Paried-Associate Learning in Institutionalized and Noninstitutionalized Old People: An Analysis of Interference and Context Effects

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Groups of old people were impaired, relative to young adults, on a test of negative transfer involving lists of paired-associate words. Susceptibility to interference effects were greater in old people living in institutions than in old people living in their own homes. The effects of varying contextual cues on performance on this task were also assessed. All participants, regardless of age, benefited from manipulations that were intrinsic to the task (e.g., relatedness of paired associates), but only the institutionalized aged responded to extrinsic contextual manipulations (e.g., environmental changes). In general, the performance of institutionalized old people resembled that of brain-damaged amnesic patients tested under similar conditions; old people living at home generally behaved more like normal, young people. The results were discussed in terms of specific age differences in cognitive function, declining brain function, and possible selective effects of institutionalization.

Key Words: Aging, Environment, Cognitive function

There are interesting parallels between the decline in learning and memory abilities of normal elderly people and deficits observed in amnesic patients with Korsakoff syndrome. The aged, of course, are less severely impaired, but comparisons based on a wide range of tasks assessing free recall and recognition (Schonfeld & Robertson, 1966; Warrington & Weiskrantz, 1973), short- and long-term memory (Baddeley & Warrington, 1970; Craik, 1977), paired-associate learning (Winocur & Weiskrantz, 1976; Zaretsky & Halberstam, 1968), and mediational strategies (Cermak, 1975; Tullick & Grossman, 1967), yield strikingly similar patterns of performance. It is probable that these behavioral similarities reflect a decline in neurological function that is common to old people and Korsakoff patients. Indeed, pathology in limbic and frontal lobe regions is indicated prominently in both populations (see Bondareff, 1980; Brion, 1969).

There is considerable speculation concerning the precise cognitive abilities affected in cases of memory disorder, but one factor that has received considerable attention is the importance of interference (see reviews by Arenberg & Robertson-Tchabo, 1977; Craik, 1977). Recently, we (Moscovitch & Winocur, in press; Winocur et al., 1981) tested nondemented Korsakoff patients (M age = 56 years), normal old people living at home or in institutions (M age = 74 years), and young adults (M age = 22 years) on a high-interference task involving release from proactive inhibition (PI). Individuals were presented with four successive lists made up of words from the same taxonomic category (e.g., clothes) and then a fifth list from a different category (e.g., animals). All groups displayed a progressive decline in recall accuracy from Lists 1 through 4, as PI built up. Recovery from List 5 was observed in the young groups and in old people living at home, presumably as a result of release from PI. In contrast, amnesic and institutionalized aged persons were virtually identical in failing to show improved recall following a category change on List 5.

Subsequent experiments examined the effect of manipulating context on PI release. When List 5
words were presented against a distinctive background that contrasted markedly with the contextual features of List 1 through 4 items, institutionalized aged and amnesic groups then displayed excellent recovery, even in the absence of a category shift.

In addition to confirming that old people are more vulnerable to interference than young people, our results demonstrate that distinctive environmental cues help them overcome its adverse effects. The present investigation examined the generality of this finding by assessing the effectiveness of different contextual manipulations in another learning situation. Old people living in the community or in institutions were tested on a negative transfer paradigm designed originally for use with brain-damaged amnesic patients (Winocur & Weiskrantz, 1976). This task has the additional advantage of allowing indirect comparisons between different populations of old people and Korsakoff amnesics. On the basis of our previous findings, institutionalized old people were expected to resemble Korsakoff patients more than would old people living at home.

**Experiment 1**

The negative transfer task used in this study was a variation of the familiar AB-AC paired-associate paradigm. Because old people, like amnesics, find it difficult to learn unrelated paired associates, we used pairs of words that were semantically related. This ensured equivalent levels of initial learning in old and young groups, so that subsequent differences in performance on the transfer test could be legitimately attributable to differential effects of interference. Lair et al., (1969) compared young and old people on a similar problem and found that when List 1 learning was equated, the older adults were significantly impaired in learning List 2. Response competition was clearly a factor in their deficit, suggesting an exaggerated susceptibility to interference.

