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Speed of Retrieval from Long-term Memory in Relation to Age, Familiarity, and Datedness of Information[1]

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The time required to name four groups of pictures was measured in 83 community dwelling males (18-70 years of age). One group consisted of objects used 50 to 70 years ago (unique dated exemplars), and another consisted of objects unique to contemporary times (unique contemporary exemplars). For comparison, other pictures of contemporary and dated objects commonly used in both periods were employed. There were three major findings. One, the familiarity of the pictured object is the major determinant of the time required to retrieve its name. Older subjects named the dated unique objects that were relatively more familiar to them more rapidly than did younger adults, while the reverse was true for contemporary unique objects. No age difference in the speed of naming common contemporary objects was found. Two, the overall age-related difference in naming latency was attributed to perceptual-motor aspects of the task. Three, the physical features as well as the familiarity of the object contributed to the speed of retrieval of the object's name.

NAMING latency, or the time required to name a picture of an object, provides one method of assessing the speed of retrieving verbal information from long-term or semantic memory. The method is useful for the study of age-related differences in long-term memory because the naming latency may be partitioned into an estimate of the time required to retrieve the name from long-term memory and that required for the perceptual-motor components of the task. Accordingly, age-related differences in the speed of memory retrieval can be examined independently of those changes in the perceptual-motor systems. The purpose of the present experiment was to employ the naming latency procedure to examine the hypothesis that the meaningfulness and familiarity of pictured objects to adults representing different age cohorts were the major determiners of the time required to retrieve the names of the pictures from long-term memory. In order to evaluate the hypothesis, the relative familiarity of the pictured objects to different cohorts was manipulated. It was expected that older adults would retrieve the names of objects in use 50 to 70 years ago more rapidly than young adults who are less familiar with such objects. On the other hand, objects that have been introduced fairly recently may be relatively more familiar to young than to elderly adults; accordingly, young adults should retrieve the names of such objects more rapidly. In contrast, there should be no age-related differences in the naming latency of objects that are equally familiar to members of different age cohorts.

Results of studies of naming latency for familiar objects on young adults have shown that time required to name pictured objects decreases when: (a) the frequency of the occurrence of the picture's verbal label in written or spoken language increases (Oldfield & Wingfield, 1965; Wingfield, 1968); (b) the chronological age at which the verbal label was presumably acquired (Carroll & White, 1973) decreases; and (c) the certainty of the verbal label to the individual increases (Lachman, 1973). The common element in all of the above studies was that shorter naming latencies were associated with greater familiarity of the pictured objects to the individual.

Using procedures adapted from Wingfield (1968), Thomas et al. (1977) found that naming latency increased with age. An estimate of the perceptual-motor time was obtained by priming the subject with the correct name just before the picture was presented. The results indicated that the observed age differences in naming latency were due to the perceptual-motor aspects of the task rather than to the time

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required to search long-term or semantic memory. For all subjects, faster naming latencies were associated with higher frequency of occurrence of the verbal labels as defined by Thorndike and Lorge (1944). No word frequency effect on naming latency was found when the picture was correctly primed. The finding of no age by word frequency interaction by Thomas et al. was congruent with the observed effects of word frequency on naming latency found in other studies, probably because the exemplars (Fozard, 1970; Shepard, 1967) were selected so that they were equally familiar to adults of different ages.

The experimental procedure employed by Thomas et al., (1977) was used to evaluate the hypotheses of the present study. Four sets of pictures were employed. One set of pictures contained objects used 50 to 70 years ago (unique dated exemplars), while another consisted of objects unique to contemporary times (unique contemporary exemplars). For comparison, two other sets of pictures of contemporary (common contemporary exemplars) and dated (common dated exemplars) objects commonly used in both periods were employed. Comparison of age difference in response times between the unique dated and unique contemporary objects would determine the effects of cohort-biased test stimuli on age-related differences in memory retrieval speed. Comparison of response times between recent and dated exemplars of common objects would determine whether familiarity of the physical features of an item affects naming latencies independently of the frequency of the verbal label. Finally, comparison of response times between the unique and common sets would verify the previously observed frequency of use effects on naming latency.

