Reconstitutive memory in kindergarten children¹

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Reconstitutive memory (ability to reproduce a display from memory) was tested in kindergarten children immediately after inspection of a serial display or one week later. Some Ss worked under reward conditions, others did not. Seventy-three Ss were retested six months later. Results agreed with Piaget's finding of improved memory over a six-month period. Evidence suggestive of forgetting within one week after display inspection was also obtained. Reward facilitated memory only under very specific conditions.

In 1967 Piaget reported a study in which 3- to 8-year-olds were shown 10 sticks (measuring from 9 to 18 cm) arranged in order from largest to smallest. One week after and six months after inspection of the sticks, memory for the series was reported by word of mouth, drawing, or gesture. Results indicated that in 74% of cases memory improved between the one-week and the six-month reports. Unfortunately, no information was given regarding differences in reports of the various age groups or differences among reports by word of mouth, drawing, or gesture.

The present study attempted to clarify Piaget's findings by narrowing the age of Ss used and by using reproduction of the series as the only indicator of memory. It also investigated the effects of conditions of reward (time of presentation and certainty of reward) on serial reproduction which occurred immediately after inspection of the series or one week later.

Table 1 shows the N, M-age, and SD-age of the 418 public school kindergarteners³ assigned to the experimental conditions. Similar statistics are shown for 73 Ss retested after six months.

With two exceptions Ss were unsystematically assigned to experimental conditions. First, within a single classroom Ss were never assigned to both no reward and reward conditions. Second, within-classroom assignments were never made to both immediate and one-week test conditions. The 73 Ss retested after six months included all Ss who had not changed schools during this period and who were tested early enough in the school year to be in school after six months. All 73 were drawn from the one-week test condition. In order to reduce any negative bias toward the E which might have resulted from interclass communication regarding rewards over the six-month period, all no-reward Ss were given a reward for "having worked on E's project" one week after the first test of memory.

Table 1
N, $\bar{X}$ of Age, and SD of Age of Subjects
(Age in Months)

Test Condition	Reward Condition					
	No Reward		Contingent Reward		Guaranteed Reward	
			Early	Late	Early	Late
Immediate	N	42	39	37	39	38
	$\bar{X}$ -age	70.4	69.8	70.8	68.4	71.1
	SD-age	3.5	4.2	3.4	3.7	3.6
1 week	N	52	48	37	44	42
	$\bar{X}$ -age	68.4	69.5	67.9	69.9	67.5
	SD-age	4.7	4.3	3.8	4.2	3.9
6 months	N	23	26		24	
	$\bar{X}$ -age	69.1	70.1		69.9	
	SD-age	5.8	4.0		4.3	

The experimental procedure consisted of presenting each S with 10 sticks arranged in serial order from largest to smallest. The S inspected the sticks for a 2-min period. Later he was given unlimited time in which to reproduce the "stick picture" from memory.

All materials and rewards were passed to S through a trap door under a one-way screen that separated E from S. Instructions were played on a tape recorder positioned on E's side of the one-way screen.

In the contingent reward conditions S selected from an array of children's rings, a ring he would like to take home after he had made a "stick picture" like E's. The S was told that possession of the selected ring depended on his making a "stick picture" exactly like E's. In the guaranteed reward condition, possession of the selected ring was not contingent on a likeness between E's and S's "stick pictures."

The Ss in the early-reward condition made their ring selections just before presentation of the inspection "stick picture." Those in the late-reward condition made their ring selections after inspection of E's "stick picture" and just before S's reproduction of the "stick picture." All reward Ss were given their rings immediately after completion of their "stick picture" reproductions. Mention of the rings was omitted for no-reward Ss. No rewards were used during the six-month retest sessions.

In addition to the ring rewards, the only materials used were two identical sets of sticks cut from square 1/4-in. varnished dowels and two white cardboards. The inspection sticks were glued on a white cardboard with a 3-in. interval between them. The sticks used for reproductions were piled loosely on a second white cardboard.

