DOCUMENT RESUME

ED 296 214 CG 020 904

AUTHOR Gollin, Eugene S.; Sharps, Matthew J.
TITLE The Encoding and Retrieval of Object Locations by Young and Elderly Adults.
SPONS AGENCY National Inst. on Aging (DHHS/PHS), Bethesda, MD.
PUB DATE Aug 87
GRANT 1R01-AG05952-01
NOTE 16p.; Paper presented at the Annual Convention of the American Psychological Association (95th, New York, NY, August 28-September 1, 1987).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Age Differences; Cognitive Processes; *Encoding (Psychology); *Memory; *Older Adults; Spatial Ability; Visualization; *Young Adults
IDENTIFIERS *Retrieval (Memory)

ABSTRACT

Recent research has demonstrated that spatial memory in young and elderly adults depends upon the context in which items to be remembered are placed. Contexts in which cues to location are distinctive and heterogeneous have been found to be associated with better object location memory for both age groups. In this study, the relative contributions of contextual visual distinctiveness at encoding and at retrieval to this effect were assessed. In an earlier study, contexts were identified that either maximized spacial memory performance (e.g., a room with highly distinctive furnishings) or minimized it (e.g., a schematic black-and-white scale map of that room). Since it has been previously demonstrated that one context (the map) hindered spatial memory while the other (the room) aided performance for both age groups, it was possible to estimate the relative importance of encoding and retrieval for successful recall by comparing results of these conditions. Subjects included 24 young adults and 24 active, healthy elderly adults; there were no significant differences in occupational or educational background of respondents. Conditions at encoding were found to be of greater importance to the spatial memory performance of both age groups than were conditions at retrieval. A second experiment using 12 young and 12 elderly adults demonstrated that respondents of both ages tended to encode object locations more effectively than they did the associations of specific locations with specific stimulus objects. (Author/ABL)

The Encoding and Retrieval of Object Locations by Young and Elderly Adults

Eugene S. Gollin Matthew J. Sharps

University of Colorado

This research was supported by grant 1R01 AG05952-01 from the National Institute on Aging. Address correspondence to Dr. E.S. Gollin or Dr. M.J. Sharps, Campus Box 345, University of Colorado, Boulder, CO 80309.

Abstract

Recent research has shown that visually distinctive spatial memory task contexts are associated with enhanced object location memory performance in young and elderly adults. In the present study, we assessed the relative contributions of contextual visual distinctiveness at encoding and at retrieval to this effect. Conditions at encoding were of greater importance to the spatial memory performance of both age groups than were conditions at retrieval. A second experiment demonstrated that respondents of both ages tended to encode object locations more effectively than they did the associations of specific locations with specific stimulus objects.

The Encoding and Retrieval of Object Locations by Young and Elderly Adults

Recent research has demonstrated that spatial memory in young and elderly adults depends upon the context in which items to be remembered are placed. Contexts in which cues to location were distinctive and heterogeneous were associated with better object location memory for both age groups. Also, unless contexts were visually distinctive, elderly persons showed marked memory deficits relative to young persons (Sharps & Gollin, 1987a). In the present study, we used these results to investigate the relative contribution of conditions at encoding and retrieval to spatial memory performance across adult development.

Experiment I

It is difficult to separate the effects of encoding and retrieval on memory performance (e.g., Smith, 1980). A partial solution to this problem in the area of spatial memory was provided by the results of an earlier study (Sharps & Gollin, 1987a). Contexts were identified that either maximized spatial memory performance (e.g., a room with highly distinctive furnishings) or minimized it (e.g., a schematic black-and-white scale map of that room and its furnishings). These two contexts varied in distinctiveness, and in the facilitative effect on spatial memory. Because the two contexts were of recognizably identical layout, it was possible to construct an experimental

manipulation that would gauge the relative importance of conditions at encoding and at retrieval for spatial memory performance. Respondents could be asked to encode and retrieve spatial information, using either the map or the room. However, they could also be asked to encode in one context, and recall in the other. Since it has been previously demonstrated that one context (the map) hindered spatial memory while the other (the room) aided performance for both age groups, it was possible to estimate the relative importance of encoding and retrieval for successful recall by comparing the results of these conditions.

