

Free Recall and Word Finding Ability in Normal Aging and Senile Dementia of the Alzheimer's Type: The Effect of Item Concreteness

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This study examined the effect of item concreteness on free recall and word finding ability in three groups: young adults, normal old adults, and individuals with senile dementia of the Alzheimer's type (SDAT). The results of Experiment 1 showed, in addition to an overall decline in recall across the three groups, an attenuation with normal aging of the memory advantage of concrete over abstract words. The SDAT group, however, did not show this attenuation. Experiment 2 compared word finding ability for concrete and abstract items. Word finding was significantly impaired in SDAT but not in normal aging. Furthermore, the SDAT group did much worse on the abstract items. This difficulty with the retrieval of abstract words can explain the unexpected concreteness effect in the SDAT group in Experiment 1. The attenuation of the concreteness effect was predicted on the basis of the communication hypothesis of age-related cognitive decline, which attributes age deficits to a breakdown of the memory network. The results are consistent with the reduced activation of information in this network.

THE following study examined the effects of normal aging and senile dementia of the Alzheimer's type (SDAT) on the concreteness effect in free recall. The concreteness effect is the advantage of memory for concrete words — those that easily evoke an image — over abstract words — those with no simple, corresponding image. This effect has been well established with young adults (Paivio, 1969, 1971).

The concreteness effect has been attributed to the more extensive encoding that occurs with concrete words. Both concrete and abstract words activate verbal (that is, semantic and phonemic) information, but the activation of additional, visual information is more likely with concrete words. The availability of two memory codes facilitates retention by providing an additional means of retrieval.

The concreteness effect is an example of a widely accepted principle of normal memory function, that the probability of remembering an event depends on the extent to which it activates relevant information stored in memory. The more information activated by a stimulus, the better it is remembered, because the activated information serves as multiple cues or routes by which the memory of the stimulus can be retrieved.

There is evidence that this activation is reduced with age. The present study was motivated by the hypothesis that a key factor in age-related memory decline is the breakdown of the information network underlying memory and cognitive processing. As the result of changes in the aging brain, communication among information stores becomes less reliable. Consequently, the activation of stored information resulting

from a given stimulus is less extensive, and the probability of remembering the stimulus is reduced.

There is considerable support for this communication hypothesis in the aging literature, as is discussed at length in an earlier paper (Rissenberg & Glanzer, 1986). It follows from this hypothesis that memory effects that depend on the more extensive activation produced by one type of stimulus or procedure over another will be attenuated in older people. The concreteness effect is an example of this type of phenomenon and, as such, is predicted to diminish with aging.

The results of the earlier study (Rissenberg & Glanzer, 1986) demonstrated the attenuation of a related phenomenon, the picture superiority effect, in normal older adults and individuals with SDAT. The picture superiority effect is the advantage for memory of items presented in picture form over items presented as words. As predicted, young adults recalled pictures better than words, whereas older adults did not. In a second experiment, it was shown that the picture superiority effect could be reestablished in the old normal group by instructing participants to read or name the stimuli aloud. Thus, older individuals are less likely to activate spontaneously the additional, phonemic information that give pictures their memory advantage.

These results demonstrate the reduced activation of phonemic, or verbal, information. The question remains whether the activation of other types of stored information is also reduced with age, as the communication hypothesis would predict. The following experiment addressed this question by examining the effect of age on the concreteness effect. Here the memory advantage of concrete over abstract

words is attributed to the activation of additional, *visual* information.

Because the concreteness effect, like the picture superiority effect, depends on successful communication within the memory network, it is predicted to diminish with age. This result would support the idea that aging affects the activation of stored information in general, not just the activation of verbal information.

Previous results on aging and the concreteness effect have been mixed. In a study of free recall, Mason and Smith (1977) did find the difference between concrete and abstract items significantly smaller in the old group. This interaction did not occur, however, in a second experiment. Two paired associates studies (Rowe & Schnore, 1971; Witte & Freund, 1976) report an interaction in the opposite direction from the one expected. That is, the concreteness effect was greater for the older adults. Both sets of authors, however, pointed out that a ceiling effect from concrete items in the young participants was the source of this reversed effect.

