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ABSTRACT

Children's short-term memory was studied under two experimental conditions: one in which recall was expected to be facilitated because of the provision of a study period, and one in which a distracting task was imposed that was expected to interfere with recall. Forty subjects at each of two age levels, 7 and 11 years, were tested in a serial-position recall task in a control as well as in one of the experimental conditions. Overall, recall was higher at the older than at the younger age level. In the facilitation condition, recall improved for the older children only, especially at the primacy positions. In the distraction condition, recall declined and performance for the older age level did not differ from that of the younger. (Author/SET)

FACILITATION AND DISTRACTION IN SHORT-TERM MEMORY

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Abstract

Children's short-term memory was studied under two experimental conditions: one in which recall was expected to be facilitated due to the provision of a study period, and one in which a distracting task was imposed that was expected to interfere with recall. Forty subjects at each of two age levels, 7 and 11 years, were tested in a serial-position recall task in a control as well as one of the experimental conditions. Overall, recall was higher at the older than at the younger age level. In the Facilitation Condition, recall improved for the older children only, especially at the primacy positions. In the Distraction Condition, recall declined and performance for the older age level did not differ from that of the younger.

FACILITATION AND DISTRACTION IN SHORT-TERM MEMORY

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Evidence from recent research indicates that developmental changes in short-term memory cannot be attributed to a mere increase in memory span or ability to remember. Instead, these performance changes seem to result from the use of certain verbal processes and rehearsal strategies by children as they grow older (Belmont & Butterfield, 1969; Flavell, 1970; Hagen, 1971, 1972). Studies investigating the role of verbal labeling of stimulus items in serial-position tasks (Hagen & Kingsley, 1968; Hagen, Meacham, & Mesibov, 1970) have demonstrated such a developmental change. Because rehearsal enhances primacy performance in a serial-position task, any activity which preempts rehearsal time, such as labeling, should produce a decrement in primacy performance. For children under age ten, there were no significant differences between the label and non-label conditions at primacy positions, thus indicating a lack of active rehearsal in these younger children. However, for older subjects, primacy performance was significantly lower under the labeling conditions.

Similar evidence has come from studies which have investigated rehearsal more directly. Flavell, Beach and Chinsky (1966) found that detectable verbalizations during the time between stimulus presentation and recall increased markedly with age between the ages of five and ten. Kingsley and Hagen (1969) found that requiring their five-year-old subjects to overtly rehearse significnatly improved primacy performance as compared to conditions in which responsibility for rehearsal was placed with the child. Finally, Sabo and Hagen (1973) compared the recall of eight-, ten-, and twelve-year-olds on a memory task under conditions which either facilitated or inhibited rehearsal. There was a

significant interaction between rehearsal condition and age: there was no significant difference between the rehearsal conditions at age eight, but significant differences appeared at the two older age levels. Because a control condition was not included in this experiment, it is impossible to determine whether rehearsal increased in the facilitative condition or decreased in the inhibitory condition.

The present experiment was designed to incorporate the experimental conditions of the Sabo and Hagen study in the serial-position recall task. Subjects first served in a Control Condition then in one of the two experimental conditions. In the Facilitation Condition, a period of time was given following presentation of the final stimulus to "think about" the stimuli before recall was tested. In the Distraction Condition, subjects were required to count out loud following presentation of the stimuli. Subjects at two age levels were tested. There were three hypotheses: (A) Overall memory should be higher at the older than at the younger age level, as short-term recall has been found to improve with age in previous studies (e.g., Hagen and Kingsley, 1968). (B) Recall should improve in the Facilitation Condition for the older subjects who rehearse the to-be-recalled stimuli when permitted to do so, but recall should decline for the younger subjects who would not be expected to rehearse even when given the opportunity. Further, it was expected that primacy recall should be especially facilitated for the older subjects but not for the younger subjects because rehearsal facilitates primarily recall at the primacy positions in a serial-position recall task. Recency recall was expected to decline at both age levels due to loss of sensory or echoic cues with the passage of time. (C) Recall was expected to decline in the Distraction Condition at the older age levels because counting aloud should interfere with rehearsal; at the younger age level, either less decline or no change was expected. In this condition, the decrement should be especially evident at the primacy positions; recency recall should decline at both age levels.

Method

Subjects.

