Threshold measures of sensory register storage (perceptual memory) on normals and retardates *

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The method of limits was used to estimate the perceptual or immediate memory thresholds for a sample of 12 normals and 12 institutionalized retardates matched on CA and perceptual intactness. A stimulus array, composed of six digits in a circular pattern, was presented tachistoscopically. On the first trial, the duration of the array increased at 100-msec intervals beginning from a 100-msec base. After three consecutive correct responses were recorded, the array duration decreased (Trial 2) in 100-msec steps until three consecutive incorrect responses were recorded. The same procedure for the remaining six trials was followed, with the exception that 50-msec steps were used. A poststimulus cue immediately followed the offset of the stimulus array for a duration of 100 msec. The offset of the cue was followed by the S naming the digit that was indicated by the cue. Averaging over trials, the mean thresholds for normals and retardates were 424.861 and 1,538.194 msec, respectively. Following a logarithmic transformation of the data, a 2 (groups) by 6 (trials) repeated-measures analysis of variance revealed a practice effect for normals, but not for retardates, and superior performance of normals on all trials. The results were interpreted within Atkinson's memory model.

Olson (1971) and Belmont & Butterfield (1969) have recently discussed the inferior performance of retardates on cognitive tasks within the general theory of human information processing. More specifically, it has been suggested that the poor performance of developmentally retarded persons on experimental tasks reflects certain restrictions (structure and/or process) in their information encoding-storage-retrieval capabilities. The present study, dealing with a comparison of normals and retardates on a specific memory structure, incorporated the model components of Atkinson's structure-process information-processing model stressing normal memory phenotypes. Atkinson and his associates (e.g., Atkinson & Shiffrin, 1968; Shiffrin & Atkinson, 1969) proposed a model of memory which included the fixed structural features of sensory register (SR), short-term store (STS), and long-term store (LTS) and of variable control processes. The SR structure (a very short-lived memory store which temporarily holds incoming information for initial processing and transfer to STS) has not received much, if any, attention in research with retardates. In fact, no comparative research is available on SR thresholds utilizing the Sperling (1960) procedure. Although Ellis (1970) presented a short-lived capacity structure (primary memory) in his memory model emphasizing retarded phenotypes, his findings are based on STS serial position curves and not on the tachistoscopic procedure. The technique for SR assessment in normals and retardates in the present study was similar to that of Averbach & Coriell (1961) and Sperling (1960).

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METHOD

A sample of 12 retarded Ss diagnosed as cultural-familial were randomly selected from the Mt. Pleasant State Home and Training School's population of educable retardates. An equal number of normals were obtained from secondary and university educational institutions. The Ss were matched on CA ranging from 14 to 20 years, with a mean age of 16.5 and 17.2 for normals .and retardates, respectively. The samples were selected from populations of average or good perceptual responders based on the Minnesota Percepto-Diagnostic Test (Fuller & Laird, 1963). The respective converted mean scores were 54.5 and 50.0 for normals and retardates. It was assumed that this test would equate Ss on perceptual intactness. Mean IQs obtained from the Peabody Picture Vocabulary Test were 118 and 69 for normals and retardates, respectively. The experiment was conducted in a soundproof booth with constant illumination. A Model GA three-channel tachistoscope (Scientific Prototype) was used to display the stimulus arrays and to control temporal variations. Stimulus materials consisted of 42 1.2192 x 1.5240 m cards. A stimulus array, consisting of six digits, was arranged in a circular pattern (r = 28.575 mm) on 36 cards. The digits were selected randomly from 1 to 9 for each of the 36 cards and assigned randomly to the six circular positions, with no digit appearing twice in the same array. Each of the remaining 6 cards consisted of one circle (the poststimulus cue), with each circle corresponding to, and surrounding, a different digital position in the array. The method of limits was used to determine the stimulus threshold as described by Woodworth & Schlosberg (1954). The stimulus array duration was varied by ascending and descending procedures. Upon entering the testing booth, each S was instructed to focus on the center of a blank field within the tachistoscope. The stimulus array was then exposed for 100 msec and immediately followed by the poststimulus cue with a duration of 100 msec. At the offset of the poststimulus cue, the S was required to recall the digit that was indicated by the cue. All Ss were given several practice trials to insure understanding of the task. On Trial 1 (ascending), the stimulus array duration increased in 100-msec intervals from the base of 100 msec until three correct responses were recorded. On Trial 2 (descending), the array duration decreased in 100-msec steps, starting from 100 msec above the last correctly reported ascending interval until three consecutive incorrect responses were recorded. For the remaining six trials, the same procedure was followed, with the exception that 50-msec intervals were used, starting from the 100-msec base. On all trials, every increase or decrease in duration was accompanied by a different stimulus array. Only the last six trials were included in the analysis. An intertrial interval of 1 min was used.

