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Effects of Age, Education and Gender on Verbal Fluency

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ABSTRACT

The objective was to study the effects of age, education and gender on verbal fluency in cognitively unimpaired, older individuals. The methods used were as follows: cognitively unimpaired elderly (55–84 years) subjects ($n = 153$), were administered category (animal) (CF) and letter (/pa/) (LF) fluency tasks, in their native language of Malayalam. Results and conclusions were (1) Level of education, but not age or gender, significantly influence LF. (2) Level of education (directly) and in the elderly subjects, age (inversely) affect CF. (3) Age, but not education, has a differential effect on the tasks of verbal fluency, influencing CF more than LF.

INTRODUCTION

Verbal fluency is a commonly used test in clinical and experimental neuropsychology. The tasks in verbal fluency are generally divided into two – category fluency (CF) and letter fluency (LF). They assess language functions (vocabulary size, naming), speed of response, mental organization, search strategies and long-term memory (Ruff, Light, Parker, & Levin, 1997). It is a popular test because it is easy and quick to administer, does not require reading or writing, and is sensitive to cognitive impairment from a variety of etiologies.

Verbal fluency deficits have been observed in patients with Frontal lobe damage (Benton, 1968), Parkinsons disease (Bayles, Trosset, Tomoeda, Montgomery, & Wilson, 1993), Schizophrenia (Allen, Liddle, & Firth, 1993), Subcortical Dementia (Cummings, 1994), Head injury (Goldstein et al., 1994), Huntington's disease (Rosser & Hodges, 1994), Vascular Dementia (Binetti et al., 1995; Cummings, 1994), and Alzheimer's disease (Binetti et al., 1995). It also differs between early Alzheimer's disease and normal controls (Eslinger, Damasio, Benton, & Van Allen, 1995) and is useful in identifying those individuals who are healthy (Masur, Sliwinski, Lipton, Blau, & Crystal, 1994), have age associated memory impairment (Hanninen et al., 1995), or Parkinson's disease (Jacobs et al., 1995), and are at a risk to develop dementia. Surprisingly, not many studies have investigated verbal fluency in normal individuals, especially in the elderly.

There are several variables that can affect verbal fluency – age, gender, education, language, ethnicity, and so forth. Most studies have found a consistently positive effect of education on verbal fluency (Benton, 1968; Crossley, Arcy, & Rawson, 1997; Kempler, Teng, Dick, Taussig, & Davis, 1998). The effects of gender, if any, are not yet clear and have varied from report to report. Lezak (1995) reported that women perform better than men on measures of verbal fluency. Crossley et al. (1997) found that older women performed better than men on letter but not on category fluency. Effect of language and ethnicity on

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category fluency have recently been studied by Kempler, Teng, Dick, Taussig, and Davis (1998) who compared subjects speaking Spanish, Vietnamese, Chinese, and English. They found that the Vietnamese speakers produced the most and Spanish the least number of animal names – an effect, related to the word length in the two languages.

In Indian subjects, variables that can influence verbal fluency include the level of literacy or education, the language in which fluency is tested (as the word-length in different languages varies), knowledge of more than one language – multilingualism (as many low-frequency words in one language (e.g., Malayalam) are altered forms or corruptions of some of the high-frequency words in another (e.g., Tamil), and the social setting of the subject-rural or urban (since the vocabulary and sometimes even the words used for the same object or expression differs). Another interesting issue that can be explored in the Indian population is the difference, if any, in the pattern of performance amongst the literate and the illiterate. Very few studies are available on verbal fluency in the Indian population. Ratcliff et al. (1998) investigated the effects of literacy and education on word fluency in a rural population from North India. Mahendra and Raksha (Personal Communication, 1996) studied generative naming in the young and the elderly controls in India and found a decrease in generative naming as a consequence of normal aging.

The diversity in the languages spoken, culture and educational abilities in the Indian population provides a good opportunity to understand more about verbal fluency and the various factors that affect it. This study was undertaken to investigate the effects of age, education and gender on verbal fluency in Malayalam, a language spoken in the southern state of Kerala.