METHOD

Subjects

Eighty-three males representing three age groups participated in the experiment. Thirty college students (median age = 20 years, range 18 to 22 years) were recruited from Boston area universities; they were paid five dollars each for their participation. Twenty-nine middle-aged (median age = 50 years, range 45 to 54 years) and 24 older subjects (median age = 65 years, range 60 to 70 years) were volunteers from the Normative Aging Study (Bell et al., 1972), a longitudinal, interdisciplinary study of normal aging. At the time of entry into the study, the Normative Aging Study volunteers were screened according to a uniform health criteria so that the middle-aged and older subjects in this experiment were generally above average in health in comparison to a randomly selected group of age peers.

Stimuli

Forty slides were shown to the subjects; ten slides selected from each of four classes of objects were employed. The objects were classified according to their datedness and estimated frequency of usage. The "unique dated" exemplars were frequently used objects during the early 1900s: bed pan, churn, collar, commode, hand pump, sad iron, spat, spittoon, wash board, and wringer. The "unique contemporary" objects were part of the contemporary 1960s and 1970s milieu: calculator, digital clock, computer card, dune buggy, hair dryer, hydrofoil, monorail, race car, transistor radio, and snowmobile. Two other sets of ten objects were shown: baby carriage, camera, heater, razor, refrigerator, sewing machine, shoes, stove, telephone, and typewriter. The "common dated" set contained versions of these objects used in the early 1900s, and the "common contemporary" set consisted of versions of the same objects that are being used today. The dated exemplars and the majority of contemporary exemplars were obtained from the Sears-Roebuck and Montgomery Ward 1910 and 1974 catalogs.

Procedure

The subjects were individually tested in front of a 13 × 17 cm viewing screen placed at eye level 50 cm from the subject. The stimuli were projected to the viewing screen by a Kodak carousel projector coupled with a Gerbrands tachistoscopic shutter. A microphone placed about 10 cm from the subject's mouth was used to trigger a voice activated relay used to time the response latencies.

A trial consisted of the presentation of a word followed by a picture of an object. The subject's task was to name the object as quickly as possible; his response triggered the voice activated relay that turned off the slide and initiated the intertrial interval prior to the next trial. The interstimulus interval between the word and the picture was randomly selected from a rectangular distribution of times from 1.0 to 2.0 sec, with a mean of 1.5 sec. The intertrial interval was 3 sec. In the event that the voice activated relay was triggered accidentally by the subject before a picture was presented, the interstimulus interval was repeated and the picture was then presented.

The experiment was divided into two parts. The first part measured the naming latency (NL) or the time required to retrieve items from long-term memory. The second part estimated the perceptual-motor component of the task (e.g., the time required to perceive the stimulus and to produce the response). In order to insure that all items have equal probability of recall from long-term memory, the naming latency condition was always presented first so that no particular items would have been primed for retrieval. In the NL condition, the subject was shown 40 pictures, one at a time, and his task was to name each picture as soon as possible following its presentation. A slide showing the word "ready" preceded each picture slide. Five practice trials were used to familiarize the subjects with the procedure prior to the recording of the data. A 3-min rest period followed at the conclusion of the NL trials.

In order to estimate the perceptual-motor component of the task the second part of the experiment recorded the response speed when the subject was correctly primed (CP) with the name of the picture. To insure that the subject did not automatically call out the picture labels without actually seeing the picture, half of the stimuli were incorrectly primed (IP). The procedure accordingly provided an estimate of the perceptual-motor component in the context of a choice reaction test. Previous research (Thomas et al., 1977) demonstrated that this procedure effectively protects against anticipation while preserving the characteristics of the naming latency task. In this part of the experiment, the subject was shown a "priming word" prior to the presentation of the picture, and the task of the subject was to name the object in the picture as soon as he recognized it. Each of the 40 objects was presented twice; once with a CP and once with an IP. The order of presentation of CP and IP was randomized across the 80 trials. Five practice trials were used to familiarize the subjects with the procedure. A 3-min rest period was given after the first 40 trials.

The timing and presentation of stimuli, recording of response latencies, editing, and summarizing of data were accomplished with the aid of a Digital Equipment Corporation PDP8/e computer connected to the slide projector, tachistoscopic shutter, and voice activated relay. The verbal labels given by the subjects for each picture were recorded by the experimenter, who also registered response errors on-line at the computer terminal. Failure to produce a response was scored as an incorrect response. Response latencies from incorrect or stammered responses were excluded from the latency analysis. Stammered but correct responses were included for error analysis.

