FACTS AND RESEARCH IN GERONTOLOGY 1995 ©

EFFECTS OF AGING ON THE RETRIEVAL OF COMMON AND PROPER NAMES

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Abstract : Subjects aged 54-85 performed three speeded name retrieval tasks: (1) naming objects from line drawings, (2) naming famous people from photographs, and (3) naming capital cities from the names of countries. Subjects aged under 65 were matched with subjects aged over 65 in terms of their scores on a vocabulary test. For both objects and people, older subjects produced significantly fewer correct responses and were significantly slower than younger subjects. For places, older subjects produced fewer correct responses and were slower than the younger subjects, but only the response time effect reached significance. The age differences in numbers correct were no greater for proper names (people and places) than for common names (objects). For all three tasks, the effect of age on correct response times increased from the fastest to the slowest responses. Distributions of correct response times were presented as scatterplots of the fastest to the slowest responses for the under 65s against the corresponding responses for the over 65s. The data for objects, people and places fell on a single function. Overall, there was no evidence that the name retrieval impairment with age was greater for proper names than for common names.

Key Words : Aging; Name Retrieval; Common Names; Proper Names; Response Times; Brinley Plots.

INTRODUCTION

The distinction between episodic and semantic memory [1] has received some attention in the aging literature because it is generally claimed that the former is impaired in the elderly but not the latter (for example, [2]). Certainly, the decline with age in episodic memory as measured by traditional laboratory tasks has been well documented (see [3] & [4] for reviews). In contrast, semantic memory, defined as "organized knowledge a person possesses about words and other verbal symbols" or, more generally, as an "organism's knowledge of its world" ([1] & [5], respectively), appears relatively preserved in old age. This conclusion is based largely on data from vocabulary tests in which subjects are presented with a word and asked either to provide a definition or to choose its synonym from a list of alternatives (see [6] & [7] for summaries).

While there may be considerable stability in the elderly with respect to the contents of semantic memory, there is increasing evidence of an age-related decline in the ability to access and/or retrieve information stored in semantic memory. The data come from three main sources. First, there are self-rated questionnaires in which elderly subjects report greater difficulty than younger subjects in remembering people's names [8] and the names of places, acquaintances, famous people and objects [9].

Second, diary studies have shown that the elderly experience increasing numbers of naturally-occurring retrieval failures for both proper names [10] and the names of objects [11]. Such blocks are often referred to as "tip of the tongue" (TOT) states because of their temporary nature (see [12] for a review including the effects of aging).

Finally, there are laboratory studies in which subjects are required to name objects, people, concepts, etc., from pictures, descriptions, definitions, and so on. To summarize some of the results, Burke and Laver [13] found that older subjects had more TOT states than younger subjects in response to general knowledge questions requiring the retrieval of proper names. Maylor [14-16] demonstrated significant impairments with age in the ability to name words from definitions (see also [17]), famous people from photographs, and television programmes from theme tunes. Note that Maylor's results were obtained even though vocabulary scores did not differ across the age groups, and in two of the studies [15 &16], there was evidence that subjects did actually know the targets producing the TOT states (i.e., semantic memory was intact but inaccessible).

Several investigators have observed age-related decline on the Boston Naming Test which is a series of 85 outline drawings of concrete objects that vary in ease of identification from a broom to a zodiac [18]. Subjects are shown one picture at a time and asked to provide the name of the object, the dependent variable being the number of items correctly named spontaneously. There is generally stable performance from the 30s to the 60s age groups, followed by significant decline in the 70s [19-

23]. One obvious possibility is that the decline is entirely attributable to visual deterioration in the elderly [24]. Indeed, Albert, Heller & Milberg [20] found an increase in perceptual errors with age (see also [25]), but there were even larger increases in semantic errors (circumlocutions, semantically related associates and nominalizations).

In addition to accuracy, two studies included picture naming latency as a dependent variable for comparison across age groups [2 & 25]. Older subjects were significantly slower than younger subjects, but in both cases the effect of age was the same for words of high and low frequency. This contrasts with interactive effects of frequency on picture naming latency with factors such as brain damage [26] and alcohol [27]. It is also surprising in view of general slowing models of cognitive aging (for example [28-30]). In other words, there is considerable evidence over a wide range of cognitive tasks to indicate that the longer it takes a younger adult to perform a task, the larger the age-related difference in response time (RT). Studies [2] and [25] observed significant effects of both age and frequency on RT, but there were no interactions between them which is contrary to the model.

