The Effects of Age, Educational Level, and Stimulus Length on Naming in Normal Subjects

Effets de l'âge, du niveau de scolarité et de la longueur du stimulus sur la dénomination chez les sujets normaux

Guylaine Le Dorze and Julie Durocher
École d'orthophonie et d'audiologie
Université de Montréal

Key Words: naming, aging, education

Abstract

A study was conducted on 136, normal, French speaking, independent adults in good health. Subjects were between 25 and 85 years of age, had a minimum of 4 years of education, and were divided into nine groups based on education and age. They were administered a naming task comprised of 40 monosyllabic, 40 bisyllabic, and 40 polysyllabic words. An analysis of variance on correct responses revealed significant main effects for age, educational level, and stimulus length (number of syllables). Significant interactions also were found between age groups and stimulus length and between educational level and stimulus length. The results are discussed in terms of a decline in the retrieval of phonological information from the lexicon associated with aging.

Résumé

Une étude a été menée auprès de 136 adultes autonomes, normaux, francophones, en bonne santé. Les sujets étaient âgés de 25 à 85 ans et comptaient au moins 4 années de scolarité. Ils ont été divisés en neuf groupes fondés sur la scolarité et l'âge. Chacun a reçu une tâche de dénomination comportant 40 mots monosyllabiques, 40 dissyllabiques et 40 polysyllabiques. Une analyse des différences dans le taux de réponse a révélé que l'âge, le niveau de scolarité et la longueur du stimulus (nombre de syllables) ont des effets importants sur l'exactitude des réponses. D'importantes interactions ont également été constatés entre les groupes d'âge et la longueur du stimulus ainsi qu'entre le niveau de scolarité et la longueur du stimulus. Les résultats ont été examinés relativement à la diminution au niveau de l'accès lexical associée au vieillissement.

Introduction

Anomia is a central feature of both aphasia (Goodglass & Kaplan, 1979) and the linguistic deficits of patients with senile dementia of the Alzheimer type (SDAT) (Bayles, Boone, Tomodea, Slauson, & Kaszniak, 1989; Bowles, Obler, & Albert, 1987). Clinical tools, such as the Boston Naming Test (BNT) (Kaplan, Goodglass, & Weintraub, 1983), have been developped in the English language for the assesment of anomia. These have been used clinically and in research for the study of anomia in both pathological and normal populations. Because similar instruments do not exist for the French language, one goal of this work was to obtain information on naming in normal French speaking subjects that could be used to study different language pathologies in this population. In developing a standardized test for anomia, one of the first objectives was to test a large number of normal individuals in order to determine the effects of age and educational level on their performance in a naming task. A second objective was to include a wide range of items varying in difficulty, similar to the BNT, so that the test could be used with patients with severe as well as mild anomia.

A frequent complaint of elderly individuals is the loss of the availability of words. Although some literature on naming ability in normal subjects exists, the phenomenon of word-finding difficulty is not well understood. Moreover, findings reporting the effects of age on naming have not been consistent. In many studies of normal individuals performing a picture naming task, significant differences have been reported between subjects in different age groups (Ardila & Rosselli, 1989; Bowles et al., 1987; Dordain, Nespoulous, Bourdeau, & Lecours, 1983; Farmer, 1990; Nicholas, Obler, Albert, & Goodglass, 1985). Other studies have reported only non-significant tendencies in the same direction (Borod, Goodglass, & Kaplan, 1980; Flicker, Ferris, Crook, & Bartus, 1987; Van Gorp, Satz, Kiersch, & Henry, 1986; Villardita, Cultrera, Cupone, & Mejia, 1985), while still others found neither significant differences nor tendencies (Béland & Lecours, 1990). These discrepancies in results may be attribuable to different methods of investigation, for example, differences in the definition of age groups and in the number of test items used. In the Nicholas et al. (1985) study, subjects were between 30 and 79 years of age, while Van Gorp et al. (1986) used subjects that were 59 to 80 years plus. The definition of the oldest group varied considerably across studies: Dordain et al. (1983) had subjects over the age of 50 as the oldest group; Ardila and Rosselli's (1989) eldest group was 76 years and up; and

Farmer (1990) had subjects between 60 and 69 years of age as the oldest group.

The number of stimuli used to test the effects of variables has differed across studies and possibly been insufficient in some of them. For example, the BNT was often used in its entirety (Borod et al., 1980; Farmer, 1990; LaBarge, Edwards, & Knesevich, 1986; Nicholas et al., 1985), but sometimes only a subset of items were selected. As a case in point, 15 items were used in the Villardita et al. (1985) study, 20 in the Flicker et al. (1987) study, and 60 items in the Van Gorp et al. (1986) study.