A second problem with the Rowe and Schnore (1971) study was that the stimulus presentation was self-paced. If older participants spent more time on concrete than abstract items, this would produce an artifactual concreteness effect. No record of the time spent on each class of words was reported.

A problem with all three studies is the failure to screen older participants for memory deficits. The Rissenberg and Glanzer (1986) study showed that the attenuation of the picture superiority effect with age depends on the presence or absence of memory impairment. As will become apparent, this screening is critical to the outcome of the concreteness effect studies as well.

One other study investigated the concreteness effect in aging (Bruning et al., 1975) using free recall. Although the findings of that study at first glance seem negative, they are actually consistent with the communication hypothesis. This study will be discussed later.

Experiment 1

METHOD

Free recall lists of concrete and abstract words were presented to young adults, normal old adults, and adults with senile dementia of Alzheimer's type (SDAT). Each participant saw and recalled five lists. The difference between the recall of concrete words and recall of abstract words was the measure of the concreteness effect. After recall of the word lists, each participant was given the vocabulary subtest of the WAIS and the Guild Memory Test (Crook et al., 1980).

Participants. — Three groups were tested. The young group consisted of 31 undergraduates, 16 men and 15 women, from 17 to 22 years old, with a mean age of 18, and a mean WAIS vocabulary score of 63.5, who were fulfilling a course requirement. The old normal group consisted of volunteers from local community organizations for older adults. There were 31 participants in this group, 6 men, 25 women, from 64 to 84 years old, with a mean age of 70.8 and a mean vocabulary score of 71.9. The SDAT group

consisted of 14 volunteers. Twelve were participating in the Geriatric Study and Treatment Program of the Department of Psychiatry at New York University Medical Center. Two were volunteers from the local community who were initially classified as memory impaired on the basis of the testing in this experiment. All participants in this group were subsequently diagnosed on the basis of more extensive testing as having SDAT. The 14 SDAT individuals comprised 8 men and 6 women, from 61 to 84 years old, with a mean age of 70.5, and a mean vocabulary score of 58.9.

The old groups were classified with respect to memory impairment on the basis of the Guild Memory Test, a set of standardized recall tests involving paragraph recall, paired associates, and design recall. Participants whose performance was within normal limits for their age and WAIS vocabulary levels were assigned to the old normal group. Those whose performance was more than one standard deviation below the mean on two or more of the five subtests were judged to be memory-impaired. Three people whose performance fell between these two categories were not included in the study. All of the memory-impaired participants underwent a complete evaluation at the Geriatric Study and Treatment Program and met the criteria for a diagnosis of probable Alzheimer's disease as outlined by the National Institutes of Health (McKhann et al., 1984). They were classified further as mildly demented (GDS 3) on the Global Dementia Scale (Reisberg et al., 1982). Individuals were excluded from the study who had a history of stroke, seizure disorder, alcoholism, or major psychiatric illness. The screening of all older participants for memory impairment is important for the full understanding of the effects of age and dementia on the concreteness effect, as will be seen later.

Material. — Five 16-item lists were prepared from the list of 925 nouns for which concreteness, imagery, and meaningfulness values have been established (Paivio et al., 1968). Half of the items in each list were words rated high in imagery and concreteness (above 6.0), and half were low (below 3.5). The mean meaningfulness value for the concrete words was 6.2 and for the abstract words 5.7. All of the words were of high normative frequency (A and AA words from Thorndike & Lorge, 1944) and from three to seven letters in length. The Kucera-Francis frequencies were 89.2 for the concrete and 103.0 for the abstract words (Kucera & Francis, 1967). The five lists were matched on all these characteristics. A practice list of 16 items with the same characteristics also was prepared.