Maylor and Valentine [31] analyzed not only mean RTs from each subject but also individual RTs ranked from the fastest to the slowest in each condition. In other words, task difficulty was determined empirically for each subject, rather than defined by frequency for all subjects. In a name retrieval task, two groups of subjects (under and over 65 years of age) were shown photographs of famous people and asked to name them as quickly as possible. All subjects successfully named at least 7 stimuli out of 20. The under 65s were faster than the over 65s, and this age difference increased from the fastest to the 7th-fastest RT, but not significantly (consistent with the previous studies). However, by dropping equal numbers of the least successful subjects in each age group, it was possible to examine the fastest 11 RTs. In this case, there was an interaction such that the age difference increased significantly with RT.

The present study was designed to provide further data on name retrieval in the elderly and, more specifically, to compare common and proper names. The elderly complain particularly of retrieval problems with proper names, but this could simply reflect the greater social embarrassment caused by forgetting someone's name, or the differential availability of suitable alternatives for blocked common and proper names.

Clearly, a laboratory study is required. On the one hand, it appears that the same organising principles apply to the identification of faces and other visual objects, with the models having the following three sequential stages in common (possibly in cascade): perceptual classification, semantic classification and name retrieval [32]. Thus both faces and objects access name codes only indirectly via the semantic system. On the other hand, there is neuropsychological evidence to suggest that there are qualitative differences between the retrieval of common and proper names. For example, there are patients with a specific deficit in the retrieval of proper names, while the retrieval of common names remains intact [33 & 34]. Furthermore, the category of proper names may itself fractionate functionally into people's names and place names, as evidenced by McKenna and Warrington's patient [35]. The names in the present study were those of objects, people, and places, so that comparisons could be made between the patterns of aging both across categories (common vs proper names) and within a category (proper names: people vs places). The experimental tasks required younger and older adults to: (1) name objects from line drawings, (2) name famous people from photographs, and (3) name capital cities from the names of countries.

METHOD

Subjects

Subjects were selected from a panel of volunteers aged over 50 who were participating in a longitudinal study of cognitive aging at the University of Manchester. Each volunteer had responded to media advertisements and had previously visited the laboratory to participate in group testing sessions. Data available for each subject included: (a) Wechsler Adult Intelligence Scale - Revised (WAIS-R) Vocabulary scores [36]: The Vocabulary subtest was adapted slightly for use with British subjects (maximum score = 74). (b) Culture fair scores: Scale 2, Form B of the the Culture Fair Intelligence Test [37] was used as a measure of fluid intelligence (maximum score = 46). (c) Processing speed: The total number of correct substitutions on a letter-letter substitution task (4 runs, each of 2 minutes). (d) Free recall scores: Ten words were each presented visually for 2s with an interstimulus interval of 1.4s. The words were all common nouns of 2 syllables such as kitchen and forest. Subjects were required to recall the words in any order immediately after presentation of the final item.

Subjects were each paid £3 (approximately $5) for participating in the experiment. All were native speakers of English. Subjects in the two age groups (under and over 65) were matched as closely as possible in terms of their WAIS-R Vocabulary scores.

There were 28 subjects under the age of 65 (11 men, 17 women; mean age=58.13; sd=2.68; range=54.0-63.7) and 28 subjects over the age of 65 (12 men, 16 women; mean age=76.08; sd=4.21; range=68.9-85.1). It can be seen from Table I that the groups were equivalent in terms of crystallized intelligence (Vocabulary), but differed significantly in terms of fluid intelligence (Culture Fair) as expected [38], processing speed [29], and memory scores [39].

Table I

Mean scores and standard deviations on the cognitive tests, with results of one-way analyses of variance.

	Under 65s		Over 65s		
Test	M	SD	M	SD	Analysis of variance
WAIS-R					
Vocabulary	58.61	8.65	57.68	7.40	$F(1,54)=0.19$, $MSe=64.76$, $p>.1$
Culture Fair	34.82	3.76	25.54	6.01	$F(1,54)=48.03$, $MSe=25.13$, $p<.001$
Processing Speed	275.96	45.63	199.89	53.74	$F(1,54)=32.60$, $MSe=2484.99$, $p<.001$
Free Recall	7.46	1.35	6.46	1.73	$F(1,54)=5.82$, $MSe=2.41$, $p<.05$

Apparatus

A British Broadcasting Corporation "B" microcomputer was used to control auditory tone and visual stimulus presentation, record responses (with millisecond accuracy), and store and analyze data. Slides were projected from a Kodak carousel projector fitted with a shutter under microcomputer control. Subjects were seated approximately 1.7m from a white wall on which the slides appeared. A microphone mounted on a stand was placed in front of the subject and the gain control of a voice key was individually adjusted so that it would trigger whenever the subject spoke.

Stimuli

Objects. The main criteria used in the selection of stimuli were: (i) the object was not so obscure or technical as to be unfamiliar to subjects (for example, "zoetrope"), and (ii) the object could be portrayed unambiguously, in other words, there was a single most appropriate name for the object.

Simple line drawings of objects were made into slides (white on black). When projected, each object measured approximately 50cm x 50cm.

There were 4 practice slides and 30 experimental slides (see Appendix A for the names of the experimental stimuli). The mean word frequency [40] for the names of the experimental items was 3.07 (sd=7.07; range=0-36).

People. Photographs of both famous and nonfamous faces (59 male; 9 female) were made into monochrome slides after placing a template with a circular hole over each photograph to conceal as much clothing and background as possible. There were 60 experimental stimuli and these were randomly assigned to one of two sets (A & B), with 25 famous and 5 nonfamous people in each set. In addition, there were 4 practice stimuli associated with each set (3 famous; 1 nonfamous).

Places. Countries were chosen so as to avoid both the obscure (for example, Surinam's capital city is Paramaribo) and the ambiguous (for example, South Africa's capital city could be Pretoria, Cape Town, or Bloemfontein). The names of countries were printed in upper and lower case (initial and remaining letters, respectively) using bold Times font, and then made into slides (white on black). When projected, the height of the letters was 36mm for upper case and 26mm for lower case. There were no practice items because of the more limited number of possible stimuli available. There were 27 experimental items and these are listed (together with their corresponding capital cities) in Appendix B.

Design & Procedure

Subjects were tested individually in experimental sessions of approximately 1 hour during which a battery of seven tasks was completed. The objects task was the third task for half the subjects in each age group and the fourth task for the other half of subjects in each age group. Similarly, the people task was either the first or the second task in the battery, and the places task was either fifth or sixth. Within each task, the stimulus presentation order was randomly determined before the experiment began so that each subject received the same stimulus order. In the people task, half of the subjects in each age group were given stimulus set A and the other half were given stimulus set B.

Each task began with instructions from the experimenter, followed (if appropriate) by the practice trials. Finally, the experimental trials were presented. The start of a trial was signalled by a 250ms warning tone. After a further interval of 250ms, a slide was presented which remained visible until the subject made a verbal response. If there was no response, the slide disappeared automatically after 20s. The intertrial interval (ITI) was 5s.

In all tasks, subjects were asked to respond as quickly and as accurately as possible.

Objects. Subjects were required to name the object depicted by the line drawing. They were encouraged to provide accurate and specific, rather than general, names. For example, responses such as "shoes" and "doll" to the practice stimuli of pictures of sandals and a golliwog, respectively, were corrected by the experimenter before proceeding with the experimental stimuli. Subjects were informed of the maximum time limit of 20s but were allowed to respond "No" if they wanted to give up and move on to the next trial.

People. Subjects were instructed to name the person shown in the photograph by providing the full name if possible, but otherwise the surname alone was acceptable. They were told that not all of the faces would be familiar to them. Again, there was a maximum time limit of 20s, but subjects were instructed to respond "No" if the face was unfamiliar or if they wanted to give up and move on to the next trial.

Places. Subjects were required to name the capital city of the country named on the slide. Again, subjects were informed of the maximum time limit of 20s but were allowed to respond "No" if they wanted to give up before then.

After performing all the tasks, subjects were given a list of the names of the famous people they had seen in the session (not including the practice stimuli). For each person, subjects were asked to write down his or her occupation, plus two other verifiable facts. The example of Marilyn Monroe (actress; married playwright; star of "Some Like It Hot") was provided.

RESULTS

The analyses reported here do not include the data from one male subject, aged 56, for whom there was evidence of a specific memory impairment [Footnote 1]. It should be noted that the results were not qualitatively affected by his removal. In addition, the data from the stimulus "astronaut" (objects task) were excluded from the analyses because the naming responses suggested that the drawing was insufficiently distinguishable from a "diving suit".

Accuracy

Objects. It can be seen from Table 2a that the under 65s age group produced significantly more correct responses than the over 65s age group.

The errors were categorized as either perceptual errors (e.g., "dog collar" for tambourine) or semantic errors, comprising circumlocutions (eg, "chopping heads off" for guillotine), semantically related associates (e.g., "chronometer" for sextant), and morphological inventions (2 only:

"bioscope" for microscope and "countometer" for metronome). There were no nominalizations. There was just one lexical error ("gondola" for pagoda), which was added to the semantic errors [Footnote 2]. Both perceptual and semantic errors were made significantly more often by the over 65s than by the under 65s (see Table IIa). Finally, the number of occasions on which there was no naming response within 20s was significantly greater for the older group.

Table II

Mean percentages and standard deviations of responses for (a) objects, (b) people, and (c) places, with results of one-way analyses of variance.

	Under 65s		Over 65s		
	M	SD	M	SD	Analysis of variance
(a) Objects					
Correct	88.76	7.51	75.00	13.65	$F(1,53)=21.23$, $MSe=122.59$, $p<.001$
Error (Perceptual)	1.53	3.22	3.45	3.25	$F(1,53)=4.82$, $MSe=10.47$, $p<.05$
Error (Semantic)	5.87	5.64	11.58	7.58	$F(1,53)=9.96$, $MSe=44.88$, $p<.005$
No response	3.83	3.62	9.98	8.31	$F(1,53)=12.48$, $MSe=41.58$, $p<.005$
(b) People					
Correct	71.11	16.50	57.57	19.58	$F(1,53)=7.66$, $MSe=328.86$, $p<.01$
Error	2.37	2.99	3.57	3.82	$F(1,53)=1.68$, $MSe=11.84$, $p>.1$
No response	26.52	16.16	38.86	18.85	$F(1,53)=6.77$, $MSe=309.14$, $p<.05$
(c) Places					
Correct	64.88	16.29	57.14	20.77	$F(1,53)=2.35$, $MSe=349.82$, $p>.1$
Error	14.81	7.96	13.76	6.75	$F(1,53)=0.28$, $MSe=54.28$, $p>.1$
No response	20.30	15.42	29.10	19.28	$F(1,53)=3.48$, $MSe=305.97$, $p<.07$

People. For each trial on which a famous face was presented, the subject's naming response was scored as correct (full name or surname only), an error (the wrong name), or no response within 20s. The under 65s produced significantly more correct responses and significantly fewer no responses than the over 65s (see Table IIb). There was no significant difference between the two age groups with respect to the number of errors [Footnote 3].

Recall that subjects were asked at the end of the session to provide the occupation and two other verifiable facts (making a total of three "semantic features") in response to the name of each famous person they had seen. When subjects failed to score the maximum of three correct semantic features, this was generally because they either left gaps or they repeated information (e.g., actor; appears in films). As in an earlier study [15], erroneous semantic features were rare (e.g., Michael Foot as Prime Minister). The mean number of correct semantic features was significantly greater for the under 65s (2.58, s.d.=0.36) than for the over 65s (2.27, s.d.=0.44; $t(53)=2.95$, $p<.01$). It is clear from the high numbers of semantic features reported by both age groups that subjects were reasonably familiar with the famous people selected for the experiment. The number of stimuli associated with zero correct semantic features for each subject provides an upper estimate of the number he or she had never before encountered. The mean percentage of stimuli per subject which resulted in zero correct semantic features was extremely low (1.2%), and not significantly different in the two age groups ($p>.05$). The analysis of variance on the numbers of correct naming responses was repeated after removing for each subject those stimuli which may have been unfamiliar (i.e., zero correct semantic features), with virtually identical results.

For nonfamous faces, subjects produced naming responses (obviously erroneous) on just 3.7% of trials overall, with no significant difference between the younger (3.7%) and older (3.6%) age groups ($F<1$), as previously observed [15]. The data from nonfamous faces will not be discussed further.

Places. The accuracy results for naming capital cities from their countries are summarised in Table IIc. The under 65s produced more correct and error responses than the over 65s, but neither difference was significant. The over 65s produced more no responses than the under 65s, and this difference approached significance.

Correct RTs

Analyses of naming latencies are usually based on each subject's overall mean correct response time (RT) in each task. It was decided not to follow this procedure here because of differences in accuracy between the two age groups, particularly for objects and people. Note that the means of correct RTs for more successful subjects would reflect, on average, more difficult stimuli than the means for less successful subjects. Instead, as a first step in analysing RTs, correlations were performed between age and the mean of the fastest m correct RTs for each subject, where m = the number of correct RTs produced by the least accurate subject in that task. The values of m were 11, 4, and 3, for the objects, people, and places tasks, respectively. In other words, all subjects produced at least 11 (objects), 4 (people), and 3 (places) correct RTs.

The correlations with age were as follows: Objects, $r=.398$, $p<.01$; People, $r=.486$, $p<.01$; Places, $r=.320$, $p<.02$ (d.f.=53 in all cases). Thus, older subjects were significantly slower than younger subjects in all three tasks.

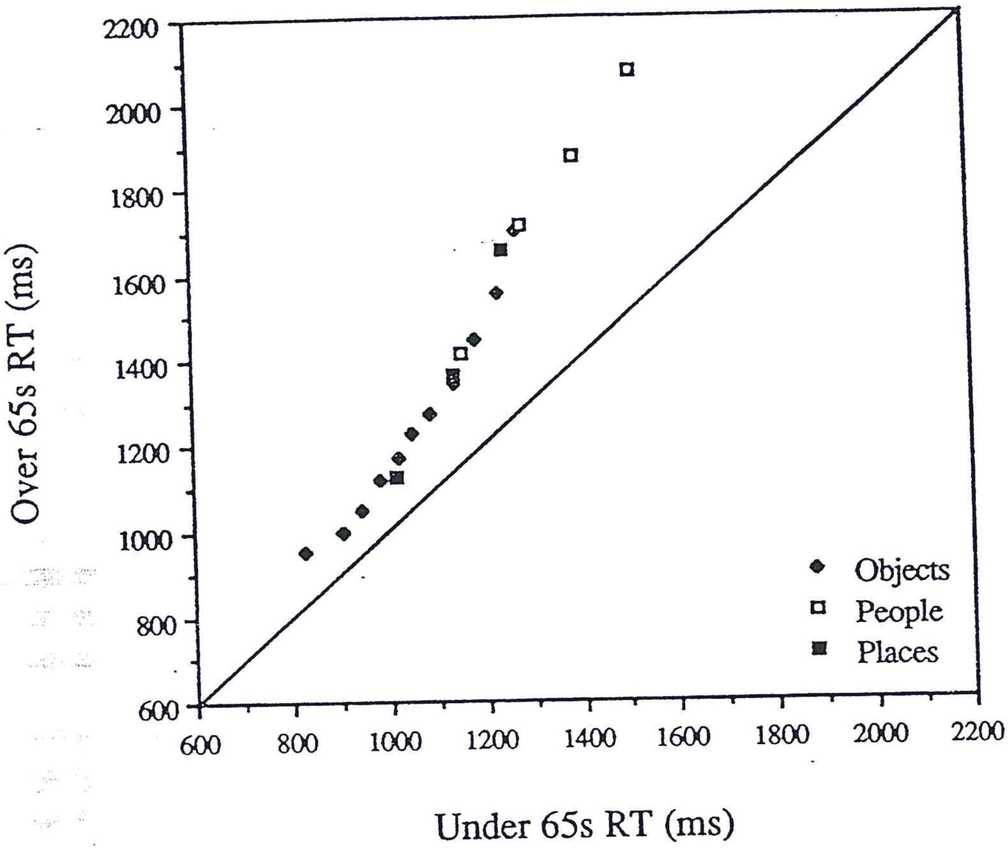
For each subject in each task, the individual correct RTs were then ranked in order from the fastest to the slowest response. The mean of the fastest correct RTs for the under 65s age group was plotted against the mean of the fastest correct RTs for the over 65s age group. This was repeated for the second-fastest RT produced by each subject, and so on, to produce a Brinley plot (see [41]) based on individual RTs rather than on mean RTs for each subject. Figure 1 shows the resulting scatterplots for objects (11 data points), people (4 data points), and places (3 data points). There are two features to emphasise: (1) The data from the three tasks fall approximately on a single function. (2) The slope of the function is greater than 1, i.e., the difference in RT between the two age groups increases from the fastest to the slowest RTs.

An analysis of variance was performed on the task for which there was a reasonable number of data points, namely, objects. Age group was the between-subjects factor (2 levels: under 65s and over 65s) and ordered RT (11 levels: from the fastest to the 11th-fastest response) as the within-subjects factor. The interaction between age group and RT 1-11 was highly significant ($F(10,530)=5.83$, $MSe=24088.67$, $p<.001$), indicating that the effect of age group increased with RT (from 121ms for the fastest RT to 425ms for the 11th-fastest RT). This confirms the second observation above, at least for the objects task.

To increase the numbers of data points on which to base analyses of variance for the people and places tasks, the least accurate subjects from each age group were excluded. By dropping just 6 subjects per group for people, and 7 subjects per group for places, it was possible to increase *m* to 11 for people and to 13 for places. These particular numbers were chosen because they seemed to provide the best compromise between maximising the numbers of responses and minimising the loss of subjects. The means are presented in Figure 2 [Footnote 4]. Again, it appears that: (1) The data from the two tasks form a single function. (2) The function slopes away from the diagonal with increasing RT, i.e., the difference between the two age groups increases from the fastest to the slowest RTs.

Figure 1

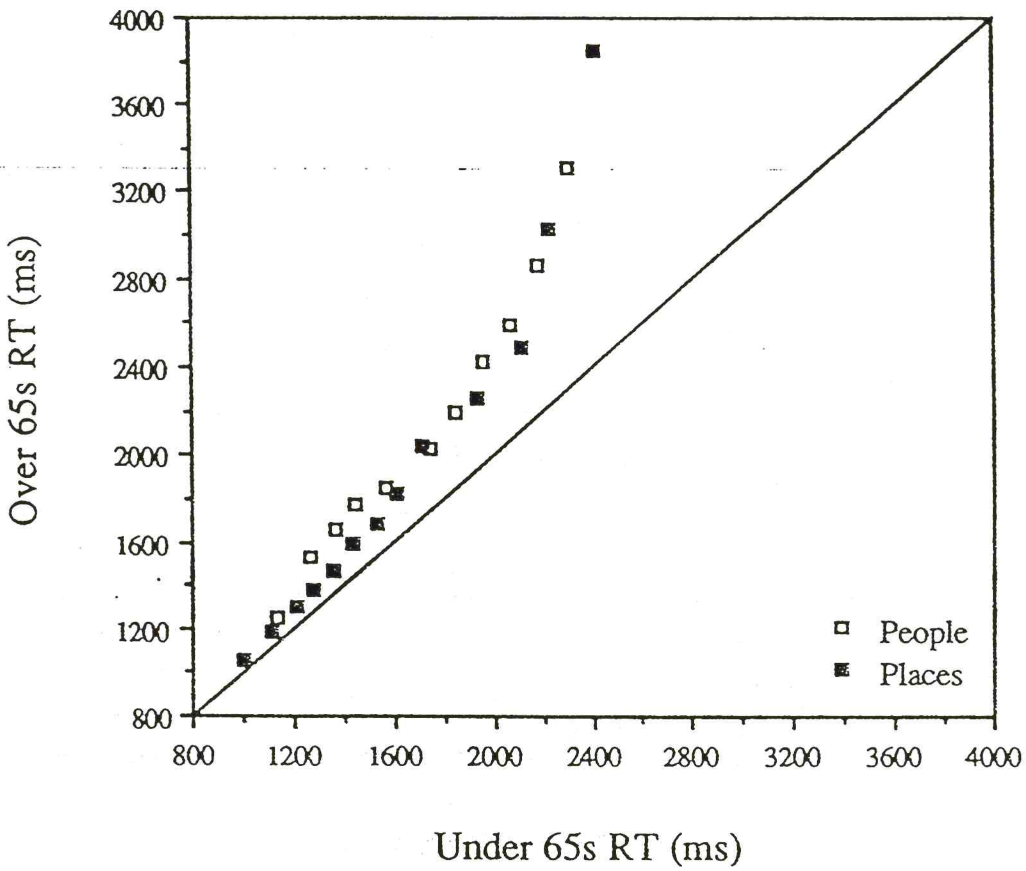
Means of the fastest 11 (objects task), 4 (people task), and 3 (places task) correct response times (RTs) for the under 65s age group plotted against the corresponding means for the over 65s. (Data from 55 subjects.) The solid line shows the line of equality (y=x).



Analyses of variance were performed with age group as the between-subjects factor (2 levels: under 65s and over 65s) and ordered RT (11 levels for people and 13 levels for places: from the fastest to the 11th- or 13th-fastest response) as the within-subjects factor. In both cases, the interaction between age group and ordered RT was highly significant ($F(10,410)=3.34$, $MSe=196342.87$, $p<.001$, for people; $F(12,468)=3.01$, $MSe=515283.38$, $p<.001$, for places). Thus the effect of age group increased from 117ms for the fastest RT to 1012ms for the 11th-fastest RT for people, and from 53ms for the fastest RT to 1428 for the 13th-fastest RT for places, consistent with the second observation above.

Figure 2

Means of the fastest 11 (people task), and 13 (places task) correct response times (RTs) for the under 65s age group plotted against the corresponding means for the over 65s. (Data from 43 subjects in the people task, and from 41 subjects in the places task.) The solid line shows the line of equality (y=x).



DISCUSSION

To summarize the main findings:

(1) Accuracy. Older subjects were less successful in naming objects from line drawings, people from photographs, and capital cities from countries, although the age effects in the third task did not reach significance. The age differences in terms of percentages correct were at least as large for common names (13.76% for objects) as for proper names (13.54% for people; 7.74% for places). In the objects task, both perceptual and semantic errors increased with age, whereas errors were unaffected by age in the people and places tasks.

(2) Correct RTs. In all three tasks, mean RT increased significantly with age. Comparing the under 65s with the over 65s, the difference between the groups increased from the fastest to the slowest RT. Brinley plots based on rank ordered RTs for each subject produced a similar function for objects, people and places.

There are several conclusions that can be drawn from this study. Clearly, the objects task provides further evidence for age-related decline in the ability to access information stored in semantic memory, both in terms of accuracy and speed. Two possible explanations can be discounted immediately. First, the impairment in accuracy cannot be attributed to visual problems alone because (i) perceptual errors were very rare, and (ii) semantic errors occurred more frequently in the older group, supporting the conclusion that "although the stimuli enable older individuals to access the semantic field of a given word, their ability to retrieve the precise word, within that field, is impaired with age" [20, page 177]; see also [42]. Second, an explanation for the decline in speed entirely in terms of peripheral factors (e.g., motor slowing) can be ruled out on the basis of the interaction between age group and ordered RT. It was noted that previous studies failed to find differential age effects for words of high and low frequency [2 & 25]. However, if the RTs from Mitchell's study [2] are compared with the data in Figure 1, the means for high and low frequency items correspond approximately to RTs 1 and 3. Note that the Brinley function is roughly parallel to the line of equality over this range. (Mitchell's stimuli were more common than those in the present study, with mean Kucera-Francis frequencies of 41.4 and 14.5 in his high and low conditions.) It is not clear why Thomas et al. [25], who produced a wider range of RTs (800-1200ms), did not observe an interaction between age group and frequency.

A third explanation for the present age deficits is that more of the stimuli were completely unknown to the older subjects than to the younger subjects. At least for the people task, this can be discounted because the age-related impairment was unaffected by the removal of the very small numbers of unfamiliar items.

In terms of 2-stage models with separate semantic and phonological lexicons (e.g., [43]), these effects of aging on name retrieval accuracy are consistent with the proposal of a particular deficit in access from a concept in a conceptually organized semantic store to a word in an orthographically and phonemically organized lexical store [42]. This contrasts with the reverse route from the word to the concept (as measured here by WAIS-R Vocabulary) in which age-related decline is not generally found.

Comparing the accuracy data across the three tasks in terms of percentages correct (see Table 2), there appears to be no evidence that access to proper names (people and places) is more impaired with respect to age than access to common names (objects). This seems contrary to self-reports, in which the elderly complain particularly about forgetting people's names [8].

However, if subjects base their ratings on incidences of name blocks, then this would be consistent with the present data viewed in terms of age differences in the percentages of "no responses" across tasks (6.15%, 12.34%, and 8.8%, for objects, people, and places, respectively). Note that there was a significant increase in errors with age for common names (particularly semantic errors) but not for proper names. As suggested earlier, older subjects may be less aware of retrieval problems for common names than for proper names because of the availability of possible alternatives for the former but not for the latter.

Within the category of proper names, age differences in accuracy were more reliable for people than for places. It should be noted that although the places task was always performed after the objects and people tasks, the final task in the session (which was similar to the people task) produced a highly significant age difference in the number of correct responses of 15% (statistically identical to that observed in the people task). This rules out a practice effect as the explanation for the observed relative sparing of place naming into old age. A more likely possibility is that the limiting factor on performance was different in the people and places tasks. It was clear from the semantic features data that the problem in the people task was one of access to, or retrieval from, semantic memory, whereas it appeared from subjects' comments afterwards that failures in the places task were due to ignorance (i.e., to the contents of semantic memory). Thus the correct capital city was often not produced because subjects were either genuinely mistaken (e.g., Sydney for Australia; Tel Aviv for Israel), or had never before encountered the name of the capital city (e.g., Lima for Peru). Certainly, it would be premature to take the present differential effect of age on people and place naming accuracy as supportive evidence for the fractionation of the proper name category proposed by others [35].

Turning to the correct RTs, in the present study Brinley plots were based on individual RTs ordered from the fastest to the slowest in each condition, which is the equivalent of plotting percentiles. Recent studies by Myerson and his colleagues have compared Brinley plots of average RTs from tasks varying in complexity with those based on faster (e.g., 25th percentile) and slower (e.g., 75th percentile) RTs of the distributions [44-46]. The data from lower, middle and upper percentiles all appear to fall along the same function. In other words, when task difficulty is manipulated, either between or within tasks, the effect is simply to move the data along the same function relating old and young RTs. This suggests that the RTs of older adults can be predicted from the corresponding RTs of younger adults without regard either to the nature of the task or to the level of performance.

General models of cognitive slowing with age, such as the proportional [28], overhead [47], and information-loss [30] models have this characteristic in common, but they differ in terms of the precise nature of the mathematical function relating old and young RTs (linear, quadratic and exponential, respectively). Note that, in all cases, faster responses are less adversely affected by age than slower responses, the function sloping or curving away from the diagonal with increasing RT.

The data shown in Figures 1 and 2 provide further support for general age-related cognitive slowing from three different tasks within the lexical domain (see also [48]). Thus a single function accounts for the retrieval of both common names (objects) and proper names (people and places), with age differences increasing significantly with RT. Regarding the exact nature of the function, there are probably insufficient data in the present study to distinguish statistically between the various models. However, the hint of some positive acceleration for the function in Figure 2 replicates an earlier study [31] in which similar nonlinearity in name retrieval was discussed in terms of a distinction between two modes of word retrieval: a rapid automatic phase followed (if necessary) by a slower voluntary search phase [49]. It is suggested that there may be a shift from the former to the latter with increasing age. In other words, the elderly retrieve fewer names immediately and experience a greater number of TOT states. Age-related slowing appears to be linear for the fastest responses produced (see Figure 1). In contrast, slower responses are more likely to be resolved TOT states, as opposed to automatically accessed names, for the older subjects than for the younger subjects, resulting in nonlinearity over a wider range of RTs (see Figure 2).

To conclude, the present study suggests that age-related naming impairments apply equally to common and proper names. Effects on accuracy can be observed even if age groups are matched on a standard estimate of information stored in semantic memory or crystallised intelligence (i.e., WAIS-R Vocabulary). Finally, the analyses of naming latencies demonstrate that principles derived previously from the nonlexical domain (e.g. [47]) can be extended to the lexical domain.

Acknowledgements : The experiments reported in this article were conducted while the author was funded from a grant awarded to Professor P. M. A. Rabbitt from the Medical Research Council and the Economic and Social Research Council of Great Britain (grant number PG8612638). I am grateful to Andy Fairhurst for drawing the stimuli, to Alison Jones for help with the testing of subjects, and to Tim Valentine for the loan of equipment and computer programs. *Correspondence concerning this article should be addressed to the author at the MRC Applied Psychology Unit, 15 Chaucer Road, Cambridge, CB2 2EF.*

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FOOTNOTES

Footnote 1. The deleted subject was a University graduate who took early retirement from a teaching position. He performed below average for the under 65s age group on the present tasks (generally more than 2 and sometimes more than 3 standard deviations below the mean). Although he had the highest Culture Fair score (41), an average WAIS Vocabulary score (53), and average processing speed (261), his scores on all the memory tasks from previous testing sessions were found to be abnormally low for his age group. For example, his free recall score of 4 was more than 2 standard deviations below the mean.

Footnote 2. Error analysis was based on the categories used by Albert and colleagues [20].

Footnote 3. There were too few errors to justify separate analyses of perceptual and semantic errors.

Footnote 4. Note that Figures 1 and 2 are not directly comparable because of the different numbers of subjects represented.

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Appendix A. Experimental stimuli - Objects.

pagoda
microscope
shuttlecock
daffodil
mitre
skeleton
xylophone
astronaut
penny farthing
stethoscope
igloo
sextant
mortarboard
guillotine
pyramids
tambourine
parachute
syringe
portcullis
typewriter
helicopter
camera
anchor
kangaroo
metronome
armadillo
lighthouse
periscope
anvil
rhinoceros

Appendix B. Experimental stimuli - Places.

Country (Stimulus)	Capital city (Response)
England	London
Norway	Oslo
Argentina	Buenos Aires
Vietnam	Hanoi
Czechoslovakia	Prague
America	Washington
Japan	Tokyo
Libya	Tripoli
Finland	Helsinki
Rep. of Ireland	Dublin
Kenya	Nairobi
France	Paris
Peru	Lima
Greece	Athens
Italy	Rome
Egypt	Cairo
Portugal	Lisbon
Iraq	Baghdad
Iceland	Reykjavik
China	Peking/Beijing
Denmark	Copenhagen
Ethiopia	Addis Ababa
Australia	Canberra
Russia	Moscow
South Korea	Seoul
Hungary	Budapest
Israel	Jerusalem