An analysis of short-term memory in familial mental retardates

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This study examined short-term memory performance in a group of familial mental retardates (FMRs), in a group of their mental age peers (MAPs), and in a group of their chronological age peers (CAPs) (N = 13 for each group). Four- and nine-item arrays of consonant letters were presented tachistoscopically (.05-sec exposure) and were immediately reproduced by the Ss. The CAPs reproduced correctly more stimulus items than either the MAPs ($p < .01$) or the FMRs ($p < .02$). There was no difference between FMR and MAP performance. Implications of these results were discussed in terms of retardate-normal differences in the area of memory processes.

Familial mental retardates (FMRs) are typically defined by their deficient performance on standardized IQ tests relative to their chronological age peers (CAPs) and by the lack of detectable brain damage. Although FMRs are equal to their mental age peers (MAPs) in overall cognitive ability, as measured by standardized IQ tests, the interpretation of this equality is confounded by the superiority of the FMRs on tasks involving experiential factors and by their inferiority on tasks involving acquisition factors (Heal & Johnson, 1970).

An account of the FMRs' performance deficit may be derived from models concerning the FMRs' functioning and/or models concerning normal short-term memory processes. For example, Ellis (1970) has posited that the FMRs' performance deficit is due to a lack of rehearsal strategies that result in the deficient accruement of more permanent memory stages. This model indicates that FMRs are qualitatively different from their CAPs in regard to memory processes.

However, Zigler (1969) espouses the belief that, due to a slower maturation and/or development of cognitive processes, FMRs differ from their CAPs only in a quantitative manner. The ascertaining of the proper label or explanation of the retardate-normal difference has obvious importance. It would appear that this distinction might be properly identified by the comparison of FMRs, MAPs, and CAPs on a task that specifically taps one of the earliest, and perhaps most basic, memory stages.

Sperling (1967) presents a memory model that includes a recognition-buffer component (RBC) involving the hierarchical organization and association of specific memory procedures (e.g., encoding, rehearsal, etc.) which serve as a precursor to all memory. Sperling hypothesized that the number of items available in short-term memory after tachistoscopic presentation was a direct measure of RBC efficiency. A retardate deficit on this tachistoscopic task would indicate that information is not present in the earliest stages of short-term memory. Since memory obviously consists of serial organization, a lack at this stage precludes normal retention performance.

Furthermore, if FMRs are indeed qualitatively different from normal Ss due to the absence of some memory process at the early stages of memory functioning, they would show deficiencies on Sperling's specified task relative to all normal Ss (MAPs and CAPs). However, if FMRs are quantitatively different from normal CAPs, then they would perhaps exhibit deficiencies relative to their CAPs but not to their MAPs.

METHOD

Subjects

Three groups (FMR, CAP, and MAP) of 13 Ss each participated. The mean chronological age (CA) for the FMR group was 201.9 months and for the CAP group was 200.3 months. The mean mental age (MA) for the FMR group was 129.3 months and for the MAP group 125.7 months.

Apparatus

A tachistoscope presented arrays of familiar (all Ss could label) stimuli consisting of 1.25-in.-high block numbers and consonants. A piece of black paper served as a dark-adaptation field.

Procedure

All groups followed the same procedure. After receiving instructions, Ss were given six habituation trials using arrays of numbers. The first three habituation trials presented three different four-item (2 by 2) arrays. The second three habituation trials presented three different nine-item (3 by 3) arrays. Each S was instructed to reproduce correctly (as to both presence and position in the array) as many items as possible immediately after exposure of the stimulus array. Reproductions of the array were done on a sheet of white paper provided by E.

The experimental session consisted of five trials using five different four-item arrays of consonants and five trials using five different nine-item arrays of consonants.

Every trial consisted of four phases, each following immediately upon completion of the preceding phase: (1) a 1.0-sec exposure of the faintly visible piece of black paper for dark adaptation and focusing purposes, (2) a .05-sec exposure of the stimulus array, (3) an indefinite period of complete darkness, and (4) one S-determined period in which the stimulus array was reproduced by the S.