In the present experiment four study trials of List 1 were presented followed by immediate recall in which participants attempted to provide the response word (B), to the stimulus word (A). Twenty minutes later participants received a single study trial of List 2 followed by a series of trials in which they were to match new response words (C) to the original stimuli. Performance on this task was compared with groups of individuals who learned List 2 without prior training on List 1.

**Method**

**Participants**

Three groups of people were tested: elderly adults between 70 and 85 years of age residing in senior citizens homes (institutionalized aged group) or in their own homes (community aged group) and young people between 20 and 35 years drawn from the community at large (young group). All participants resided in the Peterborough, Ontario area. In this and subsequent experiments groups were comprised of men and women in roughly equal numbers.

The elderly adults were free of gross cognitive deficits or neurological conditions; people with a history of cardiovascular disease, psychiatric problems, sensory or perceptual disorders were excluded from the study, as were people receiving mind-altering medication. All participants were administered the WAIS vocabulary test; only those people scoring in the normal range or better (scaled score range = 9 to 14) were included. None of the groups in the various experiments differed on this measure.

Educational background and socioeconomic level were also taken into account in selecting participants. All those in the research had been to school for at least 8 years, and nearly all had some high school experience. For the most part they were drawn from middle-income levels with a wide range of professional and semiskilled occupations represented. The composition of young and old groups was very similar in terms of these variables.

**Materials**

Two lists of paired-associate words were prepared with the same stimulus words but different response words. The lists used in this experiment were the same as those used by Winocur and Weiskrantz (1976, Experiment 1 Condition FP:4). Each word was printed in large black letters on a blank 3 × 5 inch index card. The two lists consisted of 12 triads of high frequency words drawn from the A or AA categories of the Thorndike-Lorge (1944) word counts. Each word within a pair was similar in meaning to the other word in the pair; some words were actually synonymous (e.g., ask/enquire) but more frequently words were linked on the basis of their common semantic characteristics (e.g., List 1: army/soldier; List 2, army/battle). Three identical versions of each list were prepared with the pairs arranged in different sequences to discourage rote order memorization.
Testing was conducted in small rooms in which sound and illumination levels could be controlled. In the case of institutionalized persons, the rooms were somewhat removed from their actual living area; community aged and young adults were tested in a similar room located in the Peterborough Public Library.

Procedure

Participants from each group were assigned to one of two experimental conditions.

High interference. — Participants were given four study trials of List 1 with instructions to read aloud each pair and try to associate the words. They were told that, after four presentations of the list, they would be given the first word of each pair and be asked to provide the second word. The pairs were presented at a rate of one pair every 2 sec, with 60 sec elapsing between versions. These periods were filled with conversation unrelated to the task. Recall of List 1 response words was tested 60 sec after the fourth presentation. For the recall test each stimulus word was presented for 10 sec, or until the person responded, after which the correct response word was always provided. Following List 1 recall, the individual was offered coffee and engaged in distracting conversation for 20 min.

The 12 pairs of List 2 words were presented once only followed by a series of trials in which participants were to provide the new response words for the same stimuli as in List 1. No advance information was provided about the types of words or their relationship to List 1. During the study trial the pairs were shown at a 2-sec rate, but in the test trials participants had 10 sec to respond, after which the correct response word was always provided. Testing was terminated when an errorless trial was achieved or when nine trials had been administered. Any person receiving the full nine trials would have been presented with each list sequence a total of three times.

No interference. — People in this condition were administered List 2 according to the same procedure described above but without prior List 1 training.

In the high-interference condition, 9 institutionalized aged persons (M age = 78.6 years), 9 community aged adults (M age = 76.1 years), and 11 young adults (M age = 26.8 years) were tested; in the no-interference condition, there were 10 institutionalized older adults (M age = 79.6 years), 10 community aged adults (M age = 79.4 years), and 10 young adults (M age = 29.3 years).

RESULTS

Figure 1 provides error scores for young and old groups in the high- and no-interference conditions. It is clear that any difference between groups cannot be attributed to differences in ability to learn the basic task. In the high-interference condition all groups learned List 1 to the same level, as evidenced by recall test performance, F < 1, and, as can be seen in Figure 1, young and old groups learned List 2 equally well in the no-interference condition, F(2,27) = 3.07, p > .05.

