/no experiment in half of the trials. In the forced-choice test, the subjects were forced to choose between two alternatives that were true, the actual presented sentence containing the details and the nonpresented generic sentence. Such an interpretation makes this finding similar to those reported by Bransford and Johnson (1972), who found that subjects falsely recognized sentences that were implied in presented sentences. If someone decided to eat at a specified time, it is logically necessary that the person decided what time to eat. Thus, the generic idea is a logical implication of the detailed sentence.

The truth values became more discrepant if the presented action was generic and the tested action contained a detail. If that detail was an expected one, the incorrect test statement was probably true. That is, if the action was "decided what time to eat," making the inference "decided to eat at 6 p.m." is quite likely. Such an inference is not logically necessary, but as Harris and Monaco (1978) reported, subjects often falsely recognize sentences that contain such pragmatic implications. This occurred in Experiment 1, in which the subjects called such changed actions "same" in about one third of the trials. On the forced-choice test, the subject was to choose between a certainly true and a probably true alternative, making it a difficult discrimination but not as difficult as the case where both alternatives were certainly true.

Actions that had been generic at presentation and that contained an unexpected detail at test (e.g., "decided what time to eat" changed to "decided to eat at 10 p.m.") would not be true, and, therefore, they would be called "same" infrequently. In Experiment 1, they were called "same" only 12% of the time. On the forced-choice test, the subjects needed to choose between a true and a false alternative, making it a fairly easy discrimination. The overall pattern of the data fit a truth-judgment model of the decision processes that occur at the time of the test rather nicely.

However, an alternative recognition-memory explanation is also plausible. The input assumptions described above also hold for this type of explanation, although it is assumed that subjects give frequency counts to the attributes of each action (i.e., familiarity in the experimental context is increased), as suggested by Underwood's (1983) attribute theory of memory. Detailed actions result in frequency counts in response to both the generic idea and the detail itself. That is, the presentation of a detail automatically increases familiarity with the generic idea. When a detailed action has originally been presented and a generic version is tested, it has a high familiarity; the subjects responded "same" to such actions about half of the time. On the forced-choice test, the subjects needed to choose between two familiar alternatives. The only difference between those alternatives was that one had an extra familiar feature (the detail). This proved to be a difficult discrimination.

When a generic action has originally been presented and a detailed action is tested, the subject can discriminate more easily. The new detail has almost no familiarity in the experimental context, particularly if that detail is unexpected. In either the yes/no or the forced-choice test, it is easy for the subject to reject the alternative that contains a feature with no familiarity. If the detail is expected, it may have gained some familiarity from inferences made during the input phase. This would result in a more difficult discrimination task than having a feature with no familiarity. Such a discrimination is still easier than the case in which all of the features in both alternatives are familiar, as when a detailed action has been presented and a generic action is tested.

Either the hypothesis that subjects use truth value or the hypothesis that they use frequency counts to make the recognition decision is plausible. In part, the choice of an explanation depends upon whether one thinks of this task as a recognition task that is similar to tasks involving unrelated sets of materials, or whether the schematic nature of the materials is thought to be essential to the results. Whichever explanation is accepted, the postulation of schematic processing during input seems to be essential for understanding the pattern of results.

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NOTES

1. The relevance variable did not interact with the addition or deletion of details in this analysis or in those of Experiment 2, so it will not be discussed further. Generally, changes in highly relevant actions were detected more poorly than changes in less relevant actions. This is similar to findings from scene-recognition studies (Friedman, 1979; Goodman, 1980).

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