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Pictures and images: Spatial and temporal information compared

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These studies compared the spatial (Experiment 1) and temporal (Experiment 2) contextual information in memories of perceived pictures with that available in memories of imagined pictures. As expected, contextual information was generally superior for memories derived from perception.

A number of studies demonstrate memory for spatial location or temporal order of perceived objects (Hintzman, Block, & Summers, 1973; Mandler, Seegmiller, & Day, 1977; Rothkopf, 1971; Schulman, 1973; Toglia & Kimble, 1976; Underwood & Malmi, 1978). Some studies show that visual imagery has spatial characteristics as well (Kosslyn, Ball, & Reiser, 1978; Neisser & Kerr, 1973). However, few (Peterson, 1975) compare memory for spatial or temporal characteristics of perceived information with memory for the spatial or temporal characteristics of imagined information.

One reason this comparison is of interest is that contextual cues such as time and location could help distinguish between perception and imagination in memory ("reality monitoring") if these cues are, on the average, more available for memories of perceptions than for memories of imaginations (Johnson & Raye, 1981). The present studies addressed this proposition.

EXPERIMENT 1

Method

Design and Subjects. Three variables were combined factorially. During acquisition, type of processing (seeing or imagining) and spatial context (on the right screen or on the left screen) were manipulated within subjects. Then, half the subjects received a test for spatial memory immediately following acquisition (immediate) and half received the test 1 week later (delayed). Subjects were 32 male and female students in introductory psychology classes at the State University of New York at Stony Brook.

Materials and Procedures. Ninety-six items representing familiar objects (e.g., corn, pencil, bear, violin) were randomly divided between old items for acquisition and new items for the recognition test. For any one subject, 12 acquisition items were seen on the right and 12 on the left. Similarly, the subject was asked to imagine seeing 12 acquisition items on the right and 12 on the left. The order of items was random, but the four types were distributed equally in quarters of the acquisition sequence. Four assignments of items to conditions were used equally often to rotate particular items through each condition.

Subjects were tested individually. They were told we were interested in comparing the visual properties of perceiving and imagining, and they were not told about the memory test. At the beginning of each trial, the experimenter verbally cued subjects to look at either the right or the left screen. On "seeing" trials, after the experimenter's location cue, a word appeared on the screen for 2 sec and was followed by the appropriate line drawing for 5 sec. While inspecting the picture, subjects rated the difficulty they thought they would have if we asked them to draw the picture. The rating scale ranged from 1 to 7, with larger numbers indicating greater difficulty. On "imagination" trials, after the location cue, a word was presented on the screen for 2 sec, followed by a blank screen for 5 sec, on which subjects imagined seeing a picture of the object named. Subjects were told to generate a picture in the center of the blank screen, in the same style and size as the pictures of other objects actually presented. They then rated the difficulty of drawing the picture they had imagined. Four practice trials were followed by 48 acquisition trials.

On the recognition test, subjects were given a list of 96 words and were asked to make one of three responses indicating whether they thought a word referred to an item occurring earlier to their right or to their left, or to a new item. They were also told to rate the confidence they had about each location decision on a scale from 1 to 5 (1 = guessing, 5 = high confidence). Subjects were told that it did not matter whether they had seen or imagined seeing a picture of the item. The experimenter cued subjects to move a mask down the test sheet at a 5-sec rate. Subjects received the test either about 2 min after acquisition or 1 week later. All subjects in both immediate and delayed conditions returned for the second session, and thus no subjects in either condition were lost.

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Results

Comparisons are reported that were significant at the .05 level or better.

Recognition memory. The number of new items called old (false positives) was greater on the delayed test (mean = 7.75) than on the immediate test (mean = .44) [$F(1,30) = 26.33$, MSe = 32.49]. The mean number of items that subjects failed to recognize as old (misses) is summarized in Table 1. Misses increased with delay [$F(1,30) = 20.76$, MSe = 11.02] and were greater for imagined than for seen items [$F(1,30) = 14.13$, MSe = 3.34]. The latter difference was significant only for the delayed condition [$F(1,15) = 11.91$, MSe = 6.30], producing a significant interaction between testing session and type of item missed [$F(1,30) = 8.64$, MSe = 3.34]. Thus memories of nonverbal events originating from imagination became unavailable more rapidly than those originating from perception.