A group × interference condition × trials analysis of variance, conducted on the total error data, indicated a significant three-way interaction, F(16,424) = 5.36, p < .001, ω² = .03. In addition, and of particular interest given the aims of this study, there was a significant group × condition interaction, F(2,53) = 29.31, p < .001, ω² = .23. This interaction was due to the disproportionately poorer performance of the institutionalized group in the high-interference condition. Separate analyses revealed significant group × condition interactions involving the institutionalized and community aged groups, F(1,34) = 22.02, p < .001, ω² = .15, and

![Figure 1](image_url)
the institutionalized and young groups, $F(1,36) = 36.90, p < .001, \omega^2 = .27$. The interaction involving the community aged and young groups was not statistically significant, $F(1,36) = 1.15, p > .05$, despite the fact that the numbers of errors made by these groups were significantly different in the high-interference condition, $t(18) = 4.32, p < .001, \omega^2 = .48$, and not the no-interference condition, $t < 1$. The identical pattern of interference effects was demonstrated when groups were similarly compared on the trials to criterion measure in List 2 learning (Figure 2).

It is noteworthy that in the high-interference condition the institutionalized aged group made an average of 8.2 errors on Trial 1 of List 2 learning. This compares with 8.4 (Winocur & Weiskrantz, 1976) and 9.2 (Winocur & Kinsbourne, 1978) errors made by brain-damaged amnesic patients on the same test in very similar conditions. Unlike amnesics, the institutionalized elderly adults showed substantial learning by Trial 3, although their performance lagged behind the community aged and young groups throughout testing. All young and eight out of nine community aged persons reached the criterion of an errorless trial by nine trials, but only three of nine institutionalized participants reached this criterion.

Response competition was an important factor in the impairment of elderly adults in the high-interference condition. As shown in Table 1, about two-thirds of the errors made by old people were response intrusions (RIs), that is, substitution of the corresponding and previously correct response word from List 1. In contrast, of the total errors made by young persons only 37.6% were RIs. The group differences were highly significant for both the absolute numbers of RIs, $F(2,26) = 27.15, p < .001, \omega^2 = .65$, and the percentage of total errors, $F(2,26) = 5.70, p < .001, \omega^2 = .11$. Subsequent analyses with $t$ tests showed that all groups differed significantly from each other on the absolute measure, all $p < .01$, whereas on the percentage measure the young group was significantly different from the institutionalized, $t(18) = 2.25, p < .05, \omega^2 = .17$, and community, $t(18) = 2.23, p < .05, \omega^2 = .17$, aged groups, which did not differ from each other.

**Experiment 2**

The results of Experiment 1 showed that old people were impaired on learning List 2 only when it was preceded by training on a similar task. In the case of institutionalized aged persons, there was clear evidence of an exaggerated susceptibility to interference, and indeed their performance resembled that of organic amnesics (Winocur & Kinsbourne, 1978; Winocur & Weiskrantz, 1976).

### Table 1. Mean Numbers and Percentages (of Total Errors) of Response Intrusion Errors for Aged and Control Groups in List 2 Learning of Transfer Tests

<table>
<thead>
<tr>
<th></th>
<th>Experiment 1 Semantic (High Interference)</th>
<th>Experiment 2 Rhyme</th>
<th>Experiment 3 Semantic/ Rhyme</th>
<th>Experiment 4 Context Shift</th>
<th>Experiment 5 Disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>%</td>
<td>X</td>
<td>%</td>
<td>X</td>
</tr>
<tr>
<td>Institutionalized aged</td>
<td>23.3</td>
<td>63.0</td>
<td>25.8</td>
<td>60.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Community aged</td>
<td>7.9</td>
<td>68.8</td>
<td>6.3</td>
<td>75.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Young</td>
<td>2.1</td>
<td>37.6</td>
<td>3.0</td>
<td>28.5</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Elderly people living in the community were not as severely affected by interference, although they were impaired in learning List 2 in the high-interference condition and their errors, like the institutionalized aged, were predominantly response intrusions from the previous list.