RESULTS

A three-factor mixed-design analysis of variance on total correct responses indicated significant group

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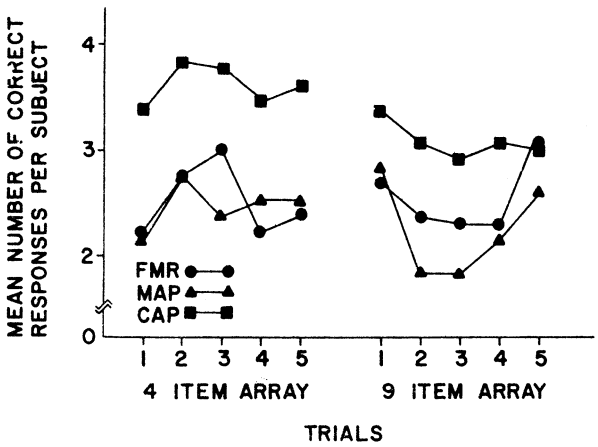

Fig. 1. Retardate and normal performance across array sizes and trials.

differences ($F = 20.17$, $df = 2/36$, $p < .001$). A Duncan's multiple range test on total scores for each group indicated that the CAP group provided significantly more correct responses than either the MAP ($p < .01$) or the FMR ($p < .02$) group.

There were significantly more correct responses on the four-item than on the nine-item arrays ($F = 5.82$, $df = 1/36$, $p < .02$), and the Trials by Array Size interaction was significant ($F = 8.42$, $df = 4/144$, $p < .001$). The results may be seen in Fig. 1.

Pearson product-moment correlations between a S's MA, CA, and total number of correct responses are found in Table 1.

Within the MAP group, there was a significant relationship between performance and both the Ss' chronological and mental ages, as well as between the two ages combined. Also significant was the multiple correlation ($p < .05$) between performance and the mental and chronological ages of the FMR Ss.

Table 1
Pearson Product-Moment Correlations

Group	Score-CA	Score-MA	Score-CA, MA
FMR	−.249	+.508	+.643*
CAP	−.453	−.410	+.459
MAP	+.639*	+.615*	+.742*

*$p < .05$

DISCUSSION

The FMR and MAP groups performed at the same level, and both were inferior to the CAP group. This is consistent with expectations derived from a hypothesis of quantitative differences between FMRs and normals. These results point to a belief that FMRs can and do learn in a normal fashion but with a reduction in efficiency. The variables which affect the development of organizational factors in human cognitive functioning need to be determined and used systematically in an effort to facilitate development of efficient cognitive functioning in FMRs. It appears that FMRs suffer a differential rate of development of at least one short-term memory component, primarily an early organizational factor which Sperling has labeled the RBC. Other performance, such as that of long-term memory, may provide different results, but at least this early component of memory appears to operate across retardates and normals similarly.

The significant correlations between CA, MA, and total number of correct responses for the MAP group support the notion of maturational factors in the cognitive processes, particularly in the development of the efficiency of the RBC. This systematic relationship is missing in the CAP group and may indicate asymptotic development of the RBC, especially for relatively simple visual perceptions. Heal & Johnson (1970) have noted both acquisition factors and experiential factors in IQ testing; if CA is more related to experiential factors than to acquisition factors in IQ testing and if MA is more related to acquisition factors than to experiential factors, then the multiple correlation of CA and MA with correct responses for the FMR group is interpretable. Mental age is directly and positively related to performance and, consequently, to RBC efficiency. Chronological age is a suppressor variable and statistically accounts for the experiential factors measured in MA, thereby reducing any confounding of experiential and acquisition factors in MA. (It is noted that the beta weight for MA is +.613 and for CA −.408.) This supports the premise that RBC efficiency (performance) is related to acquisition factors (MA), which Heal & Johnson (1970) have noted as the FMRs' problem area.

The interpretation of the Trial by Size interaction, as well as the array size difference, is unclear and could be the result of spurious array content factors.

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