The subjects were 80 children from the first, second, fifth, and sixth grades at Angell Elementary School, Ann Arbor, Michigan. Almost all of the subjects were white and from middle to upper-middle class homes. Twenty children, ten boys and ten girls, were randomly assigned to each of the four groups: Younger-Facilitation (Mean CA = 7.3 years); Younger-Distraction (7.2 years); Older-Facilitation (11.5 years); and Older-Distraction (11.2 years).

Task and procedure.

The task is taken from Hagen and Kingsley (1968). Cards with pictures of familiar animals (frog, deer, lion, bear, monkey, zebra, goldfish) were presented serially from the subject's left to right. A card was shown for approximately two seconds, then was placed face down in front of the subject. This procedure was repeated for all seven cards, so that after each trial there were seven cards face down in front of the subject. Then a cue card -- a duplicate of one of the stimulus cards -- was placed in front of the subject. The subject was instructed to turn over the matching card; the cue card remained in place until the subject had made the correct response. Each child was given a practice trial with two and then five cards. Then there were seven test trials in which the seven animals and seven serial positions were randomly probed. This part of the experiment was identical for all treatment groups and constituted the Control Condition.

In the second part of the experiment, the above procedure was repeated for seven more trials with one exception: in the Facilitation Condition there was a fifteen-second interval between the presentation of the seventh stimulus card and the cue card, during which the subjects had been instructed to "think about the cards." For the Distraction Condition, subjects were told to count aloud from one by ones, and they did so until stopped after the fifteen-second interval. Both animals and serial positions were probed in a different random order in the second part of the experiment.

All subjects were tested individually in an isolated room within the school by one of two white male experimenters. Each experimental session lasted approximately twenty minutes.

Results

The mean proportions of correct responses as a function of serial position for the three conditions and two age levels are presented in Figure 1. The first serial

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Insert Figure 1 about here

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position represents the first card shown to a subject, while the seventh serial position represents the final card shown in a given trial.

To determine if recall was higher at the older than the younger age level, a two-way analysis of variance for age level and serial position was performed on correct scores in the Control Condition. Significant age (F = 235.06, df = 1/158, $p < .001$), serial position (F = 12.90, df = 6/948, $p < .001$), and age x serial position interaction (F = 4.80, df = 6/948, $p < .001$) effects were found. Thus, total recall was higher for the older as compared to the younger subjects. Age comparisons at the primacy portion of the curve indicated that the older children performed better at the first (t = 3.57, df = 78, $p < .001$) and third (t = 3.34, df = 78, $p < .01$) serial positions than did the younger children. The earlier results (Hagen & Kingsley, 1968) were, in essence, replicated in this study.

It was expected that in the Facilitation Condition, recall would improve for the older children but would decline for the younger children as compared to recall in the Control Condition. A three-way analysis of variance for age, serial position (repeated measure) and Control versus Facilitation conditions (repeated measure) was performed. Neither the age nor the condition effects was significant; but serial position was (F = 2.36, df = 6/228, $p < .05$). All two-way interactions were significant: Age x condition (F = 4.52, df = 1/38, $p < .05$); age x serial position (F = 3.55, df = 6/228, $p < .01$); and condition by serial position

($F = 5.22$, $df = 6/228$, $p < .01$). From Figure 1, it is evident that in the Facilitation Condition the older children's primacy performance improved ($t = 2.36$, $df = 19$, $p < .05$), while the younger children's performance did not change significantly at the primacy portion of the serial position curves; but both age levels declined at the recency portion of the curves (Younger: $t = 2.70$, $df = 19$, $p < .02$; Older: $t = 2.46$, $df = 19$, $p < .05$). Even though overall recall did not change for either age level in the Facilitation Condition, clearly this condition did affect serial position recall differentially by age level. Apparently at the older age level, when the opportunity for rehearsal was provided it did occur, while it did not at the younger age level. Because recall at recency declines for both age levels, rehearsing does not seem to be responsible for this decline.

A comparison of performance by age levels in the Facilitation Condition found that total recall was higher for the older as compared to the younger age group, but not quite significantly so ($F = 3.51$, $df = 1/38$, $p < .10$). The serial position effect and age x serial position interaction were significant ($F = 5.83$, $df = 6/228$, $p < .001$; $F = 3.63$, $df = 6/228$, $p < .01$). At the first and second serial positions the older group scored higher than the younger ($t = 3.24$, $df = 38$, $p < .01$; $t = 3.56$, $df = 38$, $p < .01$). Thus, in the condition which permitted rehearsal during the delay period, once again the older subjects demonstrated higher recall at the primacy portion of the serial position curves.