Nevertheless, when found to be significant, the effect of age has been interpreted by most authors as a sign of normal cognitive decline (Albert, 1984; Albert, Duffy, & Naeser, 1987; Obler & Albert, 1981). Few studies have investigated the possible causes of anomia in elderly subjects. However, a recent study by Au, Albert, and Obler (1989) suggests that the mild anomia in elderly individuals does not appear to be associated with a general decline of other cognitive processes. They based this conclusion on the results of a regression analysis showing a decrease with age in the involvement of different measures of memory, attention, and visual perception with naming scores. They interpreted these findings to mean that elderly subjects were experiencing an anomia of a linguistic origin, but they did not specify what "linguistic" meant in this particular context.

The effect of education on normal subjects' performance on a naming task has received much less attention in the literature. In some studies, researchers have reported the mean years of education of their subject groups (e.g., Nicholas et al., 1985). But in others, the education of the subjects could not be studied independant of age (e.g., Borod et al., 1980; Labarge et al., 1986). Nevertheless, some studies have shown significant effects of educational level on naming performance (Ardila & Rosselli, 1989; Au et al., 1989; Dordain et al., 1983; Nicholas, Brookshire, MacLennan, Schumacher, & Porrazzo, 1989). One study suggested that a high level of education can offset the effects of aging on neuropsychological tests (Bornstein & Suga, 1988).

Farmer (1990) has shown that years of education do not influence naming performance. This finding may be related to the relatively high level of education (mean 14.6 years) of the subjects in this study. Béland and Lecours (1990) also reported no effect of education on naming, but the variables of age and educational level were confounded in this study such that elderly subjects were less educated, while younger subjects were more educated. These variables were also confounded in a study by Speedie, O'Donnell, Rabins, Pearlson, Poggi, and Rothi (1990). They reported that subjects having a superior level of education performed less well than subjects with a lower level of education. In this study, however, the better educated subjects were older than the less educated subjects. This brief overview of studies suggests that it is important to take educational level as well as age into consideration when studying naming in elderly subjects. However, age norms for naming tests that have been published thus far have not controlled for the education variable.

Another variable influencing naming performance is the difficulty level of the naming task. The objective of the current study was to have a wide range of difficulty of test items. Variables such as word length, word frequency, and word familiarity can be used to define the difficulty level. For the French language there is no standardized set of pictures, such as the Snodgrass and Vanderwart (1980) collection in English, that includes word familiarity as a measurable dimension of the stimuli. Moreover, not all stimuli appropriate for a test appear in Beaudot's (1989) word frequency list—the most recent list for the French language compiled in Canada. Furthermore, the Beaudot list provides frequencies for written occurrences of words and not frequencies for pictures. This may explain why the Beaudot list is incomplete for the type of stimuli required by a naming task.

Because familiarity data was unavailable and because word frequency alone would not define the level of difficulty of all of the stimuli, word length was chosen as a measure of item difficulty. Although a crude measure, this choice was also motivated by the observation that word length and word frequency are correlated with one another (Zipf, 1974). Moreover, in one study that tested the effects of this variable on normal subjects a significant correlation was found between naming latencies and stimulus length (Caroll & White, 1973). Word length is also one of the variables known to affect the performance of aphasic individuals on a naming task (Goodglass, Kaplan, Weintraub, & Ackerman, 1976; Howard, Patterson, Franklin, Morton, & Orchard-Lisle, 1984; Venus cited in Williams, 1983). Based on previous literature, it was hypothesized that all three variables, age, educational level and word length, would influence the number of correct responses adults would make on a confrontation naming task.

Method

Subjects

One hundred and forty-three (143) normal healthy subjects residing in their own homes were recruited to participate in the study. They had a minimum of 4 years of education and were between 25 and 85 years of age. They were native speakers of Québec French and had sufficient vision to read newsprint. They answered a questionnaire on their health, including questions on their vision, neurological disease, and any other health problems. Subjects reporting to be under medication for hypertension, diabetes, or heart disease were not excluded from the study. Subjects reporting neurological problems were excluded, as well as one subject reporting cataracts. Subjects were not specifically screened for dementia or hearing impairment.

In order to study the effects of age and educational level, 9 groups of subjects were defined. There were three age groups : (1) young subjects, between 25 and 44 years of age; (2) middle-aged subjects, between 45 and 64 years of age; and (3) elderly subjects, between 65 and 85 years of age. There were three levels of education: (1) low, 4 to 10 years of education, which corresponds to an incomplete elementary or high school degree; (2) intermediate, 11 to 15 years of education, which corresponds to a completed high school degree plus some years in college; and (3) high, 16 years of more of education, which corresponds to a completed university degree.