Previous work with amnesics indicated that negative transfer effects were as great with phonetically, as with semantically related paired associates. Experiment 2 was conducted to see if similar patterns were obtained with old people.

METHOD

The task and procedure were the same as those for the high-interference condition of Experiment 1. The only difference was that the stimulus and response words for Lists 1 and 2 were paired according to their rhyming characteristics (e.g., List 1, steam/dream: List 2, steam/cream).

Participants were selected in the same manner as in Experiment 1. Nine institutionalized old people (M age = 77.8 years), 10 community aged people (M age = 78.4 years), and eight young adults (M age = 27.5 years) served in the experiment.

RESULTS

Figure 3 shows a similar pattern of results with rhyming paired associates as with semantically related words. All groups showed equally good initial learning of List 1, F < 1.

Statistical analyses indicated a significant group effect in List 2 learning, F(2,24) = 25.78, p < .001, $\omega^2 = .19$, in this case attributable to the poor learning of the institutionalized aged group. The community aged and young groups did not differ in terms of List 2 performance. This was probably due to the difficulty experienced by two individuals in the young group on the second list. One failed to learn within nine trials; the other learned in seven. The mean trials-to-criterion score for the other young adults was 1.7. In a previous experiment involving identical test conditions (Winocur & Weiskrantz, 1976), normal adults took about two trials to learn the list. The two high scores in the present group were clearly atypical and contributed to an unusually large variance. The community aged group required an average of 3.8 trials to learn List 2, which was about the same rate as its corresponding group in Experiment 1.

The interference pattern that characterized the performance of both aged groups in Experiment 1 was also apparent in Experiment 2. As can be seen in Table 1, RIs were greater in number and constituted a greater percentage of the total errors in the elderly groups than in the young group. Group differences on both measures were confirmed statistically by analysis of variance, $F$ number (2,24) = 11.55, $p < .001$, $\omega^2 = .44$; $F$ percentage (2.24) = 13.46, $p < .001$, $\omega^2 = .50$.

Experiment 3

Experiment 2 showed that phonetically related pairs of words yielded negative transfer effects that were generally similar to those obtained in Experiment 1. Interference was most apparent in the institutionalized old people whose performance fell midway between young people and brain-damaged amnesics. Unlike Experiment 1, group scores of old people living at home were indistinguishable from those of the young adults, but this was because of the greater variability within the young group of Experiment 2.

It has been demonstrated that context is an important determinant of performance in tests of memory and interference. Context effects are of two types: those that are intrinsic to the test materials and influence their meaning and relation to each other, and those that are extrinsic, such as the environmental conditions in which the materials are presented and remembered. Experiments with normal individuals have shown that intrinsic context is a more powerful influence on performance than extrinsic context. For example, the influence of intrinsic context can be demonstrated in tests of free recall, cued recall, and recognition (Eich, 1980), whereas extrinsic context effects are apparent primarily in free recall (Eich, 1980; Smith et al., 1978). In contrast, amnesic persons are known to be

![Figure 3. Errors for transfer test using rhyming word pairs (Experiment 2).](image-url)
influenced by both on tests of free and cued recall (Winocur & Kinsbourne, 1978; Winocur et al., 1981).

The following three experiments were concerned with the interaction between contextual manipulation and interference in old people. Experiment 3 examined the effects of varying intrinsic context by pairing the words in each list according to different rules. In List 1 response words were either semantically or phonetically related to the stimulus words and the relation reversed for List 2. Subsequent experiments dealt with extrinsic context.

METHOD

The general procedures of the previous experiments were once again adopted. Participants received four study trials of List 1, which consisted of either semantically related (e.g., wealth/fortune) or phonetically related (e.g., wealth/health) paired associates containing the same stimulus words. A recall test followed 60 sec after the last study trial. About 20 min later List 2 was administered in the usual manner. Those persons originally trained on the semantic pairings were subsequently tested on the phonetically related pairs; the opposite arrangement applied for individuals who originally learned the phonetic pairings.

Sixteen institutionalized old people (M age = 76.8 years), 16 community old people (M age = 77.5 years), and 18 young people (M age = 28.2 years) participated in this experiment. Participants were assigned in roughly equal numbers to each testing sequence.

