Word Associations in Old Age: Evidence for Consistency in Semantic Encoding During Adulthood

Deborah M. Burke  
Pomona College

Laura Peters  
University of Utah

Word associations of 80 young and 80 older adults were compared for 113 stimulus words. The proportion of paradigmatic responses varied with the grammatical class of the stimulus word and with the vocabulary level of the subject, but not with age. The same proportion of young and older adults gave the most common responses. Although older adults had a greater number of unique responses, this seems to reflect age differences in vocabulary level, as vocabulary but not age was a good predictor. Within-subject variability was also comparable across age, as on a retest young and older adults gave the same proportion of responses that were identical to those on the original test. Both age groups were more likely to repeat common than uncommon responses on the retest. This, together with analyses of response latency, suggests equivalent use of strategic processes across age. The results indicate that semantic structure and semantic encoding in adults are related to verbal ability, but not to age.

Experimental investigation of the memory problems of older adults has focused on episodic memory tasks in which memory for personally experienced events is measured. One of the most popular explanations for aging deficits in these tasks is that they result from age-related changes in semantic memory processes. In particular, it is argued that the semantic information that is accessed and incorporated into the memory code is less extensive in older than in younger adults (Cohen, 1979; Craik & Byrd, 1982; Craik & Simon, 1980; Eyserck, 1974; Simon, 1979; Till & Walsh, 1980). There has been, however, relatively little direct investigation of semantic memory in old age, and the hypothesized age differences in semantic processing are inferred from performance on episodic retention tasks. This assessment of semantic processes has yielded inconsistent results and is complicated by the possibility of age differences in episodic memory processes that are independent of semantic deficits (Burke & Light, 1981).

In this study we use the word association task to examine more directly the hypothesis that there are age-related changes in semantic memory. Although there has been extensive analysis of the development of word associations in children (e.g., Entwisle, 1966; Nelson, 1977) and in college students (e.g., Clark, 1970; Deese, 1965, 1970; Jung, 1919; Nelson, 1977; Tulving, 1972; Woodworth & Schlosberg, 1954). Indeed, recent models of semantic memory rest heavily on priming studies that assume that semantic structure is reflected in word association norms (e.g., Anderson, 1976; Collins & Loftus, 1975). Further, there is a pervasive belief in a strength gradient for semantic activation that follows word association frequencies (e.g., Anderson, 1983; Fischler & Goodman, 1978; Warren, 1974). The influence of semantic organization on word associations can, however, be obscured by the use of subject strategies (e.g., to give rare words). In the present study, we will determine whether any age-related changes in word associations reflect age differences in strategies rather than in semantic memory.

Variability of Word Associations of Young and Older Adults

The two most popular measures of variability are the number of different words given as responses to each stimulus word and the proportion of subjects giving the most common responses for each stimulus word. Age-related increases in variability would suggest, once strategic factors had been eliminated, that the semantic structure of word meaning changes during adulthood, so that older adults have less consistent semantic encoding of words. Although some studies have reported that the word associations of older adults have greater variability in both measures (Riegel & Birren, 1966; Tresselt & Mayzner, 1964), Riegel and Riegel (1964) found an age-related increase only in the number of different words given as responses. Perlmutter (1978) observed informally that older adults seemed to generate more different words as responses than did young adults, but in a further investigation she found only a nonsignificant trend for older adults to give fewer of the most common associates in the

This research was supported by Grant AG02452 from the National Institute on Aging.

The authors thank Rose Marie Harrold, Hedy White, and Penny Yee for their assistance with the data analysis, and Leah L. Light and the reviewers for their helpful comments on an earlier version of this article.

Correspondence concerning this article should be addressed to Deborah Burke, Department of Psychology, Pomona College, Claremont, California 91711.
Palermo and Jenkins (1964) association norms (Perlmutter, 1979). One explanation of these inconsistent results is suggested by Lovelace and Cooley (1982), who found that high vocabulary was associated with high commonality of responses. Indeed, vocabulary was a better predictor of giving the most common response than was age. Thus, age differences in variability found in previous studies may depend on cohort differences in vocabulary.

Howard (1980a, 1980b) examined variability when young and older adults generated properties of the stimulus word or instances from the same category as the stimulus word. There were no age differences in either of the two variability measures. Indeed, older adults produced fewer unique responses (i.e., responses generated by only one person) in all tasks. Howard suggested that her results may differ from free-association studies because she restricted associations to category instances or properties, thus eliminating the source of the variability in the type of response. On the other hand, the older and young adults in Howard's study were carefully matched on vocabulary, and this may have eliminated the source of variability. One of the goals of the present study is to determine if age differences in the two measures of variability are related to age differences in type of response and to further evaluate the contribution of vocabulary.

In addition to greater between-subjects variability, greater within-subject variability has also been claimed in older adults. Perlmutter (1979) repeated stimulus words on four trials and found that older adults were less likely than young adults to produce the same response. She concluded that older adults have less consistent semantic encoding. However, a response set in older adults to produce unique responses could also account for her results because it would be possible to remember previous responses and thus to vary subsequent ones. In the present study we explore this issue further using a test–retest interval sufficiently long to make it difficult to remember previous responses. Under these conditions it is less likely that a set to give different responses could be used successfully.