RESULTS AND DISCUSSION

Averaging over trials, the mean thresholds for normals and retardates were 424.861 and 1,538.194 msec, respectively. A significant F_{max} ($p < .005$) indicated heterogeneity of variance between the two groups, requiring logarithmic transformation for further analyses. Employing the transformed data, the F_{max} was nonsignificant ($p > .05$). Threshold means for both groups over trials are depicted in Table 1. A 2 (groups) by 6 (trials) repeated-measures analysis of variance revealed the following significant effects: groups ($F = 15.20$, $df = 1/22$, $p < .001$), trials ($F = 3.751$, $df = 5/110$, $p < .01$), and Groups by Trials ($F = 2.368$, $df = 5/110$, $p < .05$). An analysis of simple effects revealed a significant Normals by Trials effect ($F = 4.765$, $df = 5/110$,

Table 1
Threshold Means Over Conditions

Group	1	2	3	4	5	6
Normals	779.2	391.7	520.8	237.5	429.2	190.8
Retardates	1854.2	1504.2	1637.5	1304.2	1591.7	1337.5

$p < .01$) and a nonsignificant Retardates by Trials effect ($F = 1.354$, $df = 5/110$, $p > .05$). Comparisons of normal mean thresholds over trials resulted in the following significant differences (Newman-Keuls, $p < .05$): Trial 6 > 3, 1, and 4 > 1. As can be seen in Table 1 and interpreted from the simple effects and Newman-Keuls analyses, the trials main effect reflects a practice effect for normals. Finally, random group ts were performed on normal-retardate group mean thresholds for each of the six trials. All mean differences significantly favored normals ($df = 22$, $p < .05$).

The present findings for visual SR storage appear to be relevant for comparative normal-retardate information processing models. More specifically, comparative normal-retardate memory research has dealt with LTS and STS. Belmont's (1966) review of memory suggests that retardates do not exhibit a LTS memory deficit. Since other researchers (e.g., Prehm & Mayfield, 1970) have drawn the opposite conclusion, perhaps the most appropriate conclusion to be drawn concerning the LTS of retardates is as follows: In relation to memory components investigated within a comparative framework, retardates perform least inefficiently on LTS tasks. Research on STS task performance of retardates (Anders, 1971; Ellis, 1970; Ellis, McCarver, & Ashurst, 1970; Neufeldt, 1966) is more consistent and suggests that such Ss have inefficient STS control strategies and/or a structural STS deficit. The present data indicate that initially the retardate cannot process as much information as normals when the information is presented for brief intervals. Further, the practice effect noted above suggests that normals are able to adapt somewhat to a demanding memoric task, whereas retardates cannot. What effect does the restricted SR structure have on the informatioprocessor? According to Atkinson's model, either new information interferes with the processing of old information or vice versa. Whatever the case may be, the retardate's impairment in SR processing certainly places limits on his ability to effectively process information in STS tasks. Within an information processing framework, it is presently suggested that the retardate's inefficient information processing at the SR or iconic memory stage accounts, at least in part, for his poor performance on learning and memory tasks.

A researchable question stemming from the present study is whether the retardate's inefficient SR processing is due to capacity limits, strategy or control process difficulties, or both. This qualification to the present study, along with the dimensions of developmental change and residence (institutionalization vs noninstitutionalization) is presently being investigated by the authors.

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