Method

Research participants

Twenty-four young adults (mean age 18.75 years, range 17-21 years) and twenty-four active, healthy elderly adults (mean age 75.92 years,, range 68-86 years) participated in the study. About two thirds of the respondents were female and one-third male. There were no significant differences in occupational or educational background between the two age groups. The average education of all respondents approximated one year beyond high school. All respondents were tested with the Wechsler Adult Intelligence Test Vocabulary Scale and the Snellen Test of Visual Acuity. No significant differences were found on either test. All respondents exhibited visual acuity of 20/40 or better.

Materials

A 7 x 9.75 m classroom was used in the room condition. File cabinets, piles of carpet fragments, lockers and boards were arranged into "structures" and placed in the room (see Figure 1 for the arrangement of these structures). The structures were arranged to avoid resemblance to spaces that might be familiar to respondents.

A 1/6 scale schematic map (1.167 x 1.625 m) was drawn of this room (depicted in Figure 1). This was used in the map condition.

Forty small, common objects (e.g., toys, household utensils) were used as stimulus items. The names of these objects were printed on 4 x 6 cm white cardboard cards, one name on each card.

Lighting conditions at array surfaces did not differ between the map and room contexts, ranging between 11 and 13 lx in each context.

Procedure

The forty objects were placed in the room or in corresponding positions on the map. The respondents were asked to remember the locations of these objects. The experimenter pointed out each object, and the respondent then left the room or map for two minutes. Meanwhile, the objects were removed from the room or map. When the respondent returned, he or she was asked to place cards bearing the names of the objects in the places where the objects had been.

Four conditions were used. In the first, respondents learned on the map and were tested on the map (the "map-map" condition). In the second, they learned in the room and were tested in the room (the "room-room" condition). In the third, respondents learned on the map and were tested in the room (the "map-room" condition) and in the fourth, respondents learned in the room and were tested on the map (the "room-map" condition).

The scoring system employed was a simple count of the number of "correct placements," to within equivalently-scaled margins of error in the two contexts. This method has been demonstrated to correlate highly with other measures of spatial memory (Sharps & Gollin, 1986).

Results

The results are shown in Figure 2. The effects of age and of study-test condition on spatial memory were significant, respectively $F(1,40)=6.50$, $p=.015$, and $F(3,40)=51.32$, $p<.001$. The interaction of age and study test condition was not significant. There was no effect of sex on performance.

A Tukey B procedure ($p<.05$) was used to evaluate the effect of study-test condition on spatial memory. The map-room condition actually depressed performance for the young respondents below the level seen in the map-map condition. The map-room performance of the elderly did not differ significantly from the near-floor performance observed in the map-map condition. These results

indicated that distinctive cues at retrieval were not useful for young or elderly persons if nondistinctive cues were present at encoding.

The results of the map-map condition indicated that the elderly were unable to use visually indistinctive cues as well as younger persons. However, in the room-map condition, it was shown that the elderly could achieve parity with younger persons as a result of distinctive cues at encoding alone. The salutary effect of contextual distinctiveness for the spatial memory of the elderly therefore appears to depend primarily on the presence of visually heterogeneous cues at encoding, rather than at retrieval. When distinctive cues were provided both at encoding and retrieval (in the room-room condition), the performances of young and elderly were further enhanced, but remained at parity across age levels (all results evaluated by Tukey B procedure, $p<.05$).

Although it should be noted that deficits in the retrieval processes of the elderly have been identified (e.g., Burke & Light, 1981; Ceci & Tabor, 1981; Laurence, 1967; McCormack, 1982), the present results indicated that conditions at encoding are especially important for spatial memory performance in the elderly. This is consistent with results from other areas of memory research (e.g., Hultsch, 1969; Smith, 1977). Moreover, the absence of a significant interaction between age and study-test condition indicates that the relative importance of encoding and

retrieval for spatial memory is probably stable across the adult lifespan.