In the Distraction Condition, it was expected that recall should decline relative to recall in the Control Condition, and this decline should be greater at the older as compared to the younger age level. A three-way analysis of variance for age, serial position, and Control versus Distraction Conditions was performed. Both age ($F = 9.07$, $df = 1/38$, $p < .01$) and condition ($F = 14.53$, $df = 1/38$, $p < .001$) effects were significant, but serial position was not. The interaction between age and condition effects was also significant ($F = 6.82$, $df = 1/38$, $p < .05$). There was also a significant three-way interaction

(F = 11.02, df = 6/228, p < .001) as well as a two-way interaction between serial position and condition (F = 55.01, df = 6/228, p < .001). From Figure 1, it is clear that the older subjects lost whatever advantage they had over the younger subjects in the Control Condition when the distractor was introduced. At the first, or primacy position, recall declined at the older age level (t = 1.90, df = 19, p < .10) but did not change significantly at the younger age level. At the recency position, performance at both age levels declined (Younger: t = 4.07, df = 19, p < .01; Older: t = 4.85, df = 19, p < .01).

Comparing the performance in the Distraction Condition revealed no age differences (F < 1), nor was there a significant age x serial position interaction (F < 1). At recency, the younger subjects recalled better than the older subjects (t = 2.58, df = 38, p < .02). No other age differences were significant; thus, the distractor task employed here was effective in eliminating the superior recall usually shown by older age subjects.

There were no significant sex differences in any condition. Scores from the California Test of Mental Maturity were available for the older group of subjects only. Performance on this test did not correlate with recall in any of the conditions of this study.

Discussion

Overall memory was substantially higher at the older as compared to the younger level in the Control Condition. In addition, the primacy effect is clearly evident for the older but not the younger subjects. Thus the findings of the earlier studies (e.g., Hagen & Kingsley, 1968; Hagen, Meacham, & Mesibov, 1970) were replicated in the present study.

The effects of the Facilitation Condition were substantially as predicted. While overall recall did not change significantly at either age level, recall at recency declined at both levels while recall at primacy improved for the older age level only. Apparently the uninterrupted delay period allowed the older subjects

to engage in additional rehearsal of the to-be-remembered items. The facilitation in recall occurred primarily for those items near the primacy portion of the serial-positions. Because the decline in recall at the recency portion of the serial positions occurred for both age levels, it does not seem likely that this decline can be attributed to interference with primacy rehearsal. Rather, it seems that recency recall is related to "echoic memory" as suggested by Hagen, Meacham, and Mesibov (1970), does not show developmental changes, and declines with the passage of time such as occurred in the Facilitation Condition.

In the Distraction Condition, the most striking finding was the disappearance of age differences in recall. The serial-position recall of the older subjects appears very similar to that of the younger subjects. Whatever advantages the older subjects have in either the Control or the Facilitation Condition are lost in this condition. These findings suggest that the rehearsal used by children of this age level provides an ephemeral mnemonic which is easily lost through interfering conditions. It would be interesting to know if a delay period, during which rehearsal could occur, preceding the distraction task would result in less decrement due to distraction. Recent findings with adults (Kail, Schroll, & Hagen, 1973) indicate that the rehearsal which occurs during acquisition, such as in the Control Condition, provides for only short-term store but that additional post-trial rehearsal, such as in the Facilitation Condition, results in long-term store of information.

In order to examine further the link between rehearsal and recall, those younger children who performed well in the Control Condition were considered. Twelve younger children recalled four or more items correctly, thus performing at or above the mean of the older subjects. Their serial-position recall is shown in Figure 2. It is evident that these children, like the others at their age level,

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Insert Figure 2 about here

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did not show a primacy effect, suggesting that they did not employ rehearsal in order to do well in recall. Nine of these 12 subjects were in the Facilitation Condition, and their recall is shown on Figure 2. In general, their recall was poorer in this condition than in the Control Condition, just the opposite of the finding for older children. It must be concluded, then, that those younger children who showed superior recall did not do so by employing the rehearsal strategy of older children. A different memory process apparently accounts for individual differences at this age level.