Procedure. — Participants were tested individually. They viewed each list silently as it was presented by the experimenter at a rate of 3 sec per item. Immediate free verbal recall followed presentation of each list. Both the order of presentation of the five main lists and the order of items within the lists were randomized independently for each participant. Mixed lists were used in order to minimize the anticipation of word type and the use of a different strategy for concrete and abstract words. Moreover, the concreteness effect has been clearly demonstrated with both within-lists (Paivio et al., 1969) and between-lists (Paivio & Csapo, 1969) designs in free recall.

RESULTS

The results are shown in Table 1. The overall recall scores were consistent with previous experiments. With performance on concrete and abstract words combined, the young group recalled more items than the old normal group, who recalled more than the SDAT group. The difference between the groups is statistically significant, $F(2, 73) = 110.94$, $p < .001$, $\omega^2 = .750$, as is the effect of concrete versus abstract words, $F(1, 73) = 28.32$, $p < .001$, $\omega^2 = .242$.

The key new finding is the significant interaction of concrete versus abstract words with groups, $F(2, 73) = 4.23$, $p < .025$, $\omega^2 = .056$. As is clear from the table, the mean proportion of concrete as opposed to abstract words shows the typical strong concreteness effect for the young group, but no concreteness effect for the old normal group. Orthogonal comparison of the concrete versus abstract words for the young group gives $t(73) = 4.60$, $p < .001$. Orthogonal comparison of the concrete versus abstract words for the old normal group gives $t(73) = 1.23$, $p > .20$. The mean proportions for the SDAT group were not as predicted, however. They show a strong concreteness effect, and orthogonal comparison of these means gives $t(73) = 3.55$, $p < .001$.

There was no effect of trials on either overall recall or recall for concrete versus abstract words, $F < 1$.

An analysis of the effect of serial position on recall also was carried out. List position had the usual significant effect, $F(2, 15) = 6.57$, $p < .001$, with typical primacy and recency effects. There was no interaction, however, of either group or concreteness with serial position, $F_s < 1$.

DISCUSSION

The results for the young and old normal groups were as predicted. In addition to an overall decline in recall performance with age, the concreteness effect was attenuated with age. This result, like those of the earlier study on the picture superiority effect, is attributed to reduced activation in the memory network. Older participants failed to activate the additional visual information which, in young participants, gave concrete words their memory advantage. Together, the results showed that reduced activation with age was general and not limited to a particular type of information.

The communication hypothesis predicts that with imagery instructions, the concreteness effect should reappear in the older participants. This idea was supported by the results of the Bruning et al. (1975) study in which participants were given imagery instructions. Here, both young and old adults demonstrated the concreteness effect: Imagery instructions parallel the effect of verbalization instructions with pictures in older adults shown by Rissenberg and Glanzer (1986). Special instructions that result in direct activation of stored information can apparently compensate for the communication deficit of the older participants and can reestablish the effects.

The pattern of results of the SDAT group in the present experiment, however, is a puzzle. There was a concreteness effect for the SDAT group of magnitude similar to that of the young group, although their overall performance was much lower. It is not clear why the attenuation of the concreteness

Table 1. Proportion of Recall of Concrete and Abstract Words by Young Adults, Normal Older Adults, and Individuals with SDAT

Group	Concrete	Abstract
Young	.65	.54
Old	.43	.40
SDAT	.28	.17

effect found in the old normal group reversed itself in the SDAT group. If activation is reduced in normal aging, one would expect it to be reduced to at least the same degree in individuals of the same age with dementia. The following study will demonstrate that this unexpected result was due to a particular difficulty with the retrieval of abstract words in SDAT.

A consistent feature of SDAT is word finding difficulty (De Renzi, 1980; Miller, 1977; Reisberg et al., 1982), the impaired ability to name or label objects and concepts. It is essentially a retrieval deficit. Also typical of this condition, as with other forms of diffuse brain damage, is the loss of verbal abstracting ability and the increasing concreteness of speech and thought processes (Hall et al., 1981; Miller, 1977). One of the diagnostic criteria of dementia listed in the DSM III (American Psychiatric Association, 1980) is the impairment of abstract thinking as manifested by inappropriately concrete responses on various tests. This tendency for concreteness also may reflect limitations in vocabulary, such as the comprehension and spontaneous use of abstract words. Thus, individuals with SDAT would be expected to have considerable difficulty with the abstract items in Experiment 1.

