Our ability to recognize pictures that we have seen before is remarkable. Researchers have demonstrated that individuals can distinguish large sets of old pictures from new distractor pictures at high levels of accuracy (Nickerson, 1965; Shepard, 1967; Standing, Conezio, & Haber, 1970). However, few investigators have examined memory for the elaborative visual information in pictures that are remembered. This is the focus of the present study.

The conceptual origins of the present study are two lines of research that suggest that picture-recognition memory is positively correlated with the amount of information encoded from pictures. The first of these lines of research includes several studies that have reported that recognition memory for pictures increases with the duration of the exposure (Loftus & Bell, 1975; Potter, 1976; Potter & Levy, 1969; Tversky & Sherman, 1975). The interpretation of these results has been that increased exposure duration leads to better memory because more information about the details of the picture is encoded and retained at the longer intervals. This interpretation is supported by findings that with more exposure time to view pictures subjects make more eye fixations (Loftus, 1972) and that eye fixations generally occur more often and for longer durations in regions of high information density (Antes, 1974; Yarbus, 1967).

The second line of research that suggests that picture-recognition memory is positively correlated with the amount of information encoded from each picture is the finding that pictures are recognized better than are comparable verbal stimuli such as words or sentences (cf. Shepard, 1967). It has been hypothesized that this picture superiority effect is due to the additional amount of detailed information available in pictures as compared with verbal material (Bevan & Steger, 1971; Everson & Wicker, 1974; Reese, 1970). Presumably, if the picture superiority effect can be accounted for by the amount of detail in pictures, then more detailed pictures should be better recognized.

To test this hypothesis Nelson, Metzler, and Reed (1974) used a two-alternative forced-choice recognition test with old and new test pictures. However, they found no differences in recognition among items presented as (a) black-and-white photographs, (b) complex, embellished line drawings, or (c) simple, unembellished line drawings. The three versions of each picture contained the same central information, but extra contextual details, shading, and embellishment were added in the complex pictures. Although recognition memory did not differ among these three types of pictures, memory for all three types of pictures was superior to memory for sentences that had previously been derived from the pictures. Similarly, Dirks and Neisser (1977) compared memory for added, deleted, and moved objects in real displays with memory for photographs of the same displays. Although the real displays included more detail than did the photographs of each, no significant differences resulted between these two types of visual materials with either recall or recognition measures.
On the other hand, using Nelson et al.'s materials (1974) and brief exposure durations (60 ms to 500 ms), Loftus and Bell (1975) reported that the ability to distinguish old from new pictures was greater for photographs than for simple and complex line drawings; however, memory did not significantly differ between simple and complex line drawings. Similarly, Park, Puglisi, and Smith (1986) had subjects view pictures with low, medium, and high levels of visual detail and found that the ability to distinguish old from new pictures was greater for relatively more detailed pictures. Thus, although several lines of research have suggested that increasing the amount of detailed information in a picture leads to improved recognition memory, the support for this effect is mixed.

Furthermore—and pivotal, to the purpose of the present study—each of the above studies testing the role of detail in picture-recognition memory used an old-new recognition tasks in which the distractor pictures were completely different pictures. Thus, these previous studies tested the ability to distinguish familiar pictures that activate old schemata from unfamiliar pictures that activate new schemata. The present program of research uses a same–changed recognition test and thereby assesses memory for more specific details in pictures, that is, memory for subschematic information. The issue addressed in the present program of research is thus different from the issue addressed in previous studies on the role of detail in picture-recognition memory.

