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SPONTANEOUS LANGUAGE PRODUCTION AND AGING: SEX AND EDUCATIONAL EFFECTS

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Sex and educational level effects on spontaneous language production at different ages were analyzed in a 180-normal subject sample taken from the general population. Subjects were divided into groups according to three variables: (1) age (16–30, 31–50, and 51–65 years), (2) educational level (3–7, 8–12 and more than 12 years of formal educational), and (3) sex (males and females) with 10 subjects in each cell. The oral description of the Plate #1 ("The Cookie Theft") from the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972) was selected. Number of nouns, verbs, adjectives, and grammatical connectors were scored for each subject's picture description. It was concluded that: (1) the ratio among different phrase elements was very uniform across age, educational level and sex groups; (2) the total number of words used to describe the "The Cookie Theft" picture significantly increased with the subject's educational level; (3) the amount of spontaneous language in general decreased with age; however, a significant interaction-effect between age and sex was observed. A steady and pronounced spontaneous language decrease across age-groups was observed in males. However, only mild differences across age-groups were observed in female subjects. It was hypothetized that language changes during aging are strongly sex-dependent: while in men spontaneous language rapidly decreases with aging, in women spontaneous language production remains quite well-preserved.

Keywords: Language, aging

Language represents an ability sensitive to normal, and specially, abnormal aging (Albert, 1988; Ardila & Rosselli, 1986; Bayles & Kaszniak, 1987; Cummings & Benson, 1983). Although vocabulary tends to increase well into the sixth decade of life, mild naming difficulties can be observed during the seventh decade of life (Albert, 1988; Bayles & Kaszniak, 1987). Using the Boston Naming Test scores (Kaplan, Goodglass, & Weintraub, 1983) as a measure of lexical knowledge, a significant effect of both age and level of education in normal elderly subjects has been observed (LaBarge, Edwards & Knesevich, 1986; Van Gorp *et al.*, 1986). Syntax may be preserved (Obler *et al.*, 1985), although age-related defects in comprehension of complex material can be found in elderly subjects (Ardila & Rosselli, 1986; Ulatowska, 1986). Verbal fluency decreases with age, particularly after the age of 70 (Ardila & Rosselli, 1989). Rosselli, Ardila, Florez, and Castro (1990) correlated age with the performance in the different subtests of the Boston Diagnostic Aphasia Examination in a normal population sample. They reported a correlation of 0.01 for Phrase Length, −0.20 for Word Discrimination, −0.13 for Body-Part Identification, −0.17 for Complex Material, −0.01 for Responsive Naming, −0.24 for Confrontation Naming, −0.18 for Animal Naming, 0.00 for Word Repetition, and −0.40 for Low-Probability Repetition subtests, pointing to the fact that aging has a quite different effect on different language functions.

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Performance in language ability tests is strongly associated with the subject's educational level (Ardila, Rosselli & Ostrosky, 1992; Finlayson, Johnson, & Reitan, 1977; Heaton, Grant, & Matthews, 1986; Lantz, 1979; Ostrosky *et al.*, 1985; Rojas-Drummond, 1988). This educational-level effect on language tests can be even more significant than the aging effect (Ardila & Rosselli, 1989; Rosselli *et al.*, 1990). Using verbal fluency (usually taken as the amount of words produced in a particular category within a time limit, most frequently, one minute) as a measure of language production, age, sex, and educational level have been observed to influence the performance in this test (Ardila & Rosselli, 1988; Benton & Hamsher, 1976; Rosselli, Ardila & Rosas, 1990; Wertz, 1979). Taking extreme educational levels, performance in verbal fluency tests in high-schooled adults has been observed to be around 18 items for semantic categories (animals and fruits), and 15 for phonological categories (F, A, and S) (Ardila, Rosselli & Puente, 1994); whereas performance in illiterate adults has been found to be around 12 items for semantic categories, and only four items for phonological categories (Rosselli, Ardila & Rosas, 1989).

Sex differences in language development and in language pathology have been established. Language development is believed to be usually faster in girls than in boys (Bradshaw & Nettleton, 1983); and language disorders are more frequent and severe in men than in women (Bradshaw & Nettleton, 1981). In general, males are found to do better than females on measures of spatial ability and mathematical aptitude (Benbow, 1988), whereas females excel over males in the area of verbal skill (Bryden, 1982). For several decades, it has been known that males are more likely to present developmental learning disabilities (particularly, developmental dyslexia, and developmental dysphasia) than females (Critchley, 1975; Languis & Naour, 1985). Several hypotheses have been proposed to explain this sex difference in language organization (e.g., McGlone, 1980; Geschwind & Galaburda, 1987), but none can be considered sufficiently tested and accepted. By the same token, a sex effect on the performance of verbal neuropsychological tests has been frequently reported. For instance, some sex differences in preadolescent children's naming ability (using the Boston Naming Test) have been observed; boys usually outperform girls in naming ability (Kindlon & Garrison, 1984; Halperin *et al.*, 1989).

Only a few studies have analyzed the spontaneous language production during normal aging. Obler (1980) studied the language production in the oral and written description of the "Cookie Theft" picture from the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972) in normal elderly adults. Two different styles of sentence constructions were found: abbreviated and elaborated. Subjects in their 60s were more likely to have fewer nouns per verb. Kemper (1987) studied the oral language production in the elderly between the age of 50 and 90 years. The author observed that the mean length of utterances did not change with age, but the syntactic constructions changed from left branching to right branching structures. Elderly subjects presented a superior recall for right-branching sentences and the supression of recall for left-branching propositions. She also observed a decrement in the amount of information elders could recall, and attributed this decrement to syntactic processing deficits associated with a high memory load. Kynette and Kemper (1986) reported age-related decrements in the degree of syntactic complexity in the spontaneous speech of older adults. They concluded that in advanced age, syntactic processing abilities decline to the degree they are associated with increase memory and attentional demands.