Given the impaired ability to process abstract material in SDAT, it was hypothesized that word finding difficulty is greater for abstract words than for concrete words. This would account for the pattern of results in Experiment 1. The free recall task in this experiment required word finding — retrieval of the stimulus item. A greater impairment of word finding with abstract items would result in poorer recall of abstract words. Thus, the SDAT group would demonstrate a concreteness effect, despite the fact that activation, and overall recall, are reduced as predicted on the basis of the communication hypothesis.

The performance of the participants in Experiment 1 on the WAIS vocabulary subtest was examined in order to determine whether the SDAT group did, in fact, have particular difficulty with the abstract items. This was found to be the case. The abstract items on this test also happen to be the most difficult items, however, so this finding is inconclusive.

In the following experiment, a test was designed to measure word finding ability for abstract and concrete items. The finding of a greater word finding difficulty for abstract than concrete words in SDAT would support the explanation offered for the anomalous concreteness effect found in Experiment 1. It could also account for the contradictory findings of previous investigations of the concreteness effect in aging, as will be discussed.

Experiment 2

METHOD

Young, old normal, and old participants with SDAT were given definitions of concrete and abstract words and asked to supply the appropriate word. Each participant received a separate score for the number of concrete words and the number of abstract words given correctly. As in the previous experiments, participants also were tested on the Guild Memory Test and the WAIS vocabulary subtest.

Participants. — Participants were selected using the same criteria as in the previous experiment. Again, three groups were tested. There were 20 participants in the young normal group, 8 men and 12 women, from 16 to 31 years old, with a mean age of 20.5 and a mean WAIS vocabulary score of 62.2. In the old normal group there were 15 participants, 2 men and 13 women from 64 to 77 years old, with a mean age of 70.3 and vocabulary of 71.1. The SDAT group consisted of 12 participants, 5 men and 7 women, from 58 to 80 years old, with a mean age of 69.6 years, mean vocabulary of 59.5.

Materials. — Definitions were chosen for 44 words selected from the list of 925 nouns (Paivio et al., 1968) used to generate the word lists in Experiment 1. Two college level dictionaries were consulted (The Pocket Oxford Dictionary, 1978; Webster's New Collegiate Dictionary, 1979), and definitions were compiled that were brief and simply worded. Half of the 44 words were concrete and the other half were abstract, by the same criteria as in Experiment 1. Half of the concrete words and half of the abstract words were of high normative frequency (A and AA) and half of each type were of medium frequency — between 10 and 30 per million (Thorndike & Lorge, 1944). The mean Keucera-Francis frequency for the concrete words was 102.6, for the abstract words 92.2. Two of the definitions had two acceptable responses; participants were scored correct if they gave either one. All of the other definitions had only one acceptable response. The definitions for concrete and abstract words were matched for length. Each had a mean length of 7.9 words. An example of a definition of a concrete word is: "a place where books are kept for use but not for sale" (library). An example of a definition for an abstract word is: "the space of time equal to one 24th of a day" (hour).

Procedure. — Participants were tested individually. They were told that they would be read definitions of common words, and that after each definition they were to give the word that they thought was being defined. There was no time limit for responding, and the definition was repeated if the participant so requested, or if it seemed the person had forgotten or did not understand it. No hints were given, and the same wording was always used for the definitions. Participants were encouraged to guess when they seemed unable to supply a word. The order in which the definitions were read was randomized independently for each person. When the test was completed, each participant received the Guild Memory Test and the vocabulary subtest of the WAIS.

RESULTS

Participants received a separate score for concrete and abstract items. The score was the number of words correctly supplied in response to the definitions. The results appear in Table 2 below. The pattern was as predicted. The young normal group and the old normal group did well on word finding, and the difference between concrete and abstract items was relatively small. Participants with SDAT were significantly impaired on word finding, and their performance was much worse for abstract items than for concrete items. Analysis of variance revealed significant main effects of age, $F(2, 44) = 58.43, p < .0005, \omega^2 = .710$, and concreteness, $F(1, 44) = 143.43, p < .0005, \omega^2 = .648$. In addition, a significant interaction between age group and word type was found, $F(2, 44) = 15.71, p < .0005, \omega^2 = .134$. Participants with SDAT were handicapped in word finding and were disproportionately handicapped when the words were abstract.