The present study follows from a previous study in this program of research by Pezdek and Chen (1982). In this previous study, a subset of the line drawings used by Nelson et al. (1974) was used to test subjects' memory for the elaborative detailed information in pictures. Each of 44 pictures was available in both a simple and a complex form, such as the examples in Figure 1. As with the complete set of materials used by Nelson et al. (1974), the simple and complex versions of each picture were both “best described” by the same sentence; however, extra shading, details, and elaboration were added to the figure and the background in the complex version of each picture. Subjects from three age groups were presented 22 simple and 22 complex line drawings. During the testing period, pictures were presented one at a time in a same–different recognition test. Half of the simple and complex pictures were tested in the same form in which they had been presented. The other half of the test items were changed pictures; that is, pictures previously presented in a simple form were tested with the complex form of the same pictures, and pictures previously presented in a complex form were tested with the simple form of the same pictures. In the presentation phase subjects were instructed to study the pictures carefully. During the test phase they viewed pictures one at a time and responded “same” or “changed” to each.

The results of the adults tested by Pezdek and Chen (1982) are presented in Table 1. As can be seen, recognition sensitivity was significantly higher for simple \( d' = 2.03 \) than for complex \( d' = 1.18 \) presentation pictures. This effect is referred to as the asymmetric confusability effect. Subjects more accurately distinguished copies of simple input pictures from more complex distractor pictures than they distinguished copies of complex input pictures from simple distractor pictures. The asymmetric confusability effect was replicated in a second experiment by Pezdek and Chen (1982) and has also been reported by Pezdek (1987) with first graders, third graders, young adults, and adults older than 68.

The purpose of the present study was to test a particular model for the processes underlying the asymmetric confusability effect first reported by Pezdek and Chen (1982). According to this model, pictures are schematically encoded such that the memory representation of both simple and complex pictures is similar to the simple version of each picture. Furthermore, although at least some of the nonschematic elaborative information in complex presentation pictures is stored in memory, this elaborative information is difficult to retrieve to verify changed (simple) test versions of complex presentation pictures. That is, elaborative information is easy to recognize in same complex test pictures but is

### Table 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>Simple presentation ( d' = 2.03 )</th>
<th>Complex presentation ( d' = 1.18 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Same test</td>
<td>Changed test</td>
</tr>
<tr>
<td>Percentage correct</td>
<td>71.0</td>
<td>83.8</td>
</tr>
</tbody>
</table>

Figure 1. Examples of pictures in both simple and complex forms.
difficult to retrieve when complex presentation pictures are changed to simple test pictures.

The notion that pictures are schematically encoded comes from several previous studies. Goodman (1980) found that pictures were represented in terms of the action schema depicted in each picture and that high schema-relevant items were accurately recalled but poorly recognized, and low schema-relevant items were accurately recognized but poorly recalled. Similarly, Friedman (1979) reported that objects in pictures that have the highest likelihood of being represented in a picture's frame required less visual analysis for identification, and that transformations of these objects were less likely to be noticed than were transformations of less expected objects. Findings by Hock, Romanski, Galie, and Williams (1978), Mandler and Johnson (1976), Mandler and Ritchey (1977), and Pezdek (1978) provide further evidence that people use a scene schema to encode and represent information presented in pictures as well as in real world scenes (Brewer & Treyens, 1981).

The model tested in the present study is summarized in Table 2 with the predicted pattern of results. Consider processing of the simple presentation pictures first. The model predicts that when a simple picture is presented, subjects store the visual information that is relevant for communicating the schema of the picture. It should be noted that when the simple pictures were developed by Nelson et al. (1974), an artist was shown each photograph used by Nickerson (1965) and the sentence that had been normed to best describe the photograph. The artist was instructed to sketch a line drawing of the photograph that included the least amount of visual detail in order to present the information in the photograph that was necessary for communicating the one-sentence descriptor. Thus, most of the visual information in each simple picture is predicted to be retained in the schematic representation of the picture in memory. Consequently, with a same (simple) test picture, the predicted response would be “same” because a match in memory would be made. With a changed (complex) test picture, the predicted response would be “changed” because the extra details in the complex version of the simple picture are not recognized as being part of the memory representation of the simple presentation picture. The model thus predicts high hit rates and high correct rejection rates in the simple presentation conditions.