Types of Word Associations of Young and Older Adults

Responses to stimulus words are typically classified as being syntagmatic or paradigmatic. Paradigmatic responses are in the same grammatical class as the stimulus and usually are conceptually similar terms sharing many features of meaning (e.g., man–woman, soft–hard, run–walk). Syntagmatic responses differ in grammatical class from the stimulus and could occur continguously with the stimulus in a sentence (e.g., man–work, soft–pillow, run–fast). If older adults have impoverished encoding of word meaning that involves surface rather than semantic attributes (e.g., Craik & Simon, 1980; Eysenck, 1974), we would expect to see syntagmatic responding increase with age.

Although both young and older adults tend to give paradigmatic responses, Riegel and Riegel (1964) reported a decrease in paradigmatic responding in old age for their sample of German-speaking adults, especially for verbs and concrete nouns. Lovelace and Cooley (1982) recently provided the only other data on paradigmatic responding in young and older adults: Vocabulary was the best predictor of paradigmatic responding, and age had no additional effect. However, although grammatical class was not included in this regression analysis, older adults appeared to have lower paradigmatic responding for adverbs and high frequency verbs.

Grammatical class is an important factor to consider in examining type of word association response. Previous studies with young adults show that grammatical class has a large effect on amount of paradigmatic responding, with nouns consistently producing high paradigmatic responding, verbs and adverbs producing low paradigmatic responding, and adjectives showing wide variation across studies, depending on such variables as their frequency of occurrence (Deese, 1962; Fillenbaum & Jones, 1965). Further, some grammatical classes evoke paradigmatic responses from early childhood through young adulthood, whereas in others (e.g., adjectives) a shift from syntagmatic to paradigmatic responding occurs (Nelson, 1977). In the present study we examine the effect of age on the type of word association in each of four grammatical classes.

**Automatic Versus Strategic Processes in Word Associations**

Word association instructions are to give the first word that comes to mind after presentation of the stimulus word. According to a semantic network model, the retrieval process involves an automatic spread of activation and the concept sharing the most attributes, and thus the most pathways with the stimulus word, should "come to mind" first (e.g., Collins & Loftus, 1975). Similarly, according to models postulating that word meaning is represented by features, associations are retrieved that share the most features with the stimulus word (Clark, 1970; Clark & Clark, 1977; McNeill, 1966). Within the framework of such models, age-related changes in the type or variability of word associations would indicate age-related changes in the nature of conceptual organization, or in semantic retrieval processes. However, retrieval of a word association response can involve a conscious search through semantic memory, guided by a particular strategy for finding information—for example, finding an unusual word. Indeed, Clark (1956) argued that young adults share the same semantic structure but that there are individual differences in whether a person decides to give strong or weak associations.

In the present study we analyze latency and retest responses to evaluate whether any age differences are due to strategies. First, responses based on automatic processes are faster than those based on conscious, controlled processes (e.g., Posner & Snyder, 1975). Consistent with this, when subjects have long latencies in giving word associations, their responses are often idiosyncratic words that have personal meaning and are based on elaborate memories (Clark, 1970; Clark & Clark, 1977). When responses are given quickly, they are related in a more obvious way to the stimulus and are more common responses. Thus, it seems likely that responses based on a controlled and conscious search of memory will have longer latencies than those based on automatic processes. A finding of longer latency for older adults would not, of course, indicate an age-related increase in the use of strategies for retrieval. We expect older adults to have longer latencies because of age-related slowing of perceptual and response components of latency (Salthouse, 1982). Latency can, however, be used to indicate age differences in strategies to
produce low frequency or synagmatic responses. That is, we expect response variability and syntagmatic responding to vary with grammatical class of the stimulus. If older adults are more likely to use strategies in producing such responses, then the size of the age difference in latency should also vary with grammatical class.

The second technique for evaluating the role of strategies involves the assumption that responses repeated on the retest are more likely to be the product of invariant automatic processes than are responses that are not repeated. Clark (1966) reported that when he retested stimulus words and asked young adults to recall for each stimulus the word association response they had given on a test a week previously, responses with high association frequency were more likely to be repeated as responses with low association frequency. Clark suggested that low association frequency indicated improbable responses resulting from a retrieval strategy that was not easily repeated. In the present study, we asked subjects on the retest not to think about their original response (even if they could recall it, which is doubtful). Words with high association frequency on the first test should be repeated when the stimulus word is retested, inasmuch as these responses are the products of automatic semantic processes. If low association frequency responses are the result of strategic processes, then they should be repeated less often on the retest than high association frequency responses. However, if the low association frequency responses are the product of automatic processes (in this case acting on an unusual but strong connection), they also should be repeated. Thus, we will determine if repetition of a response on the retest is related to its association frequency on the first test, and if any such relation is the same in both age groups.