METHODOLOGY

Subjects and Language

One-hundred and fifty-three elderly (55–84 years), urban, native speakers of Malayalam participated in this study. They were recruited (by a simple random procedure) from an ongoing community-based door-to-door survey of the elderly for estimating the prevalence of dementia and related disorders in an urban area in Kerala. As a part of this survey, all of them have undergone detailed clinical and neuropsychological evaluation. On a structured questionnaire, they gave no previous history of any cognitive complaints and showed education-adjusted normal performance on the Malayalam adaptation of the (global cognitive screening instrument-) Mini Mental Status Examination (Folstein, Folstein, & McHugh, 1975). Malayalam is a Dravidian language, which is orthographically regular, and has a very high phoneme-grapheme correspondence.

Materials and Procedure

For letter fluency, the subjects were instructed to generate verbally as many words as they could think, beginning with the Malayalam letter/pa/ (which is equivalent to the English letter 'P'), with the conventional restriction that proper nouns, numbers, and multiple forms of the same root word were not permitted. The letter /pa/ was chosen as there is a good proportion of high frequency words beginning with this letter in Malayalam. Responses were recorded verbatim. For category fluency, the subjects were asked to generate verbally as many animal names as possible, with the restriction that multiple forms (e.g., water-buffalo, wild-boar, etc.) of the same root word (buffalo, boar, etc.) were not permitted. On neither of the tasks were the subjects given examples using any other letter or category. Both the tasks were timed for 1 min. A credit of one point was given for each correct response. Trained personnel, who were fluent in Malayalam, administered the tests in the homes of the subjects.

Statistics

For the purpose of analysis subjects were grouped on the basis of gender (two groups), education levels (four groups) and age (three groups). Based on the total number of years of formal education that they had, each subject was categorized to one of the four, education groups: illiterate (0 years of formal education; $n = 22$), primary education (1–3 years; $n = 43$), upper primary and secondary (4–12 years; $n = 48$) and university (>12 years; $n = 40$). This type of categorization was used considering the system of education that existed in this part of India when the majority of the cohort in this study had received their education. The primary education prevailing at that time provided only a preliminary knowledge of alphabets and words and was often insufficient in equipping an individual to read or write a sentence. The upper primary and secondary education would impart an in-depth knowledge of languages (including grammar and vocabulary), science (which would include knowledge of animals) and arithmetic. University education was comparable to the

Table 1. Mean Scores on Letter (LF) and (Animal) Category (CF) Fluency in the Cohort and its Various Groups.

	n (M/F)	Mean (*SD*)			
		Age	Education	LF score	CF score
Overall demographics	153 (62/91)	66.94 (5.55)	7.24 (6.12)	5.53 (3.58)	7.84 (3.60)
Gender					
Males	62	67.27 (5.41)	8.72 (6.33)	6.12 (3.72)	8.30 (3.44)
Females	91	66.7 (5.66)	6.23 (5.79)	5.13 (3.44)	7.53 (3.69)
p		.43[a]	.03[a]	.592[b]	.530[b]
Edu. groups					
0	22 (7/5)	66.45 (5.82)	0 (0)	3.0 (2.85)	6.00 (2.83)
1–3	43 (15/28)	67.16 (5.65)	2.48 (0.63)	4.54 (3.21)	7.28 (2.83)
4–12	48 (16/32)	67.45 (4.99)	7.58 (3.05)	5.89 (3.83)	7.89 (3.94)
>12	40 (24/16)	66.35 (6.06)	15.92 (1.60)	7.55 (2.80)	9.42 (3.77)
p		.51[c]		.001[b]	.022[b]
Age groups					
55–64	50 (17/33)	61.44 (1.41)	7.78 (6.65)	5.60 (4.06)	8.32 (3.27)
65–74	85 (39/46)	67.83 (2.72)	7.1 (5.97)	5.73 (3.48)	7.98 (3.83)
75–84	18 (6/12)	78.0 (3.30)	6.38 (5.43)	4.44 (2.35)	5.83 (2.80)
p			.80[c]	.596[b]	.029[b]

Note. M/F, males/females; SD, standard deviation; edu., years of formal education; LF, letter fluency; CF, animal fluency.
[a]Independent Sample *t* test; [b]Univariate ANOVA; [c]Kruskal Wallis test.

current day university education. On the basis of age, all the participants were arbitrarily divided into three groups – 55–64 years ($n = 50$), 65–74 years ($n = 85$) and 75–84 years ($n = 18$). The range of each group consisted of 10 years. This type of grouping has also been used by Kempler et al. (1998). A decade-wise categorization was not done since it would make the sizes of the groups unequal as the age range of the cohort was 55–84 years. Means for education and age were compared between the different gender, age and education groups using Independent Sample *t*- test or Kruskal Wallis test. Letter and animal fluency scores between the different groups were explored using multivariate ANOVA (MANOVA) with age, gender and education as the fixed factors. Letter and category fluency were compared with each other by treating them as repeated measures (tasks) of verbal fluency in a 4-way repeated measure ANOVA (2 (types of task) $*$ 4 (education groups) $*$ 3 (age groups) $*$ 2 (gender groups)).