On the other hand, the complex pictures were defined by Nelson et al. (1974) as being replicas of the simple form of each picture with extra shading, details, and elaboration added. Thus, when a complex picture is presented, the model predicts that the picture will be schematically processed such that the visual information that is relevant for communicating the schema in the picture is retained in memory. This schema-relevant visual information in a complex picture is primarily the information that is in the simple form of the complex picture. Thus, the memory representation for complex presentation pictures would retain the information in the simple form of the picture.

The model further predicts that the elaborative visual information in complex presentation pictures that is not central to communicating the schema in each picture is encoded and stored differently than is the schema-relevant visual information. A consequence of this difference is that the elaborative visual details are more difficult to retrieve than are the schema-relevant visual details. Thus, elaborative information in complex presentation pictures is difficult to retrieve when a changed (simple) test picture is viewed but can be recognized when it is included in same (complex) test pictures. High hit rates but low correct rejection rates are thus predicted for complex presentation pictures. The difficulty in retrieving nonschematic elaborative details is hypothesized to result from one of two sources. The difficulty in retrieving nonschematic details may result from weaker associations in memory between nonschematic details and schematic details than exist among schematic details. Alternatively, Goodman (1980) suggested that this difficulty occurs because nonschematic details are not retained in memory with the schematic information. The present study was not designed specifically to distinguish between these two interpretations.

### Experiment 1

In Experiment 1, half of the subjects participated in the same–changed recognition procedure used by Pezdek and Chen (1982) with a 5-s presentation rate. The other half of the subjects participated in this same procedure except that they were presented a one-sentence description of each picture just prior to viewing the picture. Subjects in the sentence-prompt condition were instructed to keep each sentence in mind while studying the picture that followed. This procedure was suggested by Friedman (1979) and Bartlett, Till, and Levy (1980) as a method for encouraging thematic or schema-driven processing of each picture.

It was anticipated that although both simple and complex pictures are schematically processed, presenting the sentence prompt before each picture would serve to more clearly differentiate the schema-relevant visual information from the elaborative visual information. It was predicted that the sentence prompt would increase the probability that pictures are encoded and retained in terms of their central schema, and furthermore, would increase the probability of encoding and storing nonschematic elaborative information in a form that makes subsequent retrieval difficult. Thus, an interaction was predicted between the sentence-prompt condition and presentation form; the asymmetric confusability effect was pre-

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### Table 2

**Predictions of the Proposed Model**

<table>
<thead>
<tr>
<th>Predicted</th>
<th>Complex presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple presentation</td>
</tr>
<tr>
<td></td>
<td>Same test (simple)</td>
</tr>
<tr>
<td></td>
<td>Changed test (complex)</td>
</tr>
<tr>
<td>Response Results</td>
<td>“Same” High hit rate</td>
</tr>
<tr>
<td></td>
<td>“Changed” High CR rate</td>
</tr>
<tr>
<td></td>
<td>Same test (complex)</td>
</tr>
<tr>
<td></td>
<td>Changed test (simple)</td>
</tr>
<tr>
<td></td>
<td>“Same” High hit rate</td>
</tr>
<tr>
<td></td>
<td>“Same” Low CR rate</td>
</tr>
</tbody>
</table>

*Note. CR = correct rejection.*
dicted to be larger in the sentence-prompt condition than in the no-prompt condition.

Method

Subjects and design. The subjects were 40 undergraduates who volunteered from classes at California State University, San Bernardino. Age and sex were not specifically controlled in this experiment nor throughout the study. No students participated in more than one experiment. Twenty subjects were randomly assigned to the sentence-prompt condition and 20 to the no-prompt condition. All subjects viewed simple and complex line drawings in a presentation phase and were tested with a same–changed recognition procedure.