Experiment II

Given the findings of Experiment I, we wished to address the nature of the encoding of object locations. In Experiment II, the characteristics of object locations that are most important for successful encoding, and the priority with which these characteristics are encoded, were examined. This was accomplished by means of an analysis of the kinds of errors made by young and elderly participants in our spatial memory tasks. Two kinds of errors were made. In the first of these, the participant reported that a given object had been located in the place occupied by a different object at the time of encoding. Such an error indicated that the participant had encoded the "place" as significant, but had failed to encode the relationship of the place to the object located there. This was termed a "location" error. In the second type of error, the respondent remembered a given object as having been located somewhere in the array where no stimulus object had actually been placed. This was termed a "misplacement" error.

Method

Research participants

Twelve young and twelve elderly adults, in the same age ranges as in Experiment I, were recruited from the same sources. Demographic data did not differ from that of Experiment I.

Materials and procedures

The materials and procedures of this experiment were the same as in Experiment I, except that only the homogeneous study-test conditions (map-map and room-room) were used. This yielded a 2 x 2 between-subjects design, in which young and elderly respondents encoded and retrieved in either the room or the map condition.

Results and Discussion

Respondents of both age groups made a mean of 18.54 location errors (SD=6.85) and a mean of 5.79 misplacement errors (SD=5.69). The difference was significant, $t(1,23)=9.06$, $p<.001$. No significant age difference was observed in this ratio. However, the effect of task was significant on the ratio of location/misplacement errors. This ratio was far higher in the room condition (M=12.82, SD=6.28) than in the map condition (M=3.15, SD=3.60). The difference was significant, $F(1,20)=21.223$, $p<.001$. Parametric tests involving scale models of the room (see Sharps & Gollin, 1987a) demonstrated that this was due to the differences in contextual visual distinctiveness, rather than to the difference in size of the contexts.

The results of the error analysis indicate that locations are more strongly encoded than are the relationships between particular objects and their locations. This appears to be stable across the course of adult development. Furthermore, visually distinctive cues to location appear to enhance memory for

object-location relations, and this seems to underlie the augmentation of spatial memory performance observed when visually heterogeneous task contexts are employed.

General Discussion

The results of Experiment I indicated that conditions at encoding are more important for spatial memory performance than are conditions at retrieval. This is to be expected in the case of object-location memory. The respondent is probably better able to work with and reorganize stimulus objects and locations as they are encoded than to reorganize the traces or images of items and locations once these are in memory. The degree to which the present results would generalize to other research situations, especially those in which stimuli are themselves abstract or are hard for the respondent to "reorganize," should be the target of further research.

The results of Experiment II indicated that locations are more powerfully encoded than are the associations between locations and the items located there. We might hypothesize, then, that the remembering of spatial locations has to do with the mental construction of an image of the space in question, with items imposed in their remembered locations upon it. The associations of items and their locations may be less "fixed" in memory than the basic distance and orientation characteristics of the image of the given space, and therefore more "location" than

"misplacement" errors would be expected. Whether or not this hypothesis is correct either as fact or as metaphor, it seems that the formation of some sort of relatively immutable "cognitive map" is necessary for the recall of item locations in the given space.

None of the characteristics of memory examined in the present study exhibited significant change with age. These findings add to the growing body of work demonstrating relative stability across the adult lifespan, under specific task circumstances, in a variety of cognitive areas (e.g., Berg et al., 1982; McCormack, 1982; Sharps & Gollin, 1987 a, b; Waddell & Rogoff, 1981). Observed "age differences" in cognitive processes may often reflect the placement of elderly respondents in suboptimal task circumstances, rather than endogenous characteristics of the aging process per se. The examination of cognition under a wide variety of task circumstances is necessary both for the understanding of age-related change in cognition and, as demonstrated in the present study, for the empirical dissection of entangled processes such as encoding and retrieval.