Effects of sex and educational level on language spontaneous production across age ranges doubtless deserve further analysis. The purpose of the present study was to analyze the effects of educational and sex variables on the spontaneous language production at different

age ranges. Spontaneous language production is usually included as a core test in the neuropsychological assessment of language functions (Lezak, 1983). However, normative data on spontaneous language production are usually not reported. One additional purpose of this study, in consequence, was to obtain some normative data on spontaneous language production at different ages, and for different sex and educational groups. A standard and frequently used spontaneous language neuropsychology test (picture description) was selected.

METHOD

Subjects

One-hundred and eighty normal subjects were selected and divided into groups according to three variables: (1) age (16–30, 31–50, and 51–65 years), (2) educational level (3–7, 8–12 and more than 12 years of formal educational), and (3) sex (males and females). The groups were balanced, and a $3 \times 3 \times 2$ design was obtained with 10 subjects in each cell. Although handedness distribution was not recorded, it has been estimated that in Colombia the prevalence of left-handeness in young (average age = 24.0; SD = 5.4) and schooled subjects is about 7.5% for males and 5.0% for females (Ardila, unpublished data). In older individuals, left-handedness is expected to be lower (Gilbert & Wysocki, 1992).

The criteria for inclusion in the sample were: (1) no neurological or psychiatric background; for this purpose, a neurological and psychiatric screening was done. And for subjects 60 years and older, additionally, (2) to perform adequately in everyday life activities, (3) to have a score equal or higher than 23 in the Mini-Mental State (Folstein *et al.*, 1975); and (4) no dementia according to the DSM-III-R (1987) criteria.

For screening purposes a special questionnaire was prepared covering the following areas: motor and sensory integrity, neurologic and psychiatric consultations, current medications, history of hospitalizations, alcohol or drug abuse, recent significant memory loss, and performance in daily activities. Only subjects with motor and sensory integrity, without any neurologic or psychiatric (including alcohol and drug abuse) history, and not impaired in the daily life activities were included in the sample. All subjects were Colombians, living in Bogotá (population about 5,500,000) and native Spanish-speakers.

Spontaneous Language Scores

Spontaneous language production during the oral description of the Plate #1 ("The Cookie Theft") of the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972) was scored. No time limit was established, but usually one-two minutes were enough to describe the picture. One single question was presented to the subjects ("Please, tell me all what is happening in this picture"). Language samples were audiotaped and/or transcribed in a written form by the examiner. The words used by the subjects in their oral narrative descriptions of the picture were classified into four categories: (1) nouns, (2) verbs, (3) adjectives, and (4) grammatical connectors (articles, pronouns, adverbs, prepositions, and conjunctions were included in this group). Word-order was not taken into consideration, because Spanish language relies on an extremely flexible word-order (Seco, 1989), and in consequence, word-order is not particularly informative, either in normals or in aphasic individuals. Number of verbs were expected to correlate with the number of phrases used in the description of the picture. Because of dealing with a normal population sample, no grammatical

errors were expected in our experimental subjects. In spite of the fact that Spanish, as an inflected language, encodes grammatical information not only in grammatical connectors, but also in bound morphological elements, for simplicity sake, we preferred to calculate the number of grammatical elements (nouns, verbs, adjectives, and connectors) rather than the number of different morphemes.

RESULTS

Mean frequency of phrase elements (nouns, verbs, adjectives, and grammatical connectors) in the different subgroups were calculated. In general, a decrease in the number of nouns, verbs, and connectors between extreme age groups was observed. However, number of adjectives was highly variable and somehow inconsistent in its distribution. The total number of words decreased with age in males. In females, the total number of words presents a U-shaped curve: decreased between the first and second age range, and increased between the second and third age range. The total number of words between males and females was roughly equivalent in the first two age ranges, but significantly higher in females in the third age range.

Differences in the total number of words were calculated for the different subgroups. The total number of words used to describe the picture was about 20% higher in females (average = 27.37 words) than in males (average = 22.83 words). It was 37% higher in youngest (average = 29.77 words) than in oldest subjects (average = 21.79 words); and it was 53% higher in the highest-educated (average = 34.50 words) than in the lowest-educated group (average = 18.42 words) (Table 2). That is, the total number of words increased with the subject's level of education, and in general decreased with aging.

Table 3 presents the F-values and level of significance for the total number of words used to describe the picture. All the three analyzed variables were significant across groups. Educational level variable was most significant ($F = 43.78$; $df = 2$; $p < .001$); and Age effect was the least significant ($F = 4.05$; $df = 2$; $p < .02$). Interaction between Age and Sex was statistically significant ($F = 6.04$; $df = 2$; $p < .005$). In other words, spontaneous

TABLE 1
Mean Frequency of Various Phrase Elements (Nouns, Verbs, Adjectives, Connectors) in Different Age, Educational Level, and Sex Subgroups

Age		16–30			31–50			51–65		
Educational level		3–7	8–12	>12	3–7	8–12	>12	3–7	8–12	>12
Nouns:	Males	6.82	7.16	10.27	5.70	5.99	8.59	4.05	4.29	6.09
	Females	5.90	9.34	8.84	4.41	6.98	6.61	5.78	9.16	8.66
Verbs:	Males	5.78	6.52	11.19	3.73	4.21	7.22	3.16	3.57	6.12
	Females	5.97	10.30	9.18	