Materials. The 44 pairs of pictures used by Pezdek and Chen (1982) were used in each of the experiments in this study. These pictures were a subset of the pictures used by Nelson et al. (1974) and originally constructed by Nickerson (1965). Each of 44 basic pictures had been drawn in both a simple, unembellished line drawing form and a complex, embellished line drawing form, which yielded a total of 88 pictures. All drawings were black and white. The simple and complex forms of each picture were constructed by Nelson et al. (1974) such that both were “best described” by the same sentence; extra shading, details, and elaboration, however, were added to the figure and the background in the complex version of each picture. None of the details added in the complex form of each picture were unexpected or implausible, and these details were not essential for communicating the theme of the picture. Examples of stimulus pictures are shown in Figure 1.

The 44 test pictures consisted of 22 same pictures (11 simple and 11 complex) and 22 changed test pictures. There were two types of changed test pictures—those that included additions and those that included deletions. Additions involved simple pictures at presentation and complex versions of those same pictures at test. Deletions involved complex pictures at presentation and simple versions of those same pictures at test.

In addition to the pictorial stimuli, a typed one-sentence description of each picture was reproduced on each of 44 additional slides. The sentences were those generated by Nelson et al. (1974); two judges independently examined the pictures and created a one-sentence description of each. Differences between the two judges’ descriptions were reconciled by a third judge.

Procedure. Subjects participated in groups of 3 to 5 subjects each. The experiment consisted of a study phase followed immediately by a 3-min maze-tracing task and then a test phase. The maze-tracing task was inserted between the study and test phases to ensure that the test assessed long-term memory. In the study phase, subjects were presented 88 slides for 5 s each, with 44 representing pictures. The projected image of each picture measured 64 × 97 cm. This size was held constant for each experiment in this study. The sentence-prompt condition thus included 22 simple pictures and 22 complex pictures randomly sequenced, with each immediately preceded by the one sentence that described the picture. In the no-prompt condition the study phase included the same pictures presented in the same order as in the sentence-prompt condition. However, a blank slide was presented prior to each picture to equalize the intertrial interval in the two conditions. The background brightness of the blank slides was similar to that of the sentence slides. Subjects were instructed to study each picture carefully, because this would be important in a later part of the experiment. In addition, subjects in the sentence-prompt condition were instructed to keep each sentence in mind while studying the picture that followed. During the test phase, subjects looked at each test picture and circled on a response sheet “SAME” or “CHANGED.” Four sample items were shown before the test phase to ensure that subjects understood the task. The entire procedure lasted about 35 min.

Results

The percentage correct and $d'$ data were calculated across subjects and are presented in Table 3. Throughout this study the rejection region for all analyses was $p < .05$. A 2 (sentence prompt/no prompt) × 2 (simple or complex presentation form) analysis of variance (ANOVA) was first performed on the $d'$ data. Recognition sensitivity was greater for picture presented in the simple ($d' = 1.65$) than complex form ($d' = 0.87$), $F(1, 38) = 15.64, M_{SE} = .78$. Although the presence of a sentence prompt did not produce an overall main effect ($F < 1.00$), this variable did interact significantly with presentation form, $F(1, 38) = 4.34, M_{SE} = .78$. The sentence prompt increased the recognition advantage of simple over complex pictures relative to the no-prompt condition.

The percentage correct data were analyzed in a 2 (sentence prompt/no prompt) × 2 (simple or complex presentation form) × 2 (same or changed test form) ANOVA. Subjects were significantly more accurate in recognizing pictures presented in the simple (74.2%) than complex (64.5%) form, $F(1, 38) = 12.61, M_{SE} = 2.92$, and more accurate in recognizing same (hit rate = 73.5%) than changed (correct rejection rate = 65.0%) test pictures, $F(1, 38) = 23.71, M_{SE} = 2.28$. The Presentation Form × Test Form interaction was also significant, $F(1, 38) = 5.17, M_{SE} = 5.54$. Although the hit rate for simple (72.5%) and complex presentation pictures (74.6%) did not differ, the correct rejection rate was significantly less for complex (54.4%) than for simple presentation pictures (75.6%). This first-order interaction did not significantly vary as a function of the sentence-prompt manipulation, nor did the sentence-prompt manipulation produce a significant main effect on the percentage correct measure.