The interaction was analyzed into two orthogonal components. The first consisted of the interaction of young versus old normal groups with concrete versus abstract words. For this interaction, $t(44) = 1.17, .20 < p < .30$. There was no significant interaction. Those two groups, young normal and old normal, were then combined to set up a second interaction. That interaction was the combined groups versus the SDAT group with concrete versus abstract words. The interaction was statistically significant, $t(44) = 5.55, p < .0005$. This interaction was a result of the marked difference between concrete and abstract words in the SDAT group.

DISCUSSION

These results are important for two reasons. One, they can explain the unexpected appearance of a concreteness effect in the free recall of the SDAT group in Experiment 1. The activation of relevant, stored information by a stimulus was reduced in both normal old participants and those with SDAT. This accounts for the decline in overall recall, and the attenuation of the concreteness effect, which should occur in both groups. In SDAT, however, there was an additional deficit involving word retrieval, which was much worse for abstract words. Impaired retrieval of abstract words, superimposed on an overall communication deficit, resulted in a recall advantage for concrete words in SDAT.

The other important issue addressed by these results is the question of word finding ability in aging and SDAT. Word finding difficulty is a common complaint of older adults. The old normal participants, however, were not impaired on this task. It is generally agreed that word finding difficulty is an early and consistent feature of SDAT, but it has been difficult to quantify. The test introduced here differentiates particularly well between normal old adults and individuals

Table 2. Proportions of Successful Word Finding for Concrete and Abstract Items for Young Adults, Normal Older Adults and Individuals with SDAT

Group	Concrete	Abstract
Young	.97	.76
Old	.95	.79
SDAT	.70	.24

with SDAT and may prove to be a useful diagnostic tool. It remains to be demonstrated, however, whether this test correlates with other measures of word finding ability or with word finding in spontaneous speech.

The fact that individuals with SDAT demonstrated a significant concreteness effect in Experiment 1 can help explain the inconsistent findings on the concreteness effect in aging that have been reported previously. The results of the present study show that, although normal older adults do not show a concreteness effect, individuals with significant memory impairment do show an effect. The studies cited earlier did not include a screening procedure for memory impairment. It is quite possible that the appearance of a concreteness effect for the old participants in some of these studies was due to the failure to exclude individuals with significant memory impairment. If this memory screening had not been done in the present study, there would have been at least two individuals with significant memory impairment in the old normal group. Their scores would have lowered the overall memory performance of the group and also may have reintroduced a concreteness effect.

GENERAL DISCUSSION

The results of this study can be summarized as follows. There was a decline in overall recall performance in normal aging and a further decline in SDAT. In addition, there was an attenuation of the concreteness effect in normal aging. In the SDAT group, however, there was a significant recall advantage for concrete over abstract words. Word finding ability was impaired in SDAT but not in normal aging. This impairment was more severe for abstract than concrete words. This finding can account for the unexpected appearance of a concreteness effect in the SDAT group.

The results of Experiment 1 — the attenuation of the concreteness effect with age — and the results of a previous experiment — the attenuation of the picture superiority effect with age — both can be viewed as support for the communication hypothesis. Both effects are attributed to the more extensive activation resulting from one type of stimulus over another and thus depend on successful communication within the memory network. (This network refers to all stored information; there is no distinction here between episodic and semantic memory.) A breakdown of this communication with age could account for the attenuation of these effects. Moreover, the fact that both the picture superiority effect and the concreteness effect are diminished in normal aging suggests that reduced activation occurs generally and is not limited to a specific type of information, such as verbal or visual. This basic mechanism may underlie other observed deficits in the memory performance of older adults, in addition to the ones presented here.

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