RESULTS

Of the 153 subjects, 62 (40.5%) were males. The mean (*SD*) age of the entire cohort was 66.94 ($\pm$5.55) years and education was 7.24 ($\pm$6.12) years. The mean (*SD*) scores on category fluency of the entire cohort was 7.84 ($\pm$3.60) and on letter fluency was 5.53 ($\pm$3.58).

Gender-wise Analysis

The mean age for females and males were comparable, although females had a significantly lower education than males (Table 1). They also had lower mean scores when compared to males on both, letter (5.13 vs. 6.12; $F(1, 152) = 0.68; p = .41$) and category (7.53 vs. 8.30; $F(1, 152) = 0.39$; $p = .54$) fluency tasks, although the differences were not statistically significant on MANOVA. Category fluency scores were significantly higher than letter fluency for both the groups.

Education-wise Analysis (Fig. 1, Panel A)

The mean age in the different education groups did not show any statistically significant difference. Scores on both, letter ($F(3, 152) = 12.96$, $p < .001$) and category ($F(3, 152) = 3.66$, $p = .014$) fluency showed significant differences on MANOVA. The scores on both the tasks increased as the education increased.

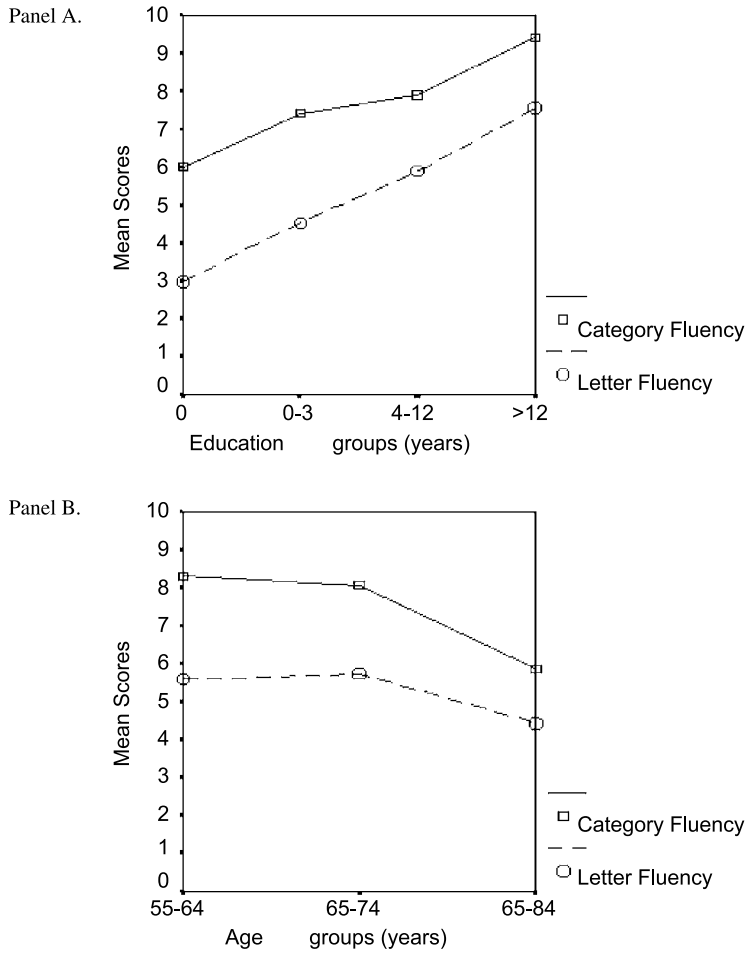

Fig. 1. The distribution of the means of the two verbal fluency tasks, letter and (animal) category fluency, across the different education (Panel A) and age (Panel B) groups.