Four planned comparisons were performed to compare performance in the sentence-prompt versus no-prompt conditions for hit rates and correct rejection rates with simple and complex pictures. As seen in Table 3, comparisons were made on the pairs of means in each of the four columns in the top half of the table. The only difference between the sentence-prompt and no-prompt conditions was in the correct rejections of complex pictures (47.3% vs. 61.5%), $t(38) = 2.10$. The presence of the sentence prompt reduced subjects’ recognition accuracy for changed versions of pictures that had been presented in their complex form. This difference con-

<table>
<thead>
<tr>
<th>Condition</th>
<th>Simple presentation</th>
<th>Complex presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Same test:</td>
<td>Changed test:</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Sentence-prompt</td>
<td>77.0</td>
<td>74.2</td>
</tr>
<tr>
<td>No-prompt</td>
<td>67.9</td>
<td>77.0</td>
</tr>
</tbody>
</table>
tributed to the significant interaction of the sentence-prompt condition and presentation form on $d'$. The results of Experiment 1 are consistent with the predictions of the model being tested. The patterns of results in the sentence-prompt and no-prompt conditions were similar, with the asymmetric confusability effect exaggerated in the sentence-prompt condition. It appears that subjects in both conditions were schematically encoding the pictures and subsequently using schematic cues to guide retrieval of visual information. However, the sentence prompt caused subjects to do this more effectively.

In addition, if subjects are schematically processing pictures as predicted by the model, then the elaborative detail that is less essential for communicating the schema of each complex picture would more likely be encoded and stored in a form that makes subsequent retrieval difficult. Thus, the correct rejection rate for changed complex presentation pictures would be lower than for changed simple presentation pictures. This occurred in Experiment 1. Furthermore, exaggerating schematic processing of pictures by the use of a sentence prompt would be expected to decrease the correct rejection rate for complex presentation pictures relative to simple presentation pictures more in the sentence-prompt condition than in the no-prompt condition. Again, this occurred in Experiment 1.

**Experiment 2**

Experiment 2 tested whether subjects used schema-guided or thematic encoding of the pictures in the previous experiments because they erroneously anticipated that the memory test would be a recall test rather than a recognition test. This interpretation follows from Nickerson and Adam's conclusion (1979) that "the visual details of an object, even a very familiar object, are typically available from memory only to the extent that they are useful in everyday life" (p. 287). This suggests that subjects in the present study may have been encoding the type of information that they anticipated would be "useful" for the subsequent memory task.

Furthermore, it has been demonstrated that subjects encode different types of information from pictures as a function of whether they are anticipating a recall- versus a recognition-memory test (Frost, 1972; Tversky, 1973). In particular, in at least one study (Goodman, 1980), it was reported that although high thematically relevant details are better recalled than are low thematically relevant details, low thematically relevant details are better recognized than are high thematically relevant details. Thus, one interpretation of the results of the present study is that subjects were using thematic encoding of the pictures because they were anticipating a recall-memory test.

Experiment 2 is a replication of the procedure used by Pezdek and Chen (1982), with the added feature that half of the subjects were told prior to the presentation phase that the test that followed would be a same–changed recognition test, and half were told to anticipate a recall test. The recognition-instruction group was shown eight sample items demonstrating the type of changes they would see during the test. The recall-instruction group was given eight sample pictures and a practice recall test before the presentation sequence. Both groups in fact received the identical same–changed recognition-memory test. If the memory advantage for simple over complex pictures is due to subjects erroneously anticipating a recall test, then the difference between recognition of simple and complex pictures should be less in the recognition-instruction condition than in the recall-instruction condition in Experiment 2.

**Method**

**Subjects and design.** Forty-five students in an introductory psychology class at California State University, Los Angeles were subjects in the recognition-instruction condition. Forty students in an introductory psychology class at Chaffey Community College were subjects in the recall-instruction condition. The students participated in class as part of a class exercise. Classes were randomly assigned to each of the two conditions. However, because students participated in class, this precluded random assignment of subjects to conditions and thus stretches the definition of a "true experiment." All subjects viewed simple and complex line drawings in a presentation phase and were tested with same and changed test pictures in a same–changed recognition procedure.