RESULTS

The results for both test sequences were identical; to simplify presentation only the results of the semantic/rhyme condition, presented in Figure 4, will be described in detail.

As can be seen in Figure 4, List 1 recall by all groups was very similar and consistent with the results of the previous experiments. All groups showed substantial improvement in List 2 learning, relative to performance by corresponding groups in the standard negative transfer paradigms of Experiments 1 and 2. In proportional terms the degree of improvement was the same (see Figures 1, 3, and 4), indicating that the groups benefitted equally from the change in the governing rule. Analysis of variance applied to the Experiment 3 results yielded significant group effects on the total error measure (Figure 4), F(2,32) = 7.20, p < .002, $\omega^2 = .26$. Group differences, as assessed subsequently by means of $t$ tests, were found to be due to the relatively poor performance of the institutionalized aged group. Comparisons between the institutionalized and community groups yielded significant differences on the error measure, t(22) = 2.40, $p < .05$, $\omega^2 = .17$. The institutionalized group also differed significantly from the young group on the error measure, t(21) = 2.92, $p < .01$, $\omega^2 = .25$. The community aged and young groups did not differ significantly on either measure.

Table 1 shows that RIs made by all groups in Experiment 3 dropped considerably, both in terms of absolute numbers and percentage of total errors from the levels of the previous experiments. Young and community aged adults made very few RI errors in this condition; indeed, most did not make any. Institutionalized adults made more RI errors, but this could not be confirmed statistically because of variance heterogeneity.

Experiment 4

In Experiment 3 intrinsic features of the negative transfer test were manipulated in an attempt to reduce interference effects. The results showed comparable reduction in RI errors and improved List 2 learning in aged and young groups. Experiment 4 examined the effects of varying extraneous contextual cues.

The procedure followed was similar to that used successfully by Winocur and Kinsbourne (1978) with brain-damaged amnesics. Lists 1 and 2 paired associates were combined according to the same rule but presented in very different environments. Amnesic patients, but not controls, benefitted sig-
significantly from the contextual shift; under these conditions there was little difference between the groups on List 2 learning. A major purpose of this study was to see if the aged groups would respond differentially to this treatment, given previous results indicating similarities between organic amnesics and institutionalized old people on one hand and old people living at home and young adults on the other (Experiments 1 through 3, Moscovitch & Winocur, in press).

METHOD

Three sets of two semantically related paired-lists were designated to those used in Experiment 1 were prepared and presented in the usual manner. For half the participants (distinctive context) List 1 was administered with the overhead lights turned off and illumination provided by a high density desk lamp that projected a bright red light directly on the cards as they were presented. Classical music, played on a tape recorder, added to the distinctive-ness of the context. The other half (standard context) received List 1 in a standard testing room with normal lighting and sound conditions.

Those subjects receiving List 1 in the distinctive context were administered List 2 20 min later in the standard context. The lights were turned on, the music turned off, and the words presented in the more conventional way; the individuals who learned List 1 in the standard context received List 2 in the distinctive context condition. As usual, one study trial of List 2 was presented, followed by a maximum of nine test trials in which the familiar stimulus was provided and participants asked to give the new words that go along with them.

A total of 31 persons were tested in this experiment; 10 institutionalized old people (M age = 79.3 years), 10 community old people (M age = 76.2 years), and 11 young people (M age = 27.2 years).

RESULTS

There were no differences related to order of context, and so the data were combined to form one context-shift condition. Total errors for List 1 recall and List 2 learning are presented in Figure 5.

Once again, there were no differences between groups on List 1 recall, F < 1. As for List 2 learning, the most dramatic finding was the improved performance of the institutionalized old people who learned List 2 as well as old people living at home. The community aged and young groups appeared unresponsive to extraneous contextual manipulation. Their performance remained very similar to their counterparts in Experiment 1.

Statistical analysis revealed a significant group effect on the total error measure, F(2,24) = 4.49, p < .02, \( \omega^2 = .18 \), during List 2 learning following the context shift. This effect was the result of significant differences between both aged groups and the young group. T tests revealed statistically significant differences between the young group and the institutionalized, t(21) = 2.64, p < .02, \( \omega^2 = .29 \), and community, t(21) = 3.62, p < .002, \( \omega^2 = .34 \), aged groups. The two aged groups did not differ from each other, both ts < 1.