Table 1 presents the number of male and female subjects in each of the groups defined by age and educational level. A minimum of 5 female and 5 male subjects were included in each group for a total of 71 females and 65 males. Table 1 also presents the mean ages and the mean number of years of education for each group. The mean ages did not differ significantly for the three young groups ($F(2)= 1.89$, $p > 0.10$), the three middle-aged groups ($F(2)= 1.54$, $p > 0.10$), and the three elderly groups ($F(2)= 0.50$, $p > 0.10$). Mean years of education did not differ for the three low level groups ($F(2)= 2.01$, $p > 0.10$), for the three intermediate groups ($F(2)= 0.04$, $p > 0.10$), and for the three high groups ($F(2)= 2.64$, $p = 0.08$).

Table 1. Mean age, mean education in years and standard deviations (in parentheses), and number of females and males in each subject group.

	Educational Level		
Age	Low	Intermediate	High
Young Group			
age	36.2 (4.9)	35.1 (4.9)	31.9 (5.6)
education	8.8 (1.8)	13.0 (1.3)	18.4 (1.3)
female/male	5/5	11/8	7/7
Middle-aged Group			
age	53.1 (6.7)	55.2 (5.3)	51.6 (6.7)
education	7.7 (2.0)	13.0 (1.4)	19.8 (2.7)
female/male	7/9	8/6	10/8
Elderly Group			
age	72.0 (5.1)	73.8 (6.4)	73.6 (5.7)
education	7.5 (1.7)	12.8 (1.6)	18.6 (1.4)
female/male	10/12	7/5	6/5

Materials

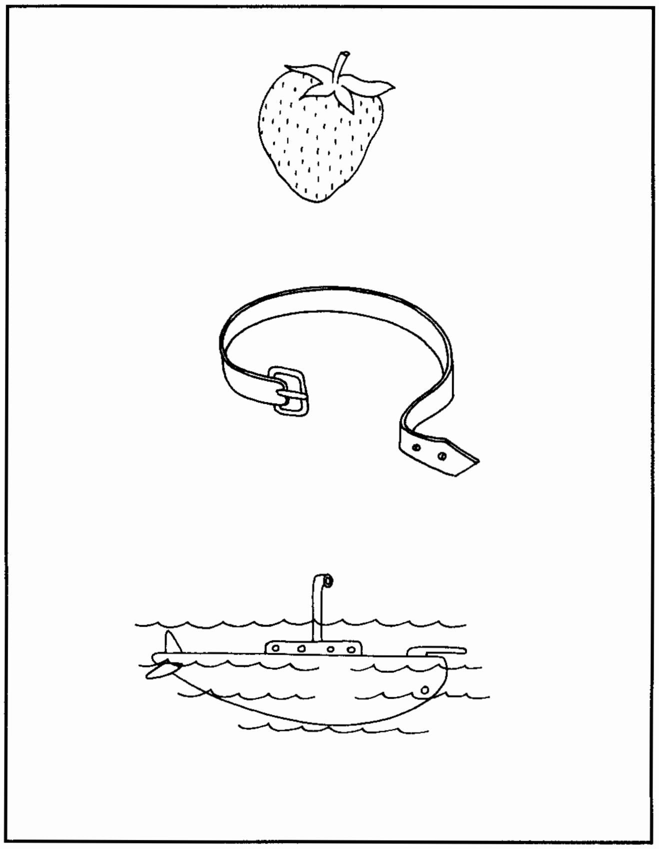
The subjects were administered a naming task consisting of 120 unambiguous line-drawn stimuli 40 of which were associated with monosyllabic words, 40 with bisyllabic words, and 40 with polysyllabic words (3 or 4 syllables). Examples are provided in Figure 1. Care was taken in the selection of stimuli to exclude synonyms. The order of presentation of the stimuli was randomly determined.

Procedures

Data collection

First, information was given to each subject concerning the objective of the study and a consent to participate was

Figure 1. Examples of stimuli: fraise (monosyllabic), ceinture (bisyllabic), sous-marin (polysyllabic).



obtained. Next, the general health questionnaire was completed. Then, testing was undertaken. Subjects were tested in French. They were instructed to name each picture. They were told that 5 seconds would be allowed for a response. The 5 second time limit was chosen to keep testing time to a minimum. The entire session was recorded with a Sony TCM-5000 tape-recorder. An orthographic and phonetic transcription[1] of the verbatim responses of each subject was made following the testing.