**Materials and procedure.** The 44 pictures from Experiment 1 were used in this experiment. In the study phase, 44 pictures were randomly arranged and presented for 5 s each. This phase was followed by a 3-min maze-tracing task and then a test phase. In the test phase 44 test pictures were randomly arranged and presented for 8 s each in a same or changed form. Subjects responded "SAME" or "CHANGED" on the response sheet provided. Four sample items were shown before the test phase to ensure that subjects understood the task. The entire procedure took about 30 min.

Before viewing the presentation pictures, subjects in the recognition-instructions condition were instructed to study each picture carefully and told that they would be tested with a recognition memory test afterward. They were then shown eight demonstration pairs, each consisting of a presentation picture followed by a test picture. The eight demonstration pairs included two each of the four presentation form/test form combinations (i.e., present simple-test same, present simple-test changed, present complex-test same, present complex-test changed). With each demonstration test picture, the experimenter indicated the correct response for that item and described the reason for the correct response in terms of the picture being (a) the same as the previous picture, (b) a changed version of the previous picture because of specific added elaborative detail, or (c) a changed version of the previous picture because of specific deleted elaborative detail.

Before viewing the presentation pictures, subjects in the recall-instruction condition were told to study each picture carefully because afterward they would be given a recall test. A recall test was defined as a test in which they would be asked to write down a one-sentence description of each of the pictures they could remember from the original sequence. They were then shown eight sample pictures followed by a practice test in which they were instructed to recall in writing as many of the pictures as they could remember.

**Results**

The percentage correct and $d'$ data were calculated across subjects and are presented in Table 4. A 2 (recognition or
Table 4
Mean Percentage Correct and d' Values in Each Experimental Condition in Experiment 2

<table>
<thead>
<tr>
<th>Condition</th>
<th>Simple presentation</th>
<th>Complex presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Same test: % correct</td>
<td>Changed test: % correct</td>
</tr>
<tr>
<td>Recognition instructions</td>
<td>73.3</td>
<td>78.0</td>
</tr>
<tr>
<td>Recall instructions</td>
<td>77.3</td>
<td>84.0</td>
</tr>
</tbody>
</table>

RECOGNITION MEMORY FOR PICTURES

Mean Percentage Correct and d' Values in Each Experimental Condition in Experiment 2

An additional control condition was included in Experiment 3 to test whether subjects who had never seen the presentation pictures would be able to indicate whether the correct response should be "added" or "deleted" for each test picture. This may have been possible if simple test pictures look relatively more empty than do complex test pictures. To test this interpretation, a separate group of subjects in Experiment 3 was tested with the changed test pictures, but this second group was not shown the presentation pictures. If such a guessing effect were operating, it would be expected that subjects who did not see the presentation pictures would be more likely to respond "added" to changed (complex) versions of simple presentation pictures than to respond "deleted" to changed (simple) versions of complex presentation pictures.

An additional control condition was included in Experiment 3 to test whether subjects who had never seen the presentation pictures would be able to indicate whether the correct response should be "added" or "deleted" for each test picture. This may have been possible if simple test pictures look relatively more empty than do complex test pictures. To test this interpretation, a separate group of subjects in Experiment 3 was tested with the changed test pictures, but this second group was not shown the presentation pictures. If such a guessing effect were operating, it would be expected that subjects who did not see the presentation pictures would be more likely to respond "added" to changed (complex) versions of simple presentation pictures than to respond "deleted" to changed (simple) versions of complex presentation pictures.

Method

Subjects and materials. Fifteen students in a cognitive psychology class at California State University, Fullerton participated in the experimental condition that included presentation pictures. They were presented the same 44 simple and complex pictures as were used in the previous experiments. Nineteen students in a social psychology class at the same university participated in the no-presentation control condition. As in Experiment 2, classes were randomly assigned to the two conditions. However, because students participated in classes, they were not randomly assigned to conditions.