The S's score was the number of correct stick placements in his reproduction regardless of whether he appeared to arrange the sticks with the largest on his left or on his right.

Results of the six-month test indicated that no S obtaining a perfect score on reproduction at one week failed to do so at six months. Also very few nonperfect scorers showed a drop in score between one week and six months (8.7% or two no-reward Ss; 11.5% or three contingent-reward Ss; 16.7% or four guaranteed-reward Ss). Of the Ss who did not earn perfect scores at one week 55.6% (10) of no-reward Ss, 57.1% (8) of contingent-reward Ss, and 56.3% (9) of guaranteed-reward Ss showed some improvement in score over the six-month period. Of these, 22.2% (4) of no-reward Ss, 21.4% (3) of contingent-reward Ss, and 6.3% (1) of guaranteed-reward Ss progressed from imperfect to perfect scores.

When scores of Ss working under contingent and guaranteed reward but under the same time of reward of test were compared, and when they were compared with the scores of no reward Ss working under similar test conditions (immediate or one week), one difference reached significance at the .05 level. The median score of contingent reward Ss exceeded that of guaranteed reward Ss when reward was late and testing occurred at one week ($z = -1.6$; $p < .05$). Chi square comparisons of frequencies of only perfect scorers yielded two differences significant at the .05 level. Both differences occurred when late reward or no reward Ss tested at one week were considered. More contingent reward than no reward Ss obtained perfect scores ($\chi^2 = 3.9$; $p < .05$) and more contingent than guaranteed reward Ss obtained perfect scores ($\chi^2 = 4.3$; $p < .05$). No reward and guaranteed reward yielded similar numbers of perfect scorers.

Two additional differences occurred when reward conditions were held constant and comparisons of frequency of perfect scorers were made between immediate and one week test

conditions. These comparisons indicated that under no reward condition there were more perfect scorers in the immediate than in the one-week condition ($\chi^2 = 9.94$; $p < .01$) and when guaranteed reward was late, immediate testing yielded more perfect scorers than one-week testing ($\chi^2 = 5.12$; $p < .05$). There was no significant difference in the frequency of perfect scorers in contingent reward regardless of whether testing was immediate or at one week.

The finding that fewer no reward Ss earned perfect scores after one week than with immediate testing suggests that forgetting occurs within a short period of time in Ss who probably have the cognitive structure needed to deal with seriation. That such forgetting is restricted to a relatively short period of time is indicated by the finding that no S who earned a perfect score at one week failed to do so at six months.

Together these findings suggest that Ss having weak, but appropriate, cognitive structure tend to forget as those having stronger and more stable structure do not. Further research is planned that will identify Ss having weak and strong structure. The performance of both types of S will be observed on a six-month test.

The finding that the imperfect scores of only a few Ss deteriorated over the six-month period as many imperfect scores improved, is consistent with Piaget's statement that

imperfect scorers know their responses are incorrect at the time of original testing but they can improve them only when the cognitive structure necessary for dealing with seriation has developed. The present data do not, however, substantiate that recognition of errors and change in cognitive structure underlie the observed improvement in scores.

Regarding the effects of reward on reconstitutive memory, the data suggest that of the types of reward investigated contingent reward is most effective. Also, when reward has any effect at all it does so only when considerable time elapses between observation and test. That reward influences memory at the time of retrieval of material from memory store rather than at the time material goes into store is suggested by the fact that reward facilitated memory only when it immediately preceded presentation of the test material.

REFERENCE

PIAGET, J. Memory. Paper presented at the University of Minnesota, Minneapolis, 1967.

NOTES

1. The author wishes to express appreciation to Francisca Esteban for her loyalty and diligent work during the execution of this study.
2. Now at St. Louis University.
3. The author wishes to express appreciation to the Moorhead Public Schools, Moorhead, Minnesota and to the principals and teachers in the schools which provided the Ss and the space required for execution of this study.