Method

Subjects

Eighty older adults between 62 and 87 years of age and 80 younger adults between 17 and 33 years of age participated in this study. The older adults were recruited at senior citizens' centers, but all were living in the community. The younger adults were undergraduates at a private or community college. All of the older subjects were native English speakers. Background information describing each age group is shown in the top half of Table 1. Subjects rated their health on a 10-point scale ranging from very poor (1), to excellent (10). The vocabulary scores are from the vocabulary subtest of the Primary Mental Abilities Test (Thurstone & Thurstone, 1949). Education (range = 12–17 years for young; 7–19 years for old) and vocabulary scores (range = 15–50 for young; 16–50 for old) each had a small but reliable (r < .05) negative correlation with age (r = −.30 and −.34, respectively) and were positively correlated with each other (r = .26). Subjects were paid $5 per hour for their participation in the study.

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td>Vocabulary score</td>
<td>Years of education</td>
<td>Health rating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-----</td>
<td>------------------</td>
<td>---------------------</td>
<td>---------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Original sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>54</td>
<td>21.7</td>
<td>82.9</td>
<td>14.3</td>
<td>1.5</td>
<td>8.7</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>26</td>
<td>21.7</td>
<td>82.9</td>
<td>14.3</td>
<td>1.5</td>
<td>8.7</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old</td>
<td>60</td>
<td>71.6</td>
<td>38.8</td>
<td>12.9</td>
<td>2.7</td>
<td>7.7</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>20</td>
<td>71.6</td>
<td>38.8</td>
<td>12.9</td>
<td>2.7</td>
<td>7.7</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>20</td>
<td>71.6</td>
<td>38.8</td>
<td>12.9</td>
<td>2.7</td>
<td>7.7</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retest sample</td>
<td>23</td>
<td>20.9</td>
<td>45.0</td>
<td>13.4</td>
<td>1.4</td>
<td>8.2</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>4</td>
<td>20.9</td>
<td>45.0</td>
<td>13.4</td>
<td>1.4</td>
<td>8.2</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>7</td>
<td>20.9</td>
<td>45.0</td>
<td>13.4</td>
<td>1.4</td>
<td>8.2</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The vocabulary subtest of the Primary Mental Abilities Test was used.

Procedure

Participants were tested individually in a quiet room at a senior citizens' center or in a college laboratory. After filling out a background questionnaire, they were told that the experimenter would say a word aloud while simultaneously holding up a card with the same word printed on it. They were asked to respond as quickly as possible with the first word to come to mind. It was emphasized that there were no correct responses and that they should not feel that they were supposed to respond in a particular way. They were also told that if they "drew a blank" on a particular word, that word would be put aside and presented again at the end. Stimulus words were presented in random order for each participant. Responses were recorded by the experimenter, and also the session was tape-recorded. After the word association task, the vocabulary test was administered.

Retest Procedure

Twenty-seven young and 27 older adults were selected from the main sample for retesting from 2 to 3 months after the original test. The young and older samples were matched as closely as possible on vocabulary scores and education. Background information describing the re-

---

1 We will use association frequency to refer to the frequency with which a word occurs as a word association response to a given stimulus word. Thus, high association frequency responses are common responses to a particular stimulus and low association frequency responses are uncommon responses. We hope this terminology avoids confusion with frequency of occurrence, which is production frequency in the language in general.
test sample is shown in the bottom half of Table 1. In the retest, subjects were given the same instructions as before, except they were told that although the words were the same as in the first session, they should try not to think of their previous response. The words were presented in the same way as in the original test.

Response Time Procedure

Response time to generate associations was measured from the recordings of the session. Response time was analyzed for 20 young (M age = 20.6 years) and 20 older adults (M age = 73.5 years) in the main sample. Only those subjects who responded to all of the stimulus words at the first time (i.e., they did not “draw a blank” on any word) and who had responses with an intelligible onset (i.e., not “ahhh orange”) were included. Subjects were selected so that the two age groups were matched as closely as possible on vocabulary scores and years of education (M vocabulary = 42.1 and 42, and M education = 14.0 and 12.9, for young and older adults, respectively). One experimenter listened to the tapes for these subjects and started a digital timer calibrated in hundredths of a second at the offset of the stimulus word and stopped it at the onset of the response. An estimate of the reliability of this procedure was obtained by determining the correlation of these latencies with those measured by a second experimenter for a subset of the data, namely, 20 latencies for each of 8 young and 8 older adults. The interexperimenter correlation for this subset was .99.

Results

Type of Response

Responses were classified as syntagmatic or paradigmatic according to Deese’s (1962) criteria that a response is paradigmatic if it is in the same grammatical class as the stimulus word and if it can be substituted for the stimulus word in a sentence. A response is syntagmatic if it differs in grammatical class from the stimulus word and can co-occur in a sentence. These classifications were made independently by the two authors, and the few disparities in classification were resolved (see Burke, Peters, & Harrold, 1986, for the complete word association norms).