Procedure and design. Subjects in the presentation condition viewed the 22 simple and 22 complex presentation pictures for 5 s each, followed by a 3-min maze-tracing task, and then the 44 test
pictures. In the presentation phase, these subjects were instructed to study each picture carefully, because it would be important in a later part of the experiment.

The test consisted of 44 changed versions of the pictures from the presentation phase; there were no same test pictures. Subjects were instructed that they would view 44 changed test pictures. For each test picture, the task was first, to detect whether the change in the test picture involved details that were added to or deleted from the original picture and to circle the corresponding word "ADDED" or "DELETED" on a response sheet. This was the detection test. Second, they were asked to identify in the space provided what elaborative details had been added to or deleted from the original picture. This was the identification test. If at least one of the added or deleted details was identified for each test picture, this was scored as an accurate identification response. Subjects were shown four practice test items in advance to ensure that they understood the task.

Subjects in the no-presentation condition were told that a different group of subjects had been shown a series of 44 pictures and then a test on these pictures. They were told that they would be given the same test as this previous group. They would not see, however, the original presentation pictures. Their task was thus to look at each picture and guess whether elaborative details had been added to or deleted from the original version of the picture seen by the other group. Then they were to indicate what elaborative details had been added to or deleted from the original picture. Subjects in both groups used the same response sheet. Subjects in the no-presentation condition were shown examples of 20 pictures, similar to those seen during the presentation phase by the previous group, to give them a sample of the range in the amount of visual detail typical with this kind of line drawings. These 20 sample pictures were from the original set used by Nelson et al. (1974) but were not included in the 44 pictures used throughout the current study. Subjects in the no-presentation condition were also shown the four practice test items to demonstrate the types of changed pictures in the test.

**Results**

The accuracy in correctly detecting additions in changed simple presentation pictures and deletions in changed complex presentation pictures was calculated and averaged for subjects in both conditions. A 2 (simple vs. complex presentation form) × 2 (presentation vs. no-presentation group) ANOVA was performed on the percentage correct detection data. Subjects in the condition with presentation pictures (84.8% correct) were significantly more accurate than were subjects in the no-presentation condition (69.1% correct), \(F(1, 32) = 8.42, MS_e = 4.90\), and these group differences interacted with presentation condition, \(F(1, 32) = 7.11, MS_e = 3.20\). Planned comparisons indicated that although subjects in the presentation condition were significantly more accurate in detecting changes in simple pictures (92.6%) than in complex pictures (76.9%), \(t(14) = 7.81\), in the no-presentation condition, detection of changes in simple (65.3%) and complex pictures (72.9%) did not differ, \(t(18) = 1.25\). The results of the no-presentation group suggest that better accuracy at detecting additions than deletions by the presentation group does not result from a greater tendency to guess "added" than "deleted."

Additional analyses were performed on subjects' second response for each item; that is, the mean percentage accurate identification given correct detection in each condition. In the presentation condition, subjects were significantly more accurate in identifying the details that were added to changed simple presentation pictures, given that additions were detected (90.2%), than they were in identifying the details that were deleted from changed complex presentation pictures, given that deletions were detected (54.2%), \(t(14) = 7.81\). Similarly, in the no-presentation condition, subjects were significantly more accurate in identifying the details that were added to changed simple pictures, given that additions were guessed correctly (55.1%), than they were in identifying the details that were deleted from changed complex pictures, given that deletions were correctly guessed (12.8%), \(t(18) = 6.37\). Thus, not only are subjects better able to detect that *something* is added to changed simple pictures than that *something* is deleted from changed complex pictures; they are also better able to identify the details that were added than those that were deleted.