In line with the total-error data indicating that only the institutionalized group benefited from the context shift, this was the only group to show any change in its RI error pattern (Table 1). Relative to its corresponding group in the transfer test of Experiment 1, which also involved semantically related word pairs, the institutionalized group exhibited a substantial reduction in the number and percentage of RI errors. Analysis of variance revealed significant group effects on both measures, F number (2,28) = 5.32, p < .01, \( \omega^2 = .22 \), and F percentage (2,28) = 3.45, p < .05, \( \omega^2 = .14 \), but here, in contrast with previous studies, the institutionalized aged group scored significantly lower on the absolute number, t(18) = 2.15, p < .05, \( \omega^2 = .15 \), and percentage, t(18) = 2.16, p < .05, \( \omega^2 = .15 \), of RI errors. The young group differed significantly from the institutionalized aged, t(19) = 2.28, p < .05, \( \omega^2 = .17 \), and community aged, t(19) = 7.95, p < .001, \( \omega^2 = .64 \), in terms of absolute number of RIs but only from the community group on the percentage measure, t(19) = 2.45, p < .05, \( \omega^2 = .19 \).
Experiment 5

The results of Experiment 4 showed that varying extrinsic context had a beneficial effect on institutionalized old people but not on old people living at home or on young people. In terms of benefitting from contextual cueing, the institutionalized group showed the same pattern as amnesics (Winocur & Kinsbourne, 1978), although the old people generally performed at a higher level.

Experiment 5 examined the effects of varying extraneous context in a different way. The procedure involved the negative-transfer paradigm but a short interlist interval during which participants simply left the testing room and walked about for a few minutes. Brain-damaged amnesics tested on this task found this type of disruption helpful in dissociating the conflicting experiences, resulting in reduced interference and improved List 2 learning (Winocur & Kinsbourne, 1978).

METHOD

New lists were prepared and standard procedures for the transfer paradigm were followed once again. The only difference occurred during the interlist interval, which was reduced to 3 min. During this period the individual was taken for a walk through the corridors of the building in which testing was conducted and then returned to the same room for immediate List 2 testing. Eight institutionalized aged ($M$ age = 80.3 years), eight community aged ($M$ age = 78.8 years), and seven young ($M$ age = 31.9 years) adults were tested in this experiment.

RESULTS

The total error results are shown in Figure 6, where it can be seen that briefly taking the institutionalized old people out of the testing room was as effective in reducing negative transfer as the contextual manipulations of Experiment 4. The community aged and young groups learned List 2 at about the same rate as their corresponding groups in Experiments 1 and 2, indicating that they were not affected by the disruptive experience.

Analysis of variance revealed no significant difference in List 1 recall, $F < 1$, but a significant difference between groups in List 2 learning on the total error measure, $F(2,20) = 16.74, p < .001, \omega^2 = .58$. The significant group effect was due to the poor learning of the aged groups, which differed significantly from the young group: institutionalized versus young, $r(13) = 4.46, p < .001, \omega^2 = .56$; community versus young, $r(13) = 7.84, p < .001, \omega^2 = .68$. There were no significant differences between the aged groups, $t < 1$.

The pattern of RI errors for all groups (see Table 1) was identical in terms of absolute numbers and percentage of total errors to that obtained in Experiment 4.

DISCUSSION

Our studies on negative transfer are consistent with previous results (Moscovitch & Winocur, in press) in showing that elderly adults are more impaired on high-interference tasks than young people. There were, however, large differences among various groups of old people in the degree to which they were affected by interference. Old people living at home were only mildly affected, whereas those who were institutionalized were affected more severely, so much so that the latter's performance consistently resembled that of patients with Korsakoff amnesia more than that of normal controls.