RESULTS

Latency

Fig. 1 presents the mean correct identification latencies for dated and contemporary exemplars in the unique (left panel) and common (right panel) categories for the NL, CP, and IP conditions for the 3 age groups. A separate analysis of variance was performed on the mean latencies in each of the three conditions. Age group (20, 50, and 65 years), uniqueness of stimulus (unique and common) and datedness of exemplar (dated and contemporary) were the independent variables in each analysis.

As evident from comparison on the left- and right-hand panels in Fig. 1, latencies were

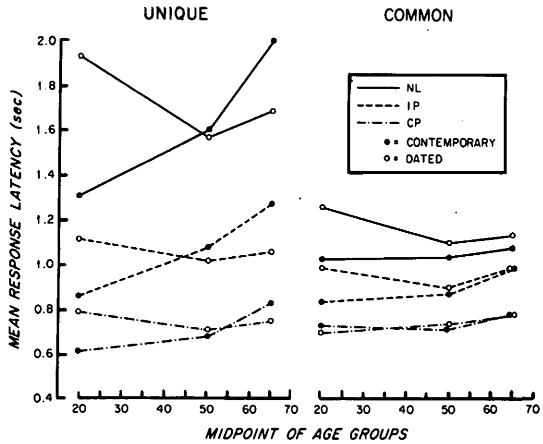

Fig. 1. Mean response latencies for the unique and common versions of contemporary (filled circles) and dated (open circles) exemplars for the naming latency (NL), incorrect prime (IP) and correct prime (CP) conditions for the 20-, 50-, and 65-year-old groups.

longer for the unique than for the common exemplars in the NL ($F(1,80) = 144.75, p < .001$) and IP ($F(1,80) = 80.17, p < .001$) conditions; this variable accounted for 23.1% and 8.5% of the variance in the two analyses respectively. The main effect of uniqueness was also significant in the CP condition ($F(1,80) = 4.25, p < .04$), but it accounted for only 0.5% of the total variance. Together, these data indicate that the frequency of usage exerted a strong effect on the speed of retrieval from long-term memory.

Response latencies were longer in the older groups. The main effects of age were statistically significant in the IP ($F(2,80) = 4.70, p < .01$) and CP ($F(2,80) = 6.29, p < .003$) conditions, but not in the NL condition.

The most striking finding shown in Fig. 1 is the statistically significant interaction among age, uniqueness of exemplars, and datedness of exemplars for the NL ($F(2,80) = 6.96, p < .002$), IP ($F(2,80) = 6.23, p < .004$), and CP ($F(2,80) = 10.47, p < .001$) conditions. The unique dated exemplars were named more rapidly by the 65-year-olds than by the 20-year-olds, while the reverse was true for the unique contemporary exemplars. On the other hand, with the common objects no significant effect of age was found with the contemporary exemplars, while the older subjects were faster with the dated exemplars. The performance of the 50-year-old group fell between those of the younger and older groups; no significant difference was found between the latencies to the unique dated and contemporary exemplars. Overall, the younger subjects named contemporary exemplars more rapidly than did older subjects, while the latter named dated exemplars more rapidly. A significant age by datedness interaction was observed in the NL ($F(2,80) = 12.99, p < .001$), IP ($F(2,80) = 28.65, p < .001$), and CP ($F(2,80) = 8.31, p < .001$) conditions.

To further examine if the observed NL effects were independent of the observed age-related differences in the perceptual-motor component of the task, an estimate of the memory retrieval component was made. An obtained latency may be conceived as having a static, perceptual-motor component (i.e., the time used to perceive the stimulus and the time to produce the response once it has been selected), and a dynamic component, or the time required to retrieve and process the verbal label of a particular picture from long-term memory. In the NL condition, no priming was given prior to the presentation of a picture. The obtained latency then was composed of time to retrieve information from long-term memory and the perceptual-motor time. In the CP condition, the obtained latency was again composed of a memory-search time and a perceptual-motor time. However, as the stimulus picture was correctly primed no search of long-term memory was required (Thomas et al., 1977). The difference between the latencies in the NL and CP conditions would estimate the time required for information processing or long-term retrieval independent of the perceptual-motor component.