Memory for location. The mean identification of location scores are summarized in Table 2. For perceived items, the number of items correctly located (to the right and left) was divided by the total number of seen items correctly recognized as old. Similarly, for imagined items, the number of imagined items correctly located was divided by the total number of imagined items correctly recognized as old items. People were better at remembering location when tested immediately than when tested after a delay [$F(1,30) = 50.84$, MSe = 1.85]. In fact, after 1 week, performance was close to chance even on seen pictures (see also Brown, Deffenbacher, & Sturgill, 1977).

The overall analysis of variance did not show a difference between memory for location of items that were seen and of those that were imagined. However, as noted above, performance was very poor after the delay and variability among subjects at both retention intervals was high. When the immediate condition alone was examined with a sign test, memory for location was significantly better for seen than for imagined items ($z = 2.22$), as predicted. This result is also consistent with Peterson's (1975) finding that memory for the location of letters in a 4 by 4 matrix was better when the matrix was actually seen than when the matrix was only imagined by subjects.

Table 1
Mean Number of Misses: Experiment 1

	Testing Session	
Item Type	Immediate	1-Week Delay
Seen	.38	2.81
Imagined	.75	5.88

Table 2
Mean Proportion of Correct Identification of Location: Experiment 1

	Testing Session	
Item Type	Immediate	1-Week Delay
Seen	.85	.59
Imagined	.80	.57

Table 3
Mean Confidence Ratings for Locations Remembered Correctly (A) and Incorrectly (B): Experiment 1

	Testing Session: A		Testing Session: B	
	Imme-diate	1-Week Delay	Imme-diate	1-Week Delay
Seen	4.29	3.37	3.56	3.21
Imagined	3.99	2.97	3.21	2.89

Confidence ratings. The mean confidence ratings for old items whose locations were remembered correctly and incorrectly are summarized in Table 3. Confidence ratings for memories of seen items were higher than confidence ratings for memories of imagined items [$F(1,30) = 18.94$, MSe = .20]. Confidence decreased with delay [$F(1,30) = 8.30$, MSe = 1.64] and was greater for correct than for incorrect location responses [$F(1,30) = 42.50$, MSe = .14]. The difference between correct and incorrect responses was greater for subjects tested immediately [$F(1,30) = 22.83$, MSe = .14].

EXPERIMENT 2

Method

The materials used in Experiment 1 were also used to investigate memory for temporal information. As in Experiment 1, subjects were told that we were interested in comparing the visual properties of perceiving and imagining. At the beginning of each trial, the experimenter said the name of an object out loud. Half of the time, subjects then saw a picture of the object in the center of a screen (seeing trials), and half the time, they imagined seeing a picture of the object on the screen (imagination trials). While some subjects were seeing a picture of a named object, other subjects imagined seeing a picture of the same object. This was accomplished by having two projection screens in the room, one to the far right and one to the far left. Subjects were randomly assigned to view one screen or the other, and they were seated accordingly. On each trial, subjects rated the difficulty of drawing the real or imagined picture on a scale from 1 to 7.

Following four practice trials and 96 acquisition trials, subjects counted backward by threes, writing the numbers for 20 sec. Then they received the temporal order test. Each page of the test booklet contained eight items (all seen or all imagined), drawn from different eighths of the acquisition list and randomly ordered on the page. For each page, subjects were told to use the numbers from 1 to 8 to indicate the relative temporal position of the items: The larger the number, the more recent the item was. They were told to use each number once only on each page and were paced through the booklet by the experimenter, who gave the signal when all subjects appeared to have finished each page. In each third of the booklet, there were 2 pages of seen and 2 pages of imagined items (for a total of 12 pages). Also, three test booklets were used to counterbalance the order of test pages across subjects.