The majority of responses were paradigmatic, and the proportion of paradigmatic responses across grammatical classes of stimulus words was the same for young and older adults, as can be seen in Table 2. An analysis of variance (ANOVA) showed that paradigmatic responding was not affected by age, F(1, 158) = 0.71, p > .1, but was affected by grammatical class, F(3, 474) = 74.70, p < .001. There was no interaction. The ordering of grammatical class from highest to lowest proportion of paradigmatic responses was adjective, noun, adverb, verb, for both age groups. This pattern is consistent with previous studies of young adults (Fillenbaum & Jones, 1965). The high paradigmatic responding for adjectives is typically found for high frequency-of-occurrence adjectives as those used here, but not for low frequency adjectives (Deese, 1962). A multiple regression analysis with age, vocabulary, and years of education entered in that order showed that vocabulary was the best single predictor of paradigmatic responses, F = 5.96, p < .01, followed by education, F = 3.95, p < .01, with age making no independent contribution.

Riegel and Riegel (1964) reported age differences in paradigmatic responding especially to verbs, so we examined responses to verbs further. For each verb, we compared the number of young and older adults who gave paradigmatic responses and found that older adults exceeded young adults on 17 verbs, and young adults exceeded older adults on 14 verbs.

Riegel and Riegel (1964) also reported an age-related decrease in paradigmatic responding for concrete nouns, and Bolton and Hamison (1975) found that older adults gave fewer paradigmatic responses for concrete than for abstract nouns. Neither trend was found here. Our 18 concrete nouns had 70.0% and 74.4% paradigmatic responses for young and older adults, respectively, and our 9 abstract nouns had 67.6% and 62.9%, respectively. In sum, our data provide no evidence for an age-related decrease in paradigmatic responses in any stimulus class. Vocabulary and education, however, are significant predictors of paradigmatic responding.

Table 2
Mean Proportion and Standard Deviation of Paradigmatic Responses by Grammatical Class of Stimulus Word

<table>
<thead>
<tr>
<th>Group</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
<th>Across grammatical class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>.69</td>
<td>.12</td>
<td>.58</td>
<td>.19</td>
<td>.76</td>
</tr>
<tr>
<td>Old</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>.72</td>
<td>.14</td>
<td>.59</td>
<td>.24</td>
<td>.78</td>
</tr>
</tbody>
</table>

Between-Subject Variability

Between-subject variability for young and older adults was compared using two measures. First, the two most popular associates for each stimulus word were found separately for each age group. Then the proportion of each subject’s responses that were the first or second most popular response in her or his age group was calculated for each grammatical class of stimuli. The results are shown in the top of Table 3. The age difference was not significant, F(1, 158) = 3.08, p < .1. Grammatical class had a significant effect, F(3, 474) = 93.35, p < .01, but did not interact with age. The ordering of grammatical class from highest to lowest commonality of responses was similar across age (i.e., adjective, noun, adverb, verb). Finally, a regression analysis with age, vocabulary, and education entered in that order showed that vocabulary was the best single predictor of proportion of first and second most popular responses, F = 11.47, p < .01, with age and education making no significant contribution independent of vocabulary. Thus, any apparent difference between age groups can best be understood as an effect of vocabulary differences between the groups, not age. The same analyses were carried out using the proportion of responses that were the first most popular response and that were the three most popular responses; these yielded the same pattern of results.

The words given as the most popular responses tended to be the same across age: Young and older adults overlapped on 60.5% of the words constituting the three most popular responses for stimulus words.

The second measure of between-subject variability was the
Table 3
Response Variability by Age and Grammatical Class of Stimulus Word

<table>
<thead>
<tr>
<th>Group</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
<th>Across grammatical class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Young</td>
<td>.52</td>
<td>.14</td>
<td>.40</td>
<td>.11</td>
<td>.56</td>
</tr>
<tr>
<td>Old</td>
<td>.46</td>
<td>.15</td>
<td>.36</td>
<td>.13</td>
<td>.56</td>
</tr>
</tbody>
</table>

Mean proportion of responses that were the first or second most popular response

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean number of different words given as responses^a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>25.1</td>
</tr>
<tr>
<td>Old</td>
<td>27.5</td>
</tr>
</tbody>
</table>

Mean proportion of identical responses on original test and retest

<table>
<thead>
<tr>
<th>Group</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
<th>Across grammatical class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Young</td>
<td>.43</td>
<td>.15</td>
<td>.35</td>
<td>.10</td>
<td>.47</td>
</tr>
<tr>
<td>Old</td>
<td>.44</td>
<td>.15</td>
<td>.34</td>
<td>.17</td>
<td>.49</td>
</tr>
</tbody>
</table>

^a Maximum = 80.

The number of different words given as responses by each age group for each stimulus word. This analysis uses the stimulus word as the unit and counts the number of different responses for each. The maximum number of different responses is the number of subjects in each age group (i.e., 80). The means for words in each grammatical class are shown in the middle of Table 3. A regression analysis showed a significant effect of age, F(1, 218) = 6.33, p < .02, and form class, F(3, 218) = 9.71, p < .01, with no significant interaction. As in the most popular response analysis, verbs and adverbs had greater response variability than nouns and adjectives.