References

Berg, C., Hertzog, C., & Hunt, E. (1982). Age differences in the speed of mental rotation. Developmental Psychology, 18, 95-107.

Burke, D.M., & Light, L.L. (1981). Memory and aging: The role of retrieval processes. Psychological Bulletin, 90, 513-546.

Ceci, S.J., & Tabor, L. (1981). Flexibility and memory: Are the elderly really less flexible? Experimental Aging Research, 7, 147-158.

Hultsch, D. (1969). Adult age differences in the organization of free recall. Developmental Psychology, 1, 673-678.

Laurence, M.W. (1967). Memory loss with age: A test of two strategies for its retardation. Psychonomic Science, 9, 209-210.

McCormack, P.D. (1982). Coding of spatial information by young and elderly adults. Journal of Gerontology, 37, 80-86.

Sharps, M.J., & Gollin, E.S. (1986). Methods of evaluating performance on spatial memory tasks. Bulletin of the Psychonomic Society, 24, 18-20.

Sharps, M.J., & Gollin, E.S. (1987a). Memory for object locations in young and elderly adults. Journal of Gerontology, 42, 336-341.

Sharps, M.J., & Gollin, E.S. (1987b). Speed and accuracy of mental image rotation in young and elderly adults. Journal

of Gerontology, 42, 342-344.

Smith, A.D. (1977). Adult age differences in cued recall. Developmental Psychology, 13, 326-331.

Smith, A.D. (1980). Age differences in encoding, storage, and retrieval. In L.W. Poon, J.L. Fozard, L.S. Cermak, D. Arenberg, & L.W. Thompson (Eds.), New directions in memory and aging: Proceedings of the George A Talland Memorial Conference (pp. 23-46). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Waddell, K., & Rogoff, B. (1981). Effect of contextual organization on spatial memory of middle-aged and older women. Developmental Psychology, 17, 878-885.