Table 4
Mean Number of Correctly Ranked Items in Each Eighth of the List: Experiment 2

	Actual Position in List							
	1	2	3	4	5	6	7	8
Seen	2.33	.90	.83	.83	.78	.68	.98	2.23
Imagined	2.20	.97	1.23	.65	1.00	.55	.95	1.42

Forty-eight male and female students at the State University of New York at Stony Brook participated in the experiment; the data from eight were discarded because they did not follow instructions.

Results

Mean position ranking. The mean position ranking given for items for each eighth of the acquisition list was computed. For seen items, the means were 3.00, 4.20, 4.09, 4.67, 4.16, 4.56, 5.28, 6.05; for imagined items, the means were 3.22, 4.03, 4.07, 4.64, 4.52, 4.44, 5.33, and 5.85. There was a main effect for position [$F(7,273) = 55.05$, $MSe = 1.01$], with items occurring earlier in the acquisition list receiving lower rankings than items occurring later in the acquisition list.

Correct ranks. Table 4 shows the number of test pages on which subjects assigned the correct rank. For seen and for imagined items, the maximum score is six in each case. There was a main effect for position [$F(7,273) = 28.99$, $MSe = .91$]; as is evident in Table 4, more items occurring in the early and late portions of the acquisition list were correctly ranked, compared with items occurring in the middle positions in the acquisition list. There was also a significant interaction between type of item and position [$F(7,273) = 3.35$]. Subsequent sign tests indicated that the difference was significant only for the last eighth of the list ($z = 3.44$), in which the mean number correct was greater for perceived than imagined items.

While the prediction that subjects would be more accurate in designating the temporal position of perceived items than that of imagined items was confirmed only for the last eighth of the acquisition list, this finding was viewed as encouraging. Some investigators (e.g., Crowder, 1976, pp. 461-464; Glenburg, Bradley, Stevenson, Kraus, Tkachuk, Gretz, Fish, & Turpin, 1980) have suggested that the recency portion of the serial position curve reflects the contribution of temporal information. If so, the last portion of the list might well be expected to be most sensitive to differences in availability of temporal information.

GENERAL DISCUSSION

In both experiments, subjects saw or imagined line drawings of common objects. The orienting task, which required subjects to rate the difficulty of drawing the object, was designed to engage the subjects' attention and to encourage the same sort of "inspection" during perception and thought. One indication that this procedure was successful is that for both experiments there was a significant correlation between the average difficulty ratings for items when they were seen and when they were imagined ($r = .56$ and $.74$, for Experiments 1 and 2, respectively).

Subjects in Experiment 1, who were tested several minutes after they had seen or imagined objects in one of two places, were better able to identify the location of seen than of imagined objects. These findings are consistent with those of Peterson (1975). In Experiment 2, subjects were more accurate in making temporal judgments about perceived pictures than about imagined pictures occurring in the last eighth of the acquisition sequence.

The greater availability of spatial and temporal information about perceived pictures might reflect a general superiority of perceptually derived over imaginally derived information. However, in a separate study as yet unpublished (Johnson, Foley, & Raye, Note 1), subjects were actually faster at making old-new decisions about imagined items than about perceived items on an immediate recognition test, indicating that memories for imaginations are not simply deficient in all types of information.

In summary, the overall pattern of results from these experiments is consistent with the proposition that spatial and temporal information are superior for memories derived from perception compared with those derived from thought. Thus, amount or availability of contextual information associated with a particular memory remains a plausible cue for reality-monitoring decisions, as proposed by Johnson and Raye (1981).

Finally, an additional result of the present Experiment 1 was that recognition over a 1-week interval dropped off faster for imagined than for perceived pictures. Previously published results indicate a superiority on immediate recall and recognition tests of self-generated over perceived verbal items (Slamecka & Graf, 1978) that is present if subjects are tested after intervals as long as 7 or 10 days (Johnson et al., 1981). Johnson et al., however, did not compare the rate of forgetting of perceived and generated items. The present results suggest that investigation of the long-term retention of externally derived vs. internally generated information might prove interesting and that the generation effect might be more readily obtained with verbal than with visual information.

REFERENCE NOTE

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