Vocabulary predicted variability in our first measure, most popular response, so we wanted to evaluate whether vocabulary was responsible for the age effects found in the second measure. However, number of different responses cannot be calculated by subject. So we used another measure that also reflects the range of responses, namely, the number of unique responses (i.e., the number of responses given by only one person in an age group). We calculated the proportion of each subject's responses that were unique, separately for each age group and grammatical class. The mean proportions are shown in the top part of Table 4. An ANOVA showed significant effects of age, F(1, 158) = 4.27, p < .05, and grammatical class, F(3, 474) = 25.43, p < .001, but no interaction, F(3, 474) = 2.16, p > .05. However, a regression analysis showed that vocabulary was the best single predictor, F = 8.60, p < .01, R = -.257, and that age made no significant contribution independent of vocabulary.

Within-Subject Variability: Retest

We calculated the proportion of each retest subject's responses that were identical for each stimulus word on the original test and on the retest. The mean proportions for young and older adults are similar within each form class, as can be seen in the bottom of Table 3. An ANOVA confirmed that although the consistency of responses varied across form class, F(3, 156) = 19.66, p < .01, there was no effect of age nor an interaction with form class (both Fs < 1). Consistent with the measures of between-subject variability, verbs and adverbs had greater variability than nouns and adjectives. A regression analysis showed that consistency was not predicted by age, vocabulary, or education (all Fs < 2.0), and the three variables combined accounted for less than 3.5% of the variance.

Because vocabulary differences seemed to underlie the age differences in unique responses in the original sample, we analyzed whether there were age differences in the proportion of unique responses on the original test for the retest sample in which young and old subjects were matched on vocabulary. As can be seen in the bottom part of Table 4, older adults in the retest sample did give slightly more unique responses, but this age difference was not significant, F(1, 52) = 1.13, p > .1, whereas grammatical class again had a significant effect, F(3,

Table 4
Mean Proportion of Unique Responses by Grammatical Class of Stimulus Word

<table>
<thead>
<tr>
<th>Group</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
<th>Across grammatical class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Original sample</td>
<td>Retest sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Old</td>
<td>.30</td>
<td>.14</td>
<td>.23</td>
<td>.15</td>
<td>.31</td>
</tr>
</tbody>
</table>

Note: *Maximum = 80.*
156) = 9.37, p < .001, but did not interact with age. As was the
case in the original sample, young and older retest subjects did not differ in the proportion of subjects who gave the two most popular responses (.51 and .49, respectively).

If low association frequency responses are the result of a stra-
tegic retrieval process, then they would be less likely to be re-
peated on the retest than if they were the result of strong, though
idiosyncratic connections and were retrieved through automatical-
processes. To determine whether low and high association
frequency responses were as likely to be repeated on the retest,
every response was assigned a 1 if it was repeated on the retest
and a 0 if it was not. We computed the correlation of these
scores with the association frequency of each response in the
first session (i.e., how many subjects in the full sample in each
age group gave that response for that stimulus). Thus, the data
for the correlations were 3,051 pairs of numbers for each age
group (113 words for each of 27 subjects) with a 0 or 1 as the
first number, depending on whether association was re-
peated, and the frequency of the association in the full sample
as the second number. Pearson rs were .52 and .48 for the young
and older subjects, respectively, both p < .01. In this analysis
we used association frequencies from the full sample rather
than from the retest sample alone, as we believe the former are
closer to normative association frequencies. However, the
association frequencies from the full sample were highly correlated
with association frequencies from the retest sample, r = .97,
for the young, and .95 for the old. Further, in a correlation
of association frequency from the retest sample and repetition
score, rs were .51 and .45 for young and older subjects, respec-
tively, thus showing the same effects as already described. In
sum, common responses were more likely to be repeated on the
retest than were low frequency responses for both young and
older subjects. Consistent with this, although young and older
adults repeated an average of 40% of their original responses,
they repeated only 7% and 8% of unique responses, respectively.

Response Time

Mean response time in each grammatical class was calculated
for each of the 20 young and 20 older adults in the subsample.
Mean latency in each age group is shown by grammatical class in
Table 5. Response time increased with age, F(1, 38) = 13.57,
p < .01, and varied with grammatical class, F(3, 114) = 13.12,
p < .01, but the interaction was not significant, F(3, 114) =
1.37, p > .1. The order of response time by grammatical class
from fastest to slowest was nouns, adjectives, verbs, and adverbs
for both young and old adults. Although the absolute size of the
age difference varied considerably among grammatical classes
(from 0.84 for adjectives to 1.31 for adverbs), the proportional
increase in older adults' latency over young adults' latency was
quite constant, namely, .55, .52, .49, .62 for nouns, verbs, adjectives,
and adverbs, respectively.