The mean latency from the pair-wise subtraction of latencies for each stimulus in the NL and CP conditions for the various picture sets and age groups were calculated. The pattern of responses was very similar to those obtained in the analyses of the NL condition. No statistically significant age effect was observed. Significant uniqueness ($F(1,80) = 142.69, p < .001$) and datedness ($F(1,80) = 5.53, p < .02$) main effects and age by datedness ($F(2,80) = 6.21, p < .004$) and age by uniqueness by datedness ($F(2,80) = 3.58, p < .03$) interactions were found. Examination of the entire distribution of NL and information processing latencies in each combination of age group and picture type revealed that the differences described were not attributable to special pictures.

The results of the latency analyses were consistent with the hypotheses that the overall age-related differences in response time were due to the perceptual-motor components of the NL and that the properties of the test stimuli were the major determiners of the magnitude and direction of age differences in the time required to retrieve the name from long-term memory. Several auxiliary analyses of the complete distributions of the latency data were performed to determine if the results based on mean differences were attributable to unusual performances of particular persons within an age group or to particular pictures. The results of all of the auxiliary analyses indicated that the average trends reported represent the data fairly.

Errors

Fig. 2 presents the mean proportion of correct identification for the various stimulus

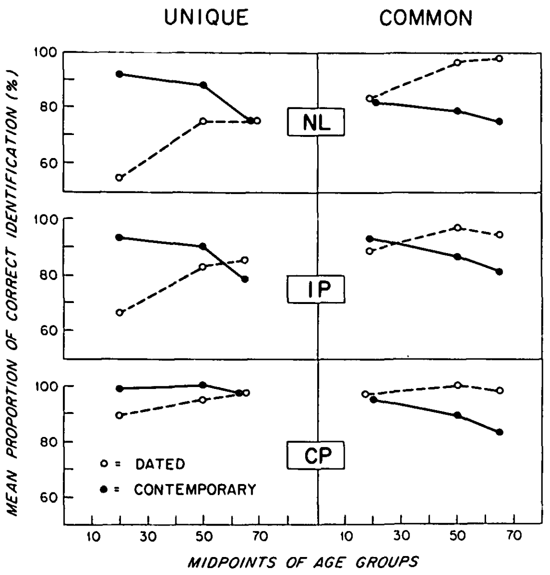

Fig. 2. Mean proportion of correct identifications for unique and common exemplars for NL, IP, and CP conditions for the 20-, 50-, and 65-year-old gorups.

types, conditions, and age groups. The age-related differences in the proportion of correct responses indicated that the unique stimuli were indeed chosen on the basis of differential familiarity to the younger and older subjects. Inspection of Fig. 2 shows that each respective age group identified greater proportions of stimuli that were more familiar to them in the unique categories. Moreover, in the common categories, the physical features of the objects were found to influence age-related differences of identification scores independently of the verbal labels. Results of analyses of variance indicated a significant main effect of uniqueness (NL ($F(1,80) = 69.17, p < .001$; IP ($F(1,80) = 41.64, p < .001$; CP ($F(1,80) = 12.39, p < .001$)), age by datedness interaction (NL ($F(2,80) = 44.43, p < .001$; IP ($F(2,80) = 52.06, p < .001$; CP ($F(2,80) = 19.29, p < .001$)), and uniqueness by datedness interaction (NL ($F(1,80) = 162.38, p < .001$; IP ($F(1,80) = 52.28, p < .001$; CP ($F(1,80) = 78.27\ p < .001$)).

Similar to the latency results, an age by uniqueness by datedness triple interaction was found in the proportion of correct responses in the NL ($F(2,80) = 5.14, p < .008$) and IP ($F(2,80) = 3.84, p < .03$) conditions. The effect was not statistically significant in the CP condition. A main effect of age was found in NL ($F(2,80) = 5.65, p < .006$) and IP ($F(2,80) = 3.37, p < .04$), but not in the CP condition.

Discussion

The major finding of the present study was that the names of pictures that were relatively more familiar to members of an age cohort were retrieved more rapidly and accurately from long-term memory by members of that cohort. The 65-year-old group was faster in retrieving the names of the unique dated pictures, the 20-year-olds were faster with the unique contemporary ones, and the speed of the 50-year-old group fell in between that of the two other groups. These data provide direct support for the hypotheses that the major determinant of speed of retrieval of information from long-term memory is familiarity of the information.