The similarity between individuals with Korsakoff amnesia and institutionalized elderly persons is further underscored by the effects of contextual cueing on learning. All participants, regardless of age, benefitted from manipulations that were intrinsic to the test material, such as changing the rule governing the paired associates (Experiment 3). On the other hand, only the institutionalized old people behaved like Korsakoff patients in responding to extrinsic contextual manipulations. This was demonstrated in Experiment 4 by presenting the
two lists in contrasting environments and in Experiment 5 by removing the person from the testing situation between list presentations. The results for young people and old people living at home are consistent with previous reports that, in tests of memory, such people are relatively insensitive to extrinsic cues and are affected mainly by cues intrinsic to the material (Eich, 1980; Moscovitch & Winocur, in press). For example, in release from PI (Moscovitch & Winocur, in press), simply changing background cues between lists did not influence recall, but changing the category of cues, a form of intrinsic cueing, resulted in significant improvement. In contrast, institutionalized old people (Moscovitch & Winocur, in press) and Korsakoff amnesics (Winocur et al., 1981) responded to extrinsic contextual changes in a way that is consistent with their behavior on the negative transfer test of the present study.

The causes for differential sensitivity to extrinsic cues between institutionalized old people and Korsakoff amnesics on one hand and old people living in the community and young people on the other are not fully understood. A general impairment in memory is obviously an important factor. Even in normal young adults distinctive extraneous cues can influence performance when memory for a specific event is poor (Mayes et al., 1981). Perhaps in such cases extraneous contextual cues are used to compensate for difficulties at one or more stages of information processing. For example, there is considerable evidence that Korsakoff amnesics and old people do not spontaneously encode information as deeply or elaborately as controls (Butters & Cermak, 1975; Craik, 1977). It is possible, therefore, that organic amnesics and institutionalized elderly adults similarly fail to derive sufficient information from task-related cues to perform effectively. As a result, they are more likely to use contextual stimuli to support learning and recall. Contextual cues appear to be used similarly by normal young people when the nature of the material, such as nonsense syllables, precludes deep semantic processing (Gardiner et al., 1976).

The observed behavioral differences among the various groups presumably reflect differences in underlying brain function. There is considerable speculation concerning those critical brain sites affected in organic amnesia and in old people with memory problems. In this regard, frontal and medial temporal lobes are particularly important. In addition to having been widely implicated in the mediation of memory, they appear to be among those brain regions most susceptible to the degenerative effects of aging (Bondareff, 1980). Patients with frontal (Milner, 1964) or medial temporal (Starr & Phillips, 1970) damage show an increased vulnerability to interference that is characterized by intrusions from previously learned but inappropriate responses. The fact that institutionalized old people showed similar patterns of performance in the present and related (Moscovitch & Winocur, in press) studies suggests some combination of frontal and medial temporal lobe involvement in their deficit.

The effects of interference and of extrinsic contextual cueing in the present and previous work (Moscovitch & Winocur, in press) were highly exaggerated in the institutionalized old people. We were careful to select only those residents who were alert and free of clinically diagnosed neurological conditions, but it is conceivable that those individuals suffered from more undetected neurological deterioration prior to institutionalization than old people living at home. It is also possible that institutionalization itself was a factor contributing to our results. Institutionalization can have a variety of psychological effects (Kasl & Rosenfield, 1980), and there is some evidence that it can also lead to an accelerated rate of decline in brain function (Greenough & Green, 1979). At the present time it is not possible to characterize adequately the relationship between institutionalization and age-related learning and memory changes, but experiments specifically addressing this issue are currently underway.

REFERENCES


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**RESEARCH FELLOWSHIPS**

The Arthritis Foundation offers a limited number of research fellowships for physicians and scientists pursuing investigative careers in the areas of science related to arthritis. Although research projects are involved, these awards are designed for advanced training in research, and not as grants-in-aid for specific projects. Applications are due by September 1, 1983.

There are also research traineeships and grants available to graduate, nonphysician health professionals. These awards are for research training and development of investigative skills. Research proposals on arthritis management and/or comprehensive patient care are appropriate for these programs. Applications for allied health professional fellowships and research grants are due November 1, 1983.

To obtain applications for these awards, which will commence July 1, 1984, write to:

Research Department
Arthritis Foundation
1314 Spring Street, N.W.
Atlanta, Georgia 30309