We predicted that latency would be longer for low association
frequency than for high association frequency responses be-
cause low association frequency responses were more likely to
involve slow, conscious retrieval processes. We computed the
correlation of response time and association frequency (based
on the full sample) for the 113 responses separately for each of
the 40 subjects in the subsample. The correlation coefficient for

<table>
<thead>
<tr>
<th>Group</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td>1.58</td>
<td>1.91</td>
<td>1.70</td>
<td>2.10</td>
</tr>
<tr>
<td>Old</td>
<td>2.45</td>
<td>2.90</td>
<td>2.54</td>
<td>3.41</td>
</tr>
</tbody>
</table>

the young subjects ranged from -.12 to -.56, with a mean of
-.35 (p < .001), and for older adults, from -.03 to -.46, with
a mean of -.28 (p < .01). The difference between the two co-
efficients was not reliable, t(38) = 1.58, p > .1.

Discussion

These results suggest that there is little change in the nature
of word associations during adulthood. First, young and older
adults gave the same proportion of syntagmatic and paradig-
matic responses. The grammatical class of the stimulus word
affected the proportion of paradigmatic responses, but these
effects were the same across age. Paradigmatic responding did,
however, increase with vocabulary and education. Second, older
adults had slightly greater response variability in range of re-
ponses, but not in frequency of most common responses. The
significant differences in variability appear to be attributable
to differences in verbal ability between young and older adults.
Indeed, when young and older adults who were matched on
vocabulary were compared, the age difference in proportion of
unique responses found in the larger sample was no longer sig-
nificant. Furthermore, young and older adults repeated the
same proportion of responses on a retest several months later,
and both were more likely to repeat responses with high than
low association frequency. Analysis of response times provided
no evidence that young and older adults differed in the inci-
dence of strategic retrieval processes. First, we will consider
the implication of these findings for age changes in semantic
organization and semantic processes, and then we will consider
the relation of verbal ability to word association. Finally, we will
return to the hypothesis that there are age differences in sen-
temantic encoding and consider whether the present findings are
consistent with this hypothesis.

Age-Related Changes in Semantic Memory

The present findings on variability and type of word associa-
ations are consistent with other recent work in suggesting that
aging has little effect on the organization of knowledge. Light
and Anderson (1983) demonstrated that young and older adults
generate very similar scripts for routine activities such as gro-
cery shopping or getting up in the morning, and they found no
age differences in number of unique responses. Howard (1980a,
1980b) reported that young and older adults generate similar
instances for category norms and similar word associations
when responses are restricted to properties or same category
instances. Older adults did not have greater variability in either of Howard's tasks. Both the Light and Anderson (1983) and the Howard (1980a, 1980b) studies used older adults whose vocabulary scores were at least as good as were the young adults'. The results of the present study suggest that this is a critical variable for obtaining age constancy, and the earlier findings of age differences in response type or variability (Perlmutter, 1979; Riegel & Birren, 1966; Riegel & Riegel, 1964) may in fact reflect age differences in verbal ability.

In the present study, both young and older adults repeated 40% of their associations on the retest. These results contrast with Perlmutter's (1979) report that within-subject variability was larger for older than young adults on word association tests repeated within a single session. It seems likely that her finding was the result of a strategy by older adults to give different responses on the repeated tests. This could not be done easily here because the two tests were months apart, making recall of the first responses unlikely. Our data suggest that older and young adults have remarkable similarity in the stability of their semantic encoding when the possibility of knowingly producing a different response is eliminated. This of course has implications for episodic memory performance because it has been demonstrated that consistency of encoding at study and at test is important for good memory performance (e.g., Tulving & Thomson, 1973). Our findings provide no evidence that the source of older adults' problems on episodic memory tasks is inconsistency of encoding on repeated occurrences of words.

Our finding of age constancy in the frequency of paradigmatic and syntagmatic responses is consistent with Howard, McAndrews, and Lasaga's (1981) study of semantic priming of lexical decision. They found faster decisions for targets that were same category associates (paradigmatic) or descriptive property associates (syntagmatic) of preceding prime words, and the priming effects were comparable for young and older adults. The two studies together suggest that the conceptual basis for associations among words is unchanged during adulthood and that this reflects the constancy of the semantic structure of memory.

Although the nature of word associations seems to be constant during adulthood, there are some age differences in the specific words selected as responses. Young and older adults differed on 39.5% of the three most popular responses for each stimulus word. A few of these differences were clearly attributable to differences in the life experiences of young and older adults, which would be expected to affect the availability of relevant concepts. For example, the most frequent association to melt was ice cream for the young, but this response was not among the three most popular for the older adults. Most of the differences, however, did not have such an obvious source. The existence of such differences points out the importance of using norms for old, not young, adults in cognitive studies of aging aiming to control association values.