Together, these results verify the predictions of the model. Although the nonschematic detail information in complex presentation pictures can be recognized when it is included in same (complex) test pictures (i.e., the high hit rate for complex presentation pictures), it is difficult to retrieve when it is deleted from changed (simple) test pictures (i.e., the low correct rejection rate for complex presentation pictures).

**General Discussion**

These three experiments testify to the robustness of the "asymmetric confusability effect" initially reported by Pezdek and Chen (1982). When subjects in Experiment 1 were given a sentence that described the central schema in each picture prior to viewing each picture, the asymmetric confusability effect was exaggerated. This suggests that schematic processing of pictures underlies the effect. A model was tested in which it was proposed that when pictures are schematically processed the visual information that communicates the schema is more likely to be encoded and retained in memory than is the elaborative information not necessary for communicating the schema. The memory representation for both simple and complex pictures is thus similar to the simple version of each picture. Elaborative details less essential for communicating the central schema of a picture are represented in memory in a manner that makes them difficult to retrieve. Thus elaborative visual information is easy to recognize in same complex test pictures, but is difficult to retrieve to verify that "something is missing" when complex presentation pictures are changed to simple test pictures. The results of Experiment 3 bear out this prediction of the model.

The finding that subjects are better able to notice what is added to changed simple presentation pictures than what is deleted from changed complex presentation pictures has been observed in several other studies. Agostinelli, Sherman, Fazio, and Hearst (1986) reported that subjects were more accurate at detecting and identifying additions to line drawings than deletions from line drawings of objects. Similarly, Healy (1981) reported that in the process of proofreading, subjects are less likely to notice missing features of a letter (e.g., when "students" is misspelled as "students") than they are to notice added features of a letter (e.g., when "factors" is misspelled as...
subjects do not accurately retain the elaborative detail information that differentiates complex from simple pictures, that is, detail information that is not essential for depicting the central schema in the picture. Although the present study appears similar to the studies of Friedman (1979) and Goodman (1980), there are significant differences in the materials used in these studies.

In Friedman’s (1979) study, subjects viewed line drawings of scenes with 25 to 34 objects in each scene. They studied each picture for 30 s. Objects had been previously rated as expected (e.g., a coffee pot in the kitchen) or unexpected (e.g., a plant in the kitchen). Changes in the unexpected items were better noticed than were changes in the expected items. Differences between the results of this study and the current study can be accounted for by the fact that the schemata presented in the pictures used in the current study were more unusual than were those used in Friedman’s pictures. Also, none of the detail information added to or deleted from pictures in the present study involved unexpected items, inasmuch as all of the information in both the simple and complex versions of each picture had existed in the photograph of the real-world scene from which each drawing had been derived.

In Goodman’s (1980) study, subjects viewed line drawings depicting action schemata such as a girl reading a book at a desk. Each picture was studied for 10 s followed by a recognition test for objects that were schema-relevant (a bookcase) or schema-irrelevant (a house plant). Although the materials used by Goodman (1980) appear similar to those used in the present study, her study was set up to compare recognition memory for physical changes in schema-relevant versus schema-irrelevant information. On the other hand, the present study compared subjects’ ability to discriminate same from changed simple versus complex pictures, and information added to changed simple presentation pictures was detected better than was information deleted from changed complex presentation pictures. Detecting the addition or deletion of information in pictures apparently involves different processes than detecting changed objects. Combining Goodman’s (1980) findings with those of the present study, one might predict that although information deleted from pictures is detected less accurately than is information added to pictures, the size of this memory difference would be greater for schema-relevant items than for schema-irrelevant items. However, a test of this prediction remains to be done.

To close on a general note, these results suggest that although people are very good at distinguishing large sets of “old” pictures from “new” distractor pictures, their ability to detect missing elaborative visual details is more limited. Studies that require people to distinguish old pictures from completely new distractor pictures only assess how well pictures that draw on familiar schemata can be distinguished from pictures that draw on unfamiliar schemata. Such studies do not assess memory for the elaborative visual information in pictures. This latter issue has been the focus of this article.

References

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