Data coding

Two researchers verified all of the transcriptions independently by comparing the audio tape to the written transcript. Disagreements were resolved with a third listener. Then, the researchers identified the five second boundary for each stimulus with a stopwatch and coded the first response produced within the five second boundary as follows: (1) correct response, (2) visual error, (3) phonological error, (4) circumlocution, (5) lexical substitution, and (6) other response, including no response, hesitation, and comment. Each of these major categories was further subdivided into subcategories for a total 30 different response types. Further detailed studies of error types would thus be possible.

For the purposes of this study, only the total number of correct responses was considered. The definition of a correct response included: immediate correct response, delayed correct response (defined as a response produced after 3 seconds but before 5 seconds), adequate synonym, and elaborate correct response (self-corrected response and correct response with a personal comment, such as "c'est pas facile, ça," [i.e.,"that one is not easy"]).

Reliability

Two coders were each responsible for approximately half of the subjects' responses. Inter-judge and intra-judge reliability of coding (of all of the different types of responses) was determined by a random selection of 20% of the subjects' responses with a unit-by-unit agreement index (A/A+D X 100%) (Hegde, 1987). Intra-judge reliabilty was assessed in this manner at two-week intervals. Agreement for coder 1 was 98% and for coder 2, 96%. Inter-judge reliability obtained from another randomly selected 20% of the subjects' responses (half coded by the first coder and half coded by the second coder) was 94%.

Analyses

Data was analysed with 3 X 3 X 3 analysis of variance procedure using age and educational level as independant variables and stimulus type as the repeated variable. Total number of correct responses was the dependant variable.

[1] Phonetic transcriptions were used mainly for vernacular expressions. For example, the stimulus "bague" (ring) is sometimes pronounced /baj/ rather than /bag/.

Table 2. Mean number of correct responses and standard deviations for each stimulus type for groups by age and education.

Stimulus type / Age Group	Educational Level: Low	Intermediate	High
	m (s.d.)	*m (s.d.)*	*m (s.d.)*
Monosyllabic			
Young	36.80 (2.4)	38.47 (1.4)	38.64 (1.3)
Middle-aged	34.50 (3.4)	37.79 (1.8)	37.56 (1.7)
Elderly	34.86 (2.9)	36.50 (2.3)	35.64 (2.9)
Bisyllabic			
Young	36.40 (2.5)	38.11 (1.8)	38.21 (1.7)
Middle-aged	32.63 (3.5)	35.86 (3.2)	35.17 (3.3)
Elderly	30.23 (4.7)	32.92 (3.3)	32.55 (3.2)
Polysyllabic			
Young	30.30 (3.6)	35.89 (3.8)	35.64 (3.1)
Middle-aged	25.63 (3.5)	33.50 (4.1)	32.89 (3.8)
Elderly	24.86 (4.5)	29.33 (3.1)	28.55 (4.8)

Rejection level for all analyses was set at $p = 0.05$. When appropriate, post-hoc testing was done using Tukey's Honestly Significant Difference (HSD) test (Daniel, 1987). If sample sizes were unequal, the smallest n was used in the equation for calculating HSD (Daniel, 1987). Rejection level for these comparisons was also set at $p = 0.05$.

Results

Table 2 shows the mean number of correct responses for each stimulus type, age group, and educational level. Table 3 presents the ANOVA results for the main effects of age, educational level, and stimulus type.

Main effects

There was a significant main effect of age. Young subjects produced the most correct responses, followed by middle-aged subjects, and then by elderly subjects. Post-hoc tests revealed that all subject groups differed significantly from one another (HSD[n=43]=0.99, for comparisons with the young subjects; HSD[n=45]=0.97, for comparisons with the elderly subjects).

There was a significant main effect of education. Subjects with a lower educational level produced fewer cor-

Table 3. ANOVA results for age, education and stimulus type.

Main Effects	*m*	*sd*	*F*	*df*	*p*
	ANOVA Results				
Age			30.18	2, 127	.0000
Young	36.80	3.3			
Middle-aged	33.92	4.6			
Elderly	31.32	5.2			
Educational level			21.50	2, 127	.0000
Low	31.24	5.5			
Intermediate	35.72	3.9			
High	35.19	4.1			
Stimulus type			308.86	2, 254	.0000
Monosyllabic	36.72	2.7			
Bisyllabic	34.54	4.2			
Polysyllabic	30.65	5.6			

rect responses than subjects with an intermediate or a high level of education. Post-hoc testing revealed that the low group differed signficantly from the other two groups (HSD[n=43]=0.99, for comparisons with the high level group; HSD[n=45]=0.97, for comparisons with the intermediate group). The groups having an intermediate or a high level of education performed similarly.

The mean number of correct responses produced for the three stimulus types decreased significantly as the stimuli increased in length. Post-hoc tests revealed that all the comparisons between the pairs of means were significantly different (HSD=1.03).