One of the aims of the present study is to determine whether young and older adults use the same retrieval processes in generating associations. The analyses of both response times and retest responses are germane to this issue. First, latencies were longer for older adults and varied with grammatical class, but the age difference was statistically equivalent in each grammatical class. If older adults used more slow, effortful processes than younger adults in producing either paradigmatic or syntagmatic responses, or in producing low frequency responses, then there should have been an Age × Grammatical Class interaction for latency because the proportion of syntagmatic responses and of low frequency responses varied with grammatical class. There is evidence that responses to verbs and adverbs involved effortful processes more than did responses to nouns and adjectives: Verbs and adverbs had longer latencies, more variability in associations, and fewer associations repeated on the retest. The fact that the age difference in latency was not statistically greater for verbs and adverbs than for nouns and adjectives suggests that any switch to strategic, effortful processes for these stimuli was made equally by both young and older adults.

Second, latency was negatively correlated with association frequency of responses for both young and older adults. We predicted that low association frequency responses would have longer latencies than high frequency responses because they are more likely to involve effortful processes that are more time consuming than automatic processes. Thus, these correlations suggest that both young and older adults are more likely to use effortful processes in retrieving uncommon responses. It is also possible, however, that the increase in latency for low association frequency responses reflects a weaker association, but one that is accessed by an automatic retrieval process. However, low association frequency responses were less likely to be repeated on the retest, suggesting that they were not the product of an automatic process.

We have argued that responses that are not repeated on a retest are more likely to be the result of an effortful, strategic search through memory. Such retrieval yields an uncommon response that is unlikely to be repeated on a retest. Repeated associations are more likely to be the result of automatic, invariant processes acting on strong connections, so that when the stimulus is repeated, the same response is produced. Consistent with this, responses repeated on the retest tended to be common associations, whereas responses that were not repeated were more idiosyncratic, with low association frequency. This relation of association frequency and repetition was the same across age as was the proportion of repeated responses. Thus, the analysis of retest responses is consistent with the latency analyses in suggesting that the incidence of strategic retrieval processes in generating word associations is constant across age.

Verbal Ability, Word Associations, and Semantic Memory

The relation of word associations to verbal ability appears to persist across a range of ages and abilities. In the present study young and older adults with lower vocabulary scores gave fewer paradigmatic responses, fewer of the most common responses, and more unique responses than did subjects with higher scores. Lovelace and Cooley (1982) reported similar findings with young and older adults. In a study of West African children and young adults, Sharp and Cole (1972) found that subjects who were literate had a higher rate of syntagmatic responding than literate subjects. Commonality of responses and paradigmatic responding also increase with education in both children and adults (Rosenzweig, 1964; Sharp & Cole, 1972). This effect may
be attributable to verbal ability, as education improves vocabulary and verbal performance (Hunt, 1978).

Both low vocabulary scores and the production of uncommon word associations may be attributable to the representation of an incomplete or atypical word meaning (cf. Hunt, 1978). For example, on the vocabulary subtest of the Wechsler Adult Intelligence Scale, where subjects must define words, performance will suffer if the aspects of meaning in the semantic representation strongly associated with the word are idiosyncratic rather than definitional. Deficient semantic representations would also lead to the production of uncommon word associations, inasmuch as the representations included atypical features or omitted salient features. In this case, the concept sharing the most features, and thus the likely response, would reflect the unique configuration of the representation. Such a response would probably differ from the responses of subjects whose semantic representations included core aspects of meaning. The effects of education on word associations are consistent with this analysis, as schooling promotes learning of standard definitions of words and thus reduces the occurrence of atypical and incomplete semantic representations of word meaning.

We are suggesting that certain factors account for some people’s having incomplete or inaccurate semantic representations of the relatively rare words on vocabulary tests, and that these factors produce atypical connections (but relatively complete information) in the semantic representations of common words like those on our word association test. We would argue that these factors involve language learning and language use, and that at a cognitive level they affect knowledge-based processes.

Studies of aphasics have shown that production of uncommon and bizarre word associations is more characteristic of aphasics with word comprehension and production problems than aphasics with other types of problems (Caramazza & Berndt, 1978). Goold & Baker (1976) made a proposal somewhat similar to the present one in accounting for such findings. They suggested that word-finding impairment in aphasia reflects an incomplete or deviant semantic representation. They argued that word retrieval is triggered by activation of converging semantic associations. An incomplete or deviant semantic representation would disrupt the pattern of activation and impair retrieval. Such a deviant representation would also yield idiosyncratic, even bizarre word associations. Thus, knowledge-based processes involved in the representation of word meaning can be affected by experiential or organic factors, with concomitant effects on word associations and verbal ability.

Conclusions

We return now to the claim that older adults have a deficit in semantic encoding. In particular, it has been suggested that the semantic processing of older adults has less “depth” so that there are age differences in the qualitative type of analysis, and less “elaboration” so that there are age differences in the extentiveness or richness of processing (Craik & Byrd, 1982; Craik & Simon, 1980). It would seem that in this view, older adults should have more syntagmatic associations than do young adults because these responses, in general, are based on more superficial attributes than are paradigmatic responses. That is, syntagmatic responses reflect situational relations based on perceptual experiences (e.g., melt–ice, stay–here, army–green), in contrast to paradigmatic responses based on semantic relations (e.g., melt–freeze, stay–go, army–soldiers). There were, however, no age differences in paradigmatic responding. Further, there were few associations in either age group that were sensory characteristics of the object named by the stimulus word, and there were none that were phonemically similar to the stimulus word (e.g., rhymes).