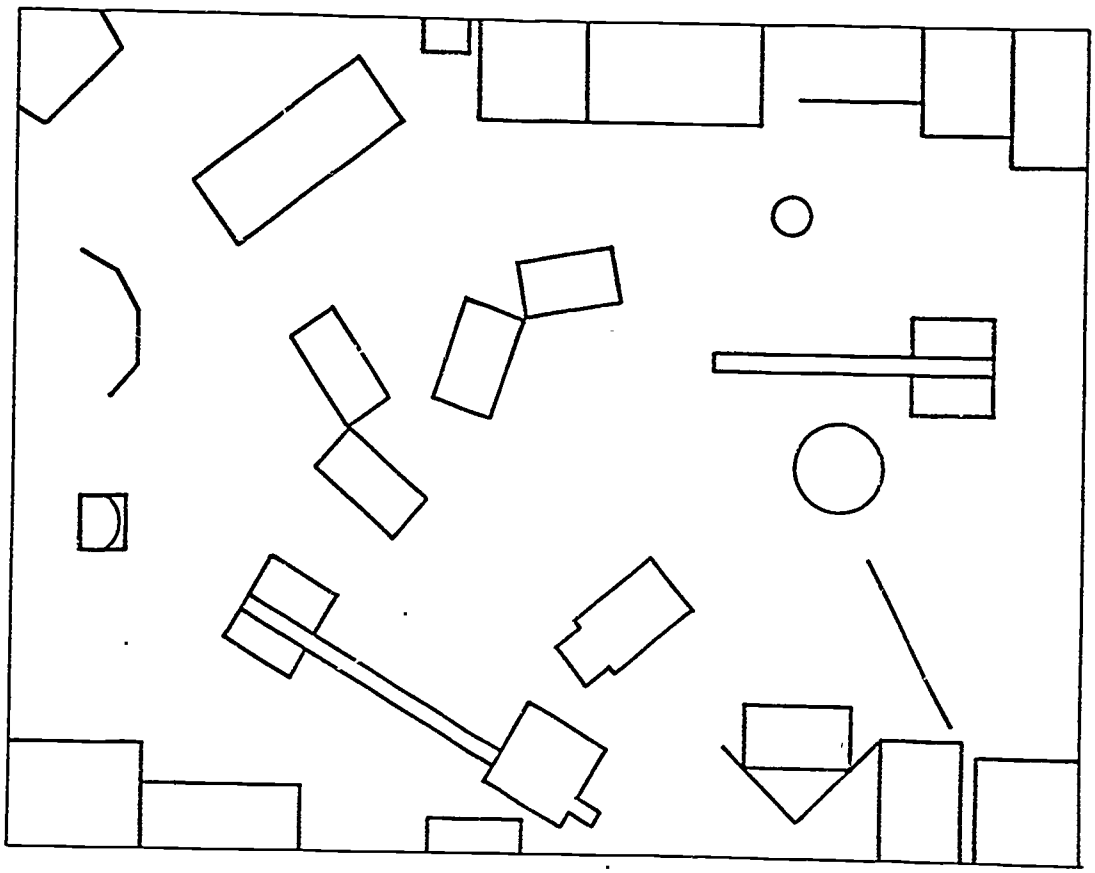

Figure 1: Layout of the map and room used in Experiments I and II.

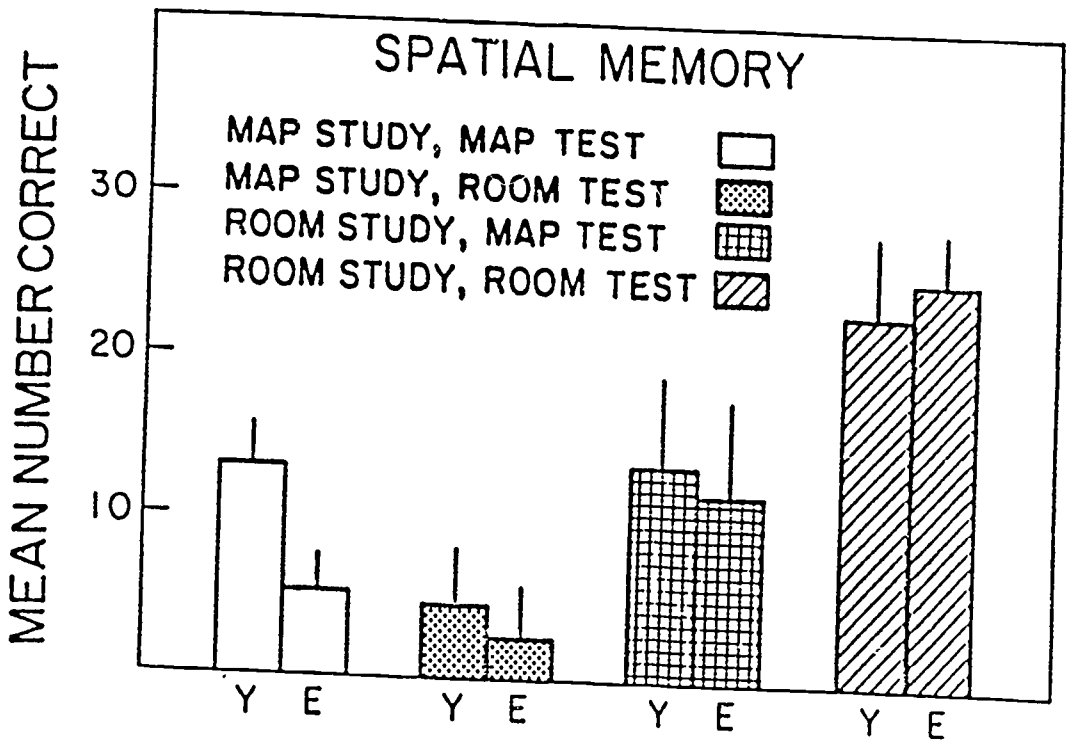

Figure 2: Means and standard deviations (represented by lines at tops of histogram bars) from young (y) and elderly (E) respondents in the four conditions of Experiment I.