Interactions

A significant interaction was found between age and stimulus type (see Table 4) ($F(4,254)$= 12.39, p=0.0000). All subject groups were affected by stimulus length in that fewer correct responses were produced as the length of the stimulus increased. This effect of length, however, was more pronounced as a function of age. Post-hoc tests revealed that all differences between means were significant with two exceptions: the monosyllabic versus bisyllabic words for the young subjects and the middle-aged versus the elderly subjects for the monosyllabic stimuli (HSD[n=43]=1.31, for comparisons involving the young subjects; HSD[n=45]=1.28, for comparisons involving the elderly subjects).

Table 4. Means for the significant interaction between age groups and stimulus types.

Age Groups	Stimulus types		
	Monosyllabic	Bisyllabic	Polysyllabic
Young	38.14	37.74	34.51
Middle-aged	36.60	34.52	30.65
Elderly	35.49	31.51	26.96

Table 5. Means for the significant interaction between educational level and stimulus types.

Educational level	Stimulus types		
	Monosyllabic	Bisyllabic	Polysyllabic
Low	35.15	32.31	26.25
Intermediate	37.73	36.02	33.40
High	37.42	35.49	32.67

There was a significant interaction between stimulus type and educational level ($F(4,254)$= 15.21, p=0.0000) (see Table 5). For each of the educational level groups, a signficant decrease in the number of correct responses occurred as the stimulus increased in length. This effect was more pronounced for the subjects with a low level of education. Subjects with an intermediate or a high level of education did not differ significantly from one another, although both groups demonstrated sensitivity to word length. Post-hoc tests revealed that all of the pairs of means were significantly different except between the intermediate and high education groups for all of the stimuli (HSD[n=43]=1.30, for comparisons involving the high educational group; HSD[n=45]=1.28, for comparisons involving the intermediate educational group).

The interaction between age and educational level was not significant ($F(4,127)$= 0.78, p=0.54). The three-way interaction between age, education, and stimulus length also was not significant ($F(8,254)$= 0.96, p=0.47).

Further Examination of the Effects of Stimulus Length

In order to further understand the effect of stimulus length, post-hoc correlational analyses with word frequency were performed. Frequency values were attributed to each one of the 120 stimuli on the basis of Beaudot's (1989) list and converted into logarithmic values (log(10)) based on the finding that there is a linear relationship between naming

Table 6. Correlational analyses (*r* values) between word frequency, word length and the number of correct responses produced by the three age groups.

	Length	Frequency	Young	Middle-aged	Elderly
Length	1.0	-0.45	-0.25	-0.28	-0.32
Frequency		1.0	0.38	0.41	0.46

latencies and log(10) frequency (Oldfield & Wingfield, 1965). Twenty-five stimuli (1 monosyllabic, 10 bisyllabic, and 14 polysyllabic) not appearing in Beaudot's list were attributed the frequency of 0.5, a value that allowed us to calculate the logarithm for these stimuli.[2] The number of correct reponses produced by each age group for each of the 120 stimuli was then assessed. Pearson's product-moment correlations were calculated and are presented in Table 6. All correlations were statistically significant (N=120, r= 0.17, p=.05).

Discussion

The results of this study revealed significant main effects of education, stimulus length, and age, as well as significant interacting effects of age and stimulus length and of educational level and stimulus length on naming in a sample of 136 French speaking subjects. These findings are discussed under the following broad headings: (1) the effects of education, (2) the effects of stimulus variables, and (3) the effects of age. Theoretical issues concerning the nature of aging are addressed along with some clinical applications of the findings.

The Effects of Education on Confrontation Naming

This research corroborates the results of other studies that demonstrate the effect of education on the performance of a naming task by normal subjects (Ardila & Rosselli, 1989; Au et al., 1989; Dordain et al., 1983; Nicholas et al., 1989). However, the results of this study show that only subjects with the lowest level of education (i.e., those not having completed high school) differed from the remaining two subject groups (intermediate and high education levels). This may indicate that the stimuli used in this study are relatively well known by individuals who have completed high school. The absence of an interaction between age and education suggests that, at least with respect to naming, a higher level of education does not offset the effects of aging, which has been suggested by Bornstein and Suga (1988). While educational level is an important variable to consider when examing naming scores, it may only be crucial in distinguishing subjects with a lower level of education.

It is possible that variables other than education influenced a subject's performance. For example, an individual's investment in language skills as measured by reading habits might affect performance and might compensate for a lower level of education. Level of employment may be a variable to consider. There may be differences associated with the type of employement (white collar versus blue collar). Further studies should examine these possibilities.