On the basis of this and similar studies (Howard, 1980a, 1980b; Light & Anderson, 1983; Lovelace & Cooley, 1982), we would argue that there is little change in the organization of semantic information and semantic processes involved in making associations. Inasmuch as these same semantic structures and processes are involved in semantic encoding more generally, as in language comprehension and episodic memory, the present results suggest no qualitative change in semantic encoding during adulthood. On the other hand, word associations represent primary, dominant semantic relations, and it is possible that age-related changes might occur in accessing more subtle aspects of meaning that may require more effort for retrieval. However, we found no age differences in the probability of low association frequency responses, which can reflect more subtle aspects of word meaning. Thus, although the present study does not have a measure of semantic elaboration—nor does any other study we know of—the results certainly provide no support for the view that older adults suffer deficits in elaborated semantic processing.

References


Howard, D. V. (1980b). Restricted word association norms for adults between the ages of 20 and 80. Psychological Documents (formerly JSAS: Catalog of Selected Documents in Psychology), 10, 6. (Ms. No. 1911)


Appendix

Stimulus Words for Word Association Test

<table>
<thead>
<tr>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 27)</td>
<td>(n = 31)</td>
<td>(n = 29)</td>
<td>(n = 26)</td>
</tr>
<tr>
<td>Apple</td>
<td>Admire</td>
<td>Able</td>
<td>Always</td>
</tr>
<tr>
<td>Army</td>
<td>Allow</td>
<td>Any</td>
<td>Bravely</td>
</tr>
<tr>
<td>Book</td>
<td>Amuse</td>
<td>Bad</td>
<td>Certainty</td>
</tr>
<tr>
<td>Chance</td>
<td>Appear</td>
<td>Bitter</td>
<td>Clearly</td>
</tr>
<tr>
<td>City</td>
<td>Attend</td>
<td>Brief</td>
<td>Completely</td>
</tr>
<tr>
<td>Crime</td>
<td>Beg</td>
<td>Calm</td>
<td>Deeply</td>
</tr>
<tr>
<td>Day</td>
<td>Buy</td>
<td>Cold</td>
<td>Earlier</td>
</tr>
<tr>
<td>Debt</td>
<td>Carry</td>
<td>Cruel</td>
<td>Easily</td>
</tr>
<tr>
<td>Dirt</td>
<td>Chew</td>
<td>Dark</td>
<td>Finally</td>
</tr>
<tr>
<td>Doctor</td>
<td>Choose</td>
<td>Empty</td>
<td>Fondly</td>
</tr>
<tr>
<td>Door</td>
<td>Earn</td>
<td>Happy</td>
<td>Gradually</td>
</tr>
<tr>
<td>Ear</td>
<td>Eat</td>
<td>Heavy</td>
<td>Hardly</td>
</tr>
<tr>
<td>Fact</td>
<td>Fail</td>
<td>Humble</td>
<td>Nearly</td>
</tr>
<tr>
<td>Fog</td>
<td>Feel</td>
<td>Lazy</td>
<td>Now</td>
</tr>
<tr>
<td>Fuel</td>
<td>Get</td>
<td>Many</td>
<td>Often</td>
</tr>
<tr>
<td>Guest</td>
<td>Go</td>
<td>Most</td>
<td>Once</td>
</tr>
<tr>
<td>Knife</td>
<td>Grow</td>
<td>Narrow</td>
<td>Ordinarily</td>
</tr>
<tr>
<td>Lake</td>
<td>Keep</td>
<td>New</td>
<td>Probably</td>
</tr>
<tr>
<td>Lunch</td>
<td>Kill</td>
<td>Raw</td>
<td>Properly</td>
</tr>
<tr>
<td>Man</td>
<td>Learn</td>
<td>Same</td>
<td>Quietly</td>
</tr>
<tr>
<td>Money</td>
<td>Melt</td>
<td>Shiny</td>
<td>Rarely</td>
</tr>
<tr>
<td>Shoe</td>
<td>Must</td>
<td>Smooth</td>
<td>Readily</td>
</tr>
<tr>
<td>Sister</td>
<td>Pray</td>
<td>Soft</td>
<td>Simply</td>
</tr>
<tr>
<td>Size</td>
<td>Put</td>
<td>Sour</td>
<td>Slowly</td>
</tr>
<tr>
<td>Story</td>
<td>Speak</td>
<td>Tall</td>
<td>Soon</td>
</tr>
<tr>
<td>Time</td>
<td>Stay</td>
<td>Tame</td>
<td>Swiftly</td>
</tr>
<tr>
<td>Year</td>
<td>Sweep</td>
<td>Thick</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take</td>
<td>Ugly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>Weak</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Want</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warn</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>