Age-wise Analysis (Fig. 1, Panel B)

The mean education for the three groups was comparable. The letter fluency scores in the three groups did not show any statistically significant difference, $F(2,\ 152) = 2.74,\ p = .07$. On category fluency, however, with increasing age the scores were lower and the scores of the oldest age-group was significantly lower than that of the other two, $F(2, 152) = 5.19, p = .007$, on Manova.

Interactions of Education and Age With Verbal Fluency

A significant main effect of the verbal fluency task was seen (within-subject), $F(1,\ 152) = 350.30$, $p < .001$, with higher scores on category fluency compared to letter fluency. A significant interaction of the age groups on the type of task, $F(2,\ 152) = 3.96,\ p = .021$, was also seen. This was a consequence of the lower category fluency scores in the oldest age-group of 75–84 years.

DISCUSSION

A major consideration in the administration and interpretation of neuropsychological tests in any Indian population is the heterogeneity in culture, language and educational abilities. Even if a culturally and linguistically fair instrument is used, it is often difficult to eliminate the educational bias.

We had the advantage of testing the population in an Indian state that is relatively high in literacy (91%; Director of Census Operations Kerala, 2001). Even amongst people with no formal education, a good number of them have elementary reading and writing ability. The only other published study on verbal fluency on an Indian cohort was by Ratcliff et al. (1998). They studied 90 subjects between 34 and 55 years of age in a rural area in North India in a population that spoke Hindi, an Indo-European language, which, like Malayalam, has a high grapheme-phoneme concordance. The cohort was stratified based on education into 0, 5 and 10 years of formal education, with 30 subjects in each group. Animal fluency and initial phoneme (instead of initial letter) fluency were used. The tests were preceded by examples on both the tasks, provided by the raters.

The overall preponderance of females in the present study reflects the higher female to male ratio for the state of Kerala (Director of Census Operations Kerala, 2001). The mean scores on both category and letter fluency tasks were lower when compared to that with some of the other studies. While the reason for this is unclear, it is possible that the abstractness of the task (especially for the lower education group subjects) and the lack of examples/demonstrations before the formal testing may have contributed to this. Nevertheless, this needs to be investigated separately.

Effects of Gender on the Tasks

Lezak (1995) and Crossley et al. (1997) found that women outperformed men on verbal fluency, especially letter fluency. Kempler et al. (1998) found that men had better animal fluency than women. These gender-related differences in these studies (Crossley et al., 1997; Kempler et al., 1998; Lezak, 1995), have to be interpreted with caution since the groups were not adjusted for education, age or ethnicity. In the present study, women had lower education than men, a pattern universal to the Indian subcontinent and attributable to the prevailing cultural practices that limit educational opportunities for women. When controlled for age and education, no significant difference in the performance on either of the two tasks was found between men and women.

Effects of Education on the Tasks

In this study, a distinct trend for a graded increase in the score on letter as well as category fluency is seen with increasing education level even after controlling for age and gender. This clearly establishes that education has an independent and positive effect on both, letter and category fluency. This finding is perhaps explained by the benefits of education seen on language tasks in general as suggested by Neils et al. (1995). While education improves the performance on both the tasks, lack of significant interaction with the type of fluency task on repeated measure ANOVA suggests that it does not affect one task more than it does the other. Ratcliff et al. (1998) too found a significant effect of the level of education (higher education showing higher scores) on the verbal fluency scores. In contrast to the present study, however, they found a significant interaction of education with the type of task, resulting from the effects of education on the initial phoneme task (more than that on category fluency task). They suggest that this is the result of an association between phonological awareness and literacy (reading ability). The discrepancy between their study and the present study may be due to the differences in the task used (phoneme fluency vs. letter fluency), the language used for testing (Hindi vs. Malayalam), the ages of the two cohorts (younger (34–55 years) vs. older (55–84 years)) or to the difference in the literacy levels of the two populations (22% vs. 91%). The first two reasons seem unlikely since phoneme and letter fluency tasks are functionally similar, and the two languages are essentially regular with high phoneme-grapheme correspondence. It will be interesting to see if this difference in the interaction of education on verbal fluency tasks seen in these two studies can be reproduced in a well-designed study having both, younger and older subjects in the cohort. If this difference were real then it would mean that education has a differential effect on the two tasks of verbal fluency only in younger subjects. An alternate explanation lies in the difference in the literacy levels of the two populations. As stated earlier, although the number of years of formal education was low, the literacy level in the population from which the present study cohort

was taken was high. It is possible, therefore, that this high level of literacy may have negated the differential effect of education on the two verbal fluency tasks in this study.