The Effects of Stimulus Variables on Confrontation Naming

Stimulus length was found to be a significant variable. Increased stimulus length, in terms of the number of syllables in a word, produced a significant decrease in the number of correct responses. This suggests that stimulus length is an index of difficulty. Item difficulty is, in all likelihood, not only due to length alone, but also relates to other stimulus variables, such as word frequency. The post-hoc correlational analyses showed that word length and word frequency were moderately correlated in this study. As well, both of these variables were associated, weakly to moderately, with the subjects' performance (i.e., fewer correct responses were produced for rarer and longer words). Because a number of the stimuli (i.e., those not appearing in the Beaudot list) were attributed a low frequency value there may be a certain bias in these results. The correlation found here between frequency and naming is smaller than that reported by Carroll and White (1973). Their correlations were r=0.57 for response latencies and word frequency (as defined by the Kucera and Francis [1967] word count) in young and college educated subjects. The subjects in this study were a more diverse group in terms of education and age, and the number of correct responses rather than latencies was examined. These factors may account for the differences in results.

The degree of correlation between subject performance and stimulus variables appears to be greatest for the oldest subject group. This suggests an increase in sensitivity with age to lexical variables of word frequency and word length. Taken together, these results are suggestive of changes in the processes of lexical retrieval with increasing age.

[2] We decided to attribute a near-zero value to the stimuli not appearing in Beaudot's frequency list for the French-language because a logarithmic value cannot be calculated for 0. We inferred that if a word was absent from Beaudot's 1,035,770 word list, it was infrequent.

The Effects of Aging on Confrontation Naming

These results for French speaking subjects support a number of previous studies demonstrating the effects of age in other populations (Ardila & Rosselli, 1989; Bowles et al., 1987; Dordain et al., 1983; Farmer, 1990; Nicholas et al., 1985). The age of our subjects varied across the adult life-span from 25 to 85 years. Such a wide age span was not employed in some studies that found no significant difference between groups (Labarge et al., 1986; Van Gorp et al., 1986; Nicholas et al., 1989). Other studies that did not find age effects (Béland & Lecours, 1990; Flicker et al., 1987; Villardita et al., 1985) used a smaller sampling of naming behavior, which could explain why significant differences were not found. It is also possible that test items were too simple or did not cover a sufficient range of difficulty.

Because our subjects were not screened specifically for dementia or hearing-impairement, a certain degree of caution must be exercised when considering this effect of age. Despite the fact that all subjects were living independantly, some of the elderly subjects may have been experiencing early manifestations of dementia. It is also possible that some degree of undetected hearing impairement also may have affected the general linguistic functioning of some subjects. These factors could explain why elderly subjects scored poorer than the other subject groups. However, there were also significant differences between the young and middle-aged groups suggesting that changes in naming may occur relatively early in adult life and that this may be a manifestation of the normal aging process. Villardita et al. (1985) found an erosion of some cognitive abilities in the area of memory, but not for naming, in a middle-aged group. Further studies are needed to determine more precisely at what age the decline in naming abilities is likely to begin in normally aging adults. It is also important to distinguish this decline from any type of communication impairment.

The underlying nature of the decline in naming can be addressed in the context of this study. Although no definitive answers are forthcoming, some light may be shed on this question. Confrontation naming can be conceived of as involving the activation of conceptual or semantic information concerning a particular object and the activation of phonological information about the word associated with the object. This separation of meaning (semantics) and sign (phonology or orthography), basic to linguistics (Lyons, 1970), translates into two different basic processes involved in lexical access, access to semantic and phonological representations. This basic dichotomy is present in current theories of information processing and memory (Klatsky, 1988), language production (Garrett, 1982), and anomia in aphasia (Lesser, 1989). Another important distinction is between *structure,* or the representation of information in long term memory, and *activation,* or the retrieval of information. This difference is also integrated and discussed in the previously cited theoretical models.

It appears unlikely that the decline in naming occurs because the representation of information is affected. Salthouse (1988) favours the view that the structural organization of semantic knowledge remains intact in aging. His review of the psychometric literature on vocabulary scores shows that receptive vocabulary increases with age. This observation may signify that, while information about words increases with age, naming failures occur because of a difficulty in the retrieval of the information. Support for this general idea also comes from a study of spontaneously occurring tip-of-the-tongue (TOT) episodes in adults (Burke, Worthley, & Martin, 1987). These authors found that TOTs happened more frequently in older subjects for object names and for polysyllabic words. They concluded that this difficulty constituted a retrieval problem because spontaneous recovery was frequent (i.e., subjects found the words at a later moment in time).

Although speculative, we also propose that our older subjects were experiencing more retrieval failures rather than problems related to degraded representations. The greater sensitivity of the elderly subjects to the effects of word length may reflect their decreased ability to retrieve phonological representations in the lexicon. This inference is based on the idea that word length information is presumably stored in phonological representations (Garrett, 1982).