The findings of the present study demonstrate that differences in naming latency are dependent on inter-age group familiarity with the test stimuli, frequency of use, physical features of the pictures, and uniqueness and datedness of the stimuli to an individual. The results extend the generality of the findings of Oldfield and Wingfield (1965) and Thomas et al. (1977) who found that frequency of occurrence in written English of the verbal label is an important determiner of naming latency. In the present study common objects, both contemporary and dated, were named faster than unique ones by adults of all ages.

Older individuals were faster in naming the dated version of the common stimuli than the younger cohorts, while no age difference was found with the common contemporary objects. Such results suggest that the familiarity with the physical features of the stimuli, independently of the age at which the verbal label was learned (c.f. Carroll & White, 1973) also contributes to age-related differences in naming latency.

The perceptual-motor time as measured by the CP condition increased with age. The 65-year-old group was the slowest (.79 sec) followed by the 50 (.71 sec) and the 20-year-old group (.70 sec). In contrast, no overall age effect was found in the estimated long-term memory retrieval time obtained by subtracting the CP data from the NL data. The ranges of average retrieval time were 0.64 to 1.24 sec for the unique stimuli and 0.30 to 0.54 sec for the common stimuli. The observed variations of processing times within these ranges were found to reflect inter-age group differences with respect to the familiarity of the stimuli. In a study with college students, Lachman (1973) found that increased uncertainty of the labels increased intra-subject response latency. In the present study there are very large cohort differences in naming latency in addition to intra-subject differences.

The present results demonstrate clearly that the types of material used in tests that compare the memory functioning of younger and older adults are major determiners of the magnitude of the observed age-related differences in performance. Frequently, unfamiliar or nonsense test stimuli are employed in studies of age differences in adult memory (i.e., remembering digits and letters, paired associates, and spatial designs). The results of these studies have convincingly demonstrated that the elderly have poorer memory for newly memorized information than the young (Botwinick, 1973). Perhaps younger cohorts may have the advantage on these memory tests because they have more recent experience and practice in adapting to and memorizing unfamiliar material (Fozard & Thomas, 1975). In any case, the present results suggest that the magnitude of age differences may be magnified by the unfamiliarity of the use of test stimuli to the older subjects, independent of the other peculiarities of the task.

The present results, together with data from a variety of other studies, indicate that the magnitude of age differences in long-term memory are small when familiar and meaningful test stimuli are employed. For example, in a test of memory for well-learned information (names of presidents, birthdate, birthplace, etc.), Shakow et al. (1941) found minimal age-related differences. Poon and Fozard (1975) found similar results in testing adults of different ages on recognition for colloquial information from the 1910s to the 1970s. No age difference was found in the recognition of information from the 1950s to the 1960s. More importantly, the recall of older cohorts stayed relatively intact for colloquialisms from the 1920s through the 1950s. In addition, the older cohorts could accurately recognize more items from the earlier decades than the younger ones, presumably because of their greater familiarity with these events. Accordingly, the "good memory" of elderly adults for dated information is not the result of selective rehearsal of particular information.

Summary

Speed of retrieval of verbal information from long-term memory was examined using a naming latency procedure. The purpose of the study was to evaluate the hypothesis that the meaningfulness and familiarity of pictured objects to adults representing different age cohorts was the major determiner of the time required to retrieve the names of the pictures from long-term memory. Eighty-three males (18 to 70 years of age) were presented four types of pictures, one at a time, and their task was to name each picture as soon as possible. One group of pictures consisted of objects used 50 to 70 years ago, and another consisted of objects unique to contemporary times. For comparison, other contemporary and dated pictures of objects commonly used in both periods were employed.

The results showed: (a) the names of pictures that were relatively more familiar to members of an age cohort were retrieved more rapidly from long-term memory by members of that cohort; (b) the overall age-related difference in naming latency was attributed to perceptual-motor aspects of the task; and, (c) the physical features as well as the familiarity of the object's name contributed to the retrieval speed. The present data indicate that the types of test stimuli used in tests to evaluate and compare memory of old and young adults exert an important impact on the magnitude of observed age differences.

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