Effects of Age on the Tasks

The cohort in the present study is mainly elderly with the mean age being more than 65 years. The result suggests that when controlled for education and gender there is no significant difference in the performance on the letter fluency task between the different age groups. This means that letter fluency function is probably resistant to age related changes. On the other hand, this study shows comparatively lower scores on category fluency in the age group of 75–84 years. This effect was also seen in the significant interaction between age and the type of task and was attributable to its effect on category fluency, more than that on letter fluency. Ratcliff et al. (1998) failed to find any interaction of age with the type of task. This is probably because their cohort did not have the subjects above the age of 55 years. Subjects above the age of 75 years in the cohort of Kempler et al. also show comparatively lower scores on category fluency (Kempler et al., 1998). A similar finding on confrontation naming ability was reported by Nicholas, Obler, Albert, and Goodglass (1985) in healthy adults above the age of 70 years. Thus, it appears, that irrespective of the level of education, category fluency is lower in the very elderly (>70-year-old) subjects when compared to those below that age. Nebes and Madden (1988) suggest that this effect is attributable to a general slowness that is age-related. If this explanation were correct, then one would expect the age-related slowness to also affect letter fluency, which was not the case in the present study. We feel that age related slowing, therefore, is unlikely to account for this finding.

Ability to name depends on the semantic stores of the individuals. 'Degradation of semantic stores,' as in AD (Binetti et al., 1995) or 'defect(s) in accessing and/or retrieving information from relatively intact semantic stores,' as in Vascular dementia, Parkinson's disease or Huntington's disease (Binetti et al., 1995; Cummings, 1994) have been proposed as the mechanisms leading to impairments on category fluency in disease states. Although it has been shown that in normal individuals, the effect of age on category fluency results from impaired naming abilities as age advances (Au et al., 1995; Nicholas et al., 1985) the exact mechanism(s) responsible for this is not clear yet. The differential effects of age (in cognitively unimpaired individuals) on the two tasks seen in this study, that is, category fluency being affected more than letter fluency, is similar to that reported in patients with dementia (Barr & Brandt, 1996; Chertkow & Bub, 1990). This could possibly suggest that the mechanisms may be similar in both, the disease and normal states. However, only a longitudinal study, investigating confrontation naming and category fluency in healthy subjects, will help in understanding the exact mechanism.

Comparison Between the Two Tasks

The finding, in this study, of higher scores on category fluency as compared to letter fluency is consistent with that of other investigators (Crowe, 1998; Monsch et al., 1992; Ratcliff et al., 1998). Rosser and Hodges (1994) suggest that the difference in performance on the two tasks are attributable to the differences in the type of cues available for search strategies employed in the two tasks. The search strategies utilizing semantic cues are thought to be more effective and faster than those employing phonological cues.

Results obtained from this study, consisting of an elderly cohort, cannot be extrapolated to younger subjects. On similar grounds, these results cannot be extrapolated to a rural population since the cohort in this study consisted mainly of urbanites. We feel this is an important factor because in our experience the vocabulary of the urban and the rural subjects in Malayalam, varies considerably, as in most other Indian languages. A comparison between the urban and rural population on verbal fluency tasks can clarify this issue. The low mean scores on both the fluency tasks in this study could have produced a 'floor effect.' This, however, has not affected the detection of the variance between the education groups. Although, it could have truncated the variance between the different age groups, other studies with higher mean scores have also failed to show significant age related variance, except for that above 75 years

(Kempler et al., 1998). This variance in the above-75 age group has also been reproduced in this study. We feel, therefore, that the low mean scores on the fluency tasks may not have been a serious limiting factor in detecting the variance in the various groups in this study. Other issues not addressed in this study include the clustering in category fluency and the influences of word length and mono and multilingualism on the performance on verbal fluency. These issues are relevant since the length of the word can affect the number of responses generated in a timed task, and because theoretically, performance on timed verbal fluency can vary between mono and multilinguals.

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