In this study, other stimulus variables, specifically related to semantic retrieval, were not examined. Thus we cannot rule out the possibility that semantic retrieval becomes problematic with aging. More studies of stimulus variables related to semantic retrieval, such as word familiarity, are needed in order to explore this possibility.

It is possible that if subjects had been allowed more time to respond, older subjects may have been capable of producing more correct responses. Further studies could measure the time involved in confrontation naming to determine if aging causes only a slowing in the process of naming. A study of production errors will also allow the examination of this issue in that different error types may reflect different problems with the naming process. For example, delayed correct responses may be due to a slowing of retrieval, while circumlocutions might reflect a problem in phonological retrieval. It would also be useful to compare the errors produced by healthy individuals with those produced by persons with aphasia and persons with cognitive impairment. Similar or different proportions of error types to one or the other of these clinical populations may also help in indicating more precisely the cause of naming problems.

Clinical Applications

The stimuli used in this study could be used eventually for the clinical examination of anomia in French speaking Canadians. The data from these normal subjects provide norms for comparison with other clinical populations. It is important that both education and age are considered in clinical studies. Moreover, studies of the reliability and validity of the stimuli and procedures used in this study need to be undertaken. All of these factors need to be considered in the development of an instrument for the diagnosis of language impairment in French speaking Canadians. It is hoped that this study has made a significant first step in advancing this goal.

Acknowledgements
We thank Chantal Pitts and Geneviève Boivin for their assistance in data collection, Francine Giroux for her help in data analysis, and Brigitte Rolland for the preparation of the stimuli. Thanks is extended to the subjects who participated. Helpful comments on the manuscript given by John Ryalls and JSLPA reviewers were also appreciated. This research was supported by CAFIR (Comité d'Attribution des Fonds Internes de Recherche) funds of the University of Montréal and by the FRSQ (Fonds de la Recherche en Santé du Québec) through a team grant to the first author (#901448) and a scholarship to the second author.

Address all correspondence to: Guylaine Le Dorze, Ph.D., Ecole d'orthophonie et d'audiologie, Faculté de médecine, Université de Montréal, C.P. 6128, succ. A, Montréal, Québec H3C 3J7 Canada.

References

Albert, M. (1984). Assessment of cognitive function in the elderly. *Psychosomatics, 25,* 310-317.

Albert, M., Duffy, F. H., & Naeser, M. (1987). Nonlinear changes in cognition with age and their neuropsychologic correlates. *Canadian Journal of Psychology, 41,* 141-157.

Ardila, A., & Rosselli, M. (1989). Neuropsychological characteristics of normal aging. *Developmental Neuropsychology, 5,* 307-320.

Au, R., Albert, M. L., & Obler, L. K. (1989). Language in normal aging: Linguistic and neuropsychological factors. *Journal of Neurolinguistics, 4,* 347-364.

Bayles, K. A., Boone, D. R., Tomodea, C. K., Slauson, T. J., & Kaszniak, A K. (1989). Differentiating Alzheimer's patients from the normal elderly and stroke patients with aphasia. *Journal of Speech and Hearing Disorders, 54,* 74-87.

Beaudot, J. (1989). Liste de fréquence des mots en français écrit contemporain. Document inédit. Montréal: Université de Montréal.

Béland, R., & Lecours, A. R. (1990). The MT-86 B Aphasia Battery: A subset of normative data in relation to age and level of school education. *Aphasiology, 4,* 439-462.

Bornstein, R. A., & Suga, L. J. (1988). Educational level and neuropsychological performance in healthy elderly subjects. *Developmental Neuropsychology, 4,* 17-22.

Borod, J. C., Goodglass, H., & Kaplan, E. (1980). Normative data on the Boston Diagnostic Aphasia Examination, Parietal Lobe Battery, and the Boston Naming Test. *Journal of Clinical Neuropsychology, 2,* 209-215.

Bowles, N. L., Obler, L. K., & Albert, M. L. (1987). Naming errors in healthy aging and dementia of the Alzheimer type. *Cortex, 23,* 519-524.

Burke, D., Worthley, J., & Martin, J. (1987). I'll never forget what's -her-name: Aging and tip-of-the-tongue experiences in everyday life. In M. M. Grunberg, P. E. Morris & R. N. Sykes (Eds.), *Practical aspects of memory: Current research and issues* (Vol. 2). New York: John Wiley & Sons.

Carroll, J. B., & White, M. N. (1973). Word frequency and age of acquisition as determiners of picture-naming latency. *Quarterly Journal of Experimental Psychology, 25,* 85-95.