The inclusion of a Control Condition in this study, in which no delay occurred between presentation of stimuli and testing for recall, permitted the effects of a unfilled delay period and a distraction-delay period to be observed separately. In the Sabo and Hagen study (1973), this separation was not possible and serial-position recall was not tested either. In the present study, it is established that there are indeed distinguishable effects due to each condition. Further evidence was also obtained that children in the 7 year age range do not yet characteristically engage in rehearsal to improve recall but by age 11 years, children are proficient in using this strategy.

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Footnote

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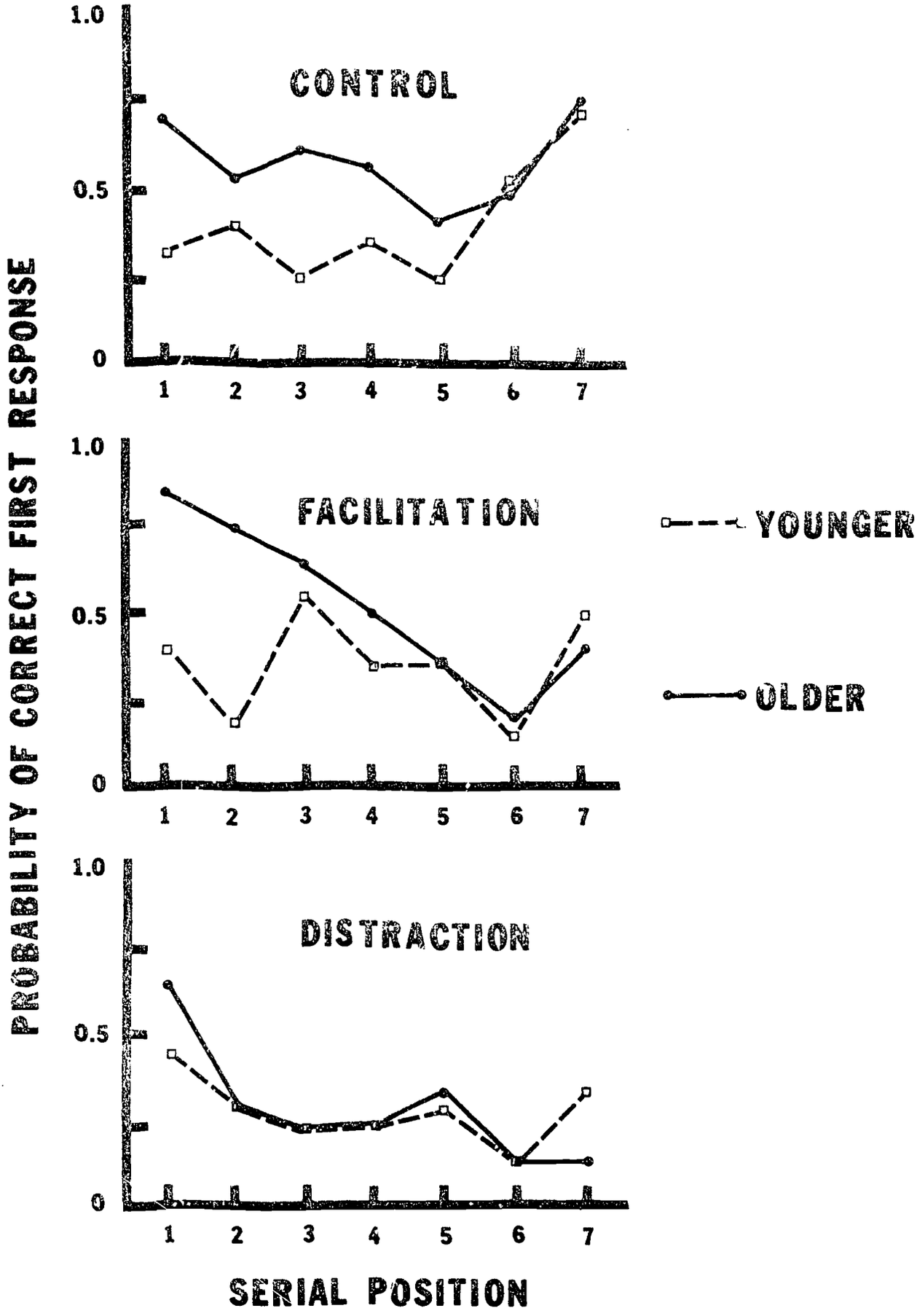
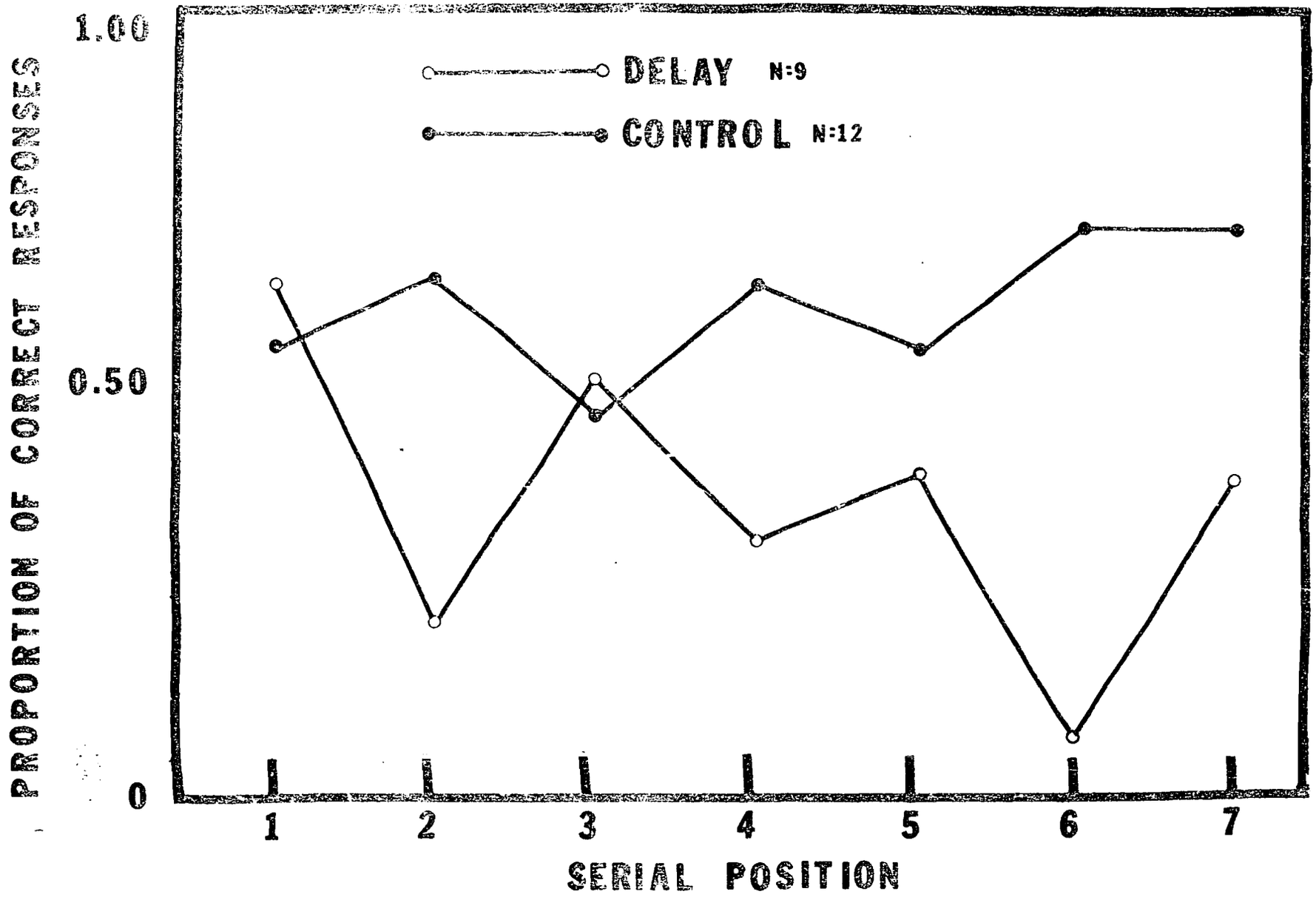
Figure Captions

Figure 1. Proportion of correct responses at each serial position for younger and older subjects in the Control, Delay and the Distraction Conditions.

Figure 2. Proportion of correct responses at each serial position for those younger subjects who performed at or above the mean of the older subjects in the Control Condition.


CONTROL
FACILITATION
DISTRACTION
1.0
0.5
0
1
2
3
4
5
6
7
PROBABILITY OF CORRECT FIRST RESPONSE
SERIAL POSITION
YOUNGER
OLDER


DELAY N:9
CONTROL N:12
PROPORTION OF CORRECT RESPONSES
1.00
0.50
0
1
2
3
4
5
6
7
SERIAL POSITION