Daniel, W. W. (1987). *Biostatistics: A foundation for analysis in the health sciences.* New York: John Wiley & Sons.

Dordain, M., Nespoulous, J.-L., Bourdeau, M., & Lecours, A. R. (1983). Capacités verbales d'adultes normaux soumis à un protocole linguistique de l'aphasie. *Acta Neurologica Belgica, 83,* 5-16.

Farmer, A. (1990). Performance of normal males on the Boston Naming Test and the Word Test. *Aphasiology, 4,* 293-296.

Flicker, C., Ferris, S. H., Crook, T., & Bartus, R. T. (1987). Implications of memory and language dysfunction in the naming deficit of senile dementia. *Brain and Language, 31,* 187-200.

Garrett, M. F. (1982). Production of speech: Observations from normal and pathological language use. In A. W. Ellis (Ed.), *Normality and pathology in cognitive functions.* London: Academic Press.

Goodglass, H., Kaplan, E., Weintraub, S., & Ackerman, N. (1976). The "Tip-of-the-Tongue" phenomenon in aphasia. *Cortex, 12,* 145-153.

Goodglass, H., & Kaplan, E. (1979). *The assessment of aphasia and related disorders.* Philadelphia: Lea and Febiger.

Hegde, M.N. (1987). *Clinical research in communicative disorders.* Boston: College-Hill Press.

Howard, D., Patterson, K., Franklin, S., Morton, J., & Orchard-Lisle, V. (1984). Variability and consistency in picture naming by aphasic patients. In F. C. Rose (Ed.) *Advances in Neurology,* *Vol. 42 : Progress in Aphasiology*. New York: Raven Press.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *The Boston Naming Test*. Philadelphia: Lea & Febiger.

Klatsky, R. L. (1988). Theories of information processing and theories of aging. In L. L. Light & D. B. Burke (Eds.), *Language, memory, and aging*. Cambridge: Cambridge University Press.

Kucera, H., & Francis, W. N. (1967). *Computational analysis of present-day American English*. Providence, R.I.: Brown University Press.

LaBarge, E., Edwards, D., & Knesevich, J. W. (1986). Performance of normal elderly on the Boston Naming Test. *Brain and Language, 27*, 380-384.

Lesser, R. (1989). Some issues in the neuropsychological rehabilitation of anomia. In X. Seron & G. Deloche (Eds.), *Cognitive approaches in neuropsychological rehabilitation*. Hillsdale, NJ.: Lawrence Erlbaum.

Lyons, J. (1970). *Linguistique générale* (F. Dubois-Charlier & D. Robinson, Trans.). Paris: Librairie Larousse. (Original work published 1968).

Nicholas, L. E., Brookshire, R. H., MacLennan, D. L., Schumacher, J. G., & Porrazzo, S. A. (1989). Revised administration and scoring procedures for the Boston Naming Test and norms for non-brain-damaged adults. *Aphasiology, 3*, 569-580.

Nicholas, M., Obler, L., Albert, M., & Goodglass, H. (1985). Lexical retrieval in healthy aging. *Cortex, 21*, 595-606.

Obler, L. K., & Albert, M. L. (1981). Language and aging: A neurobehavioral analysis. In D. S. Beasley and G. A. Davis (Eds.) *Aging communication processes and disorders*. New York: Grune & Stratton.

Oldfield, R.C. & Wingfield, A. (1965). Response latencies in naming objects. *The Quarterly Journal of Experimental Psychology, 17*, 273-281.

Salthouse, T. A. (1988). Effects of aging on verbal abilities: Examination of the psychometric literature. In L. L. Light & D. B. Burke (Eds.), *Language, memory, and aging*. Cambridge: Cambridge University Press.

Snodgrass, G. J. & Vanderwart, M. A. (1980). A standardized set of 260 pictures : Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory, 6*, 174-215.

Speedie, L., O'Donnell, W., Rabins, P., Pearlson, G., Poggi, M., & Gonzalez Rothi, L. J. (1990). Language performance deficits in elderly depressed patients. *Aphasiology, 4*, 197-205.

Van Gorp, W.G., Satz, P., Kiersch, M. E., & Henry, R. (1986). Normative data on the Boston Naming Test for a group of normal older adults. *Journal of Clinical and Experimental Neuropsychology, 8*, 702-705.

Villardita, C., Cultrera, S., Cupone, V., & Mejia, R. (1985). Neuropsychological test performances and normal aging. *Archives of Gerontology and Geriatrics, 4*, 311-319.

Williams, S. (1983). Factors influencing naming performance in aphasia: A review of the literature. *Journal of Communication Disorders, 16*, 357-372.

Zipf, E. B. (1974). *La psychobiologie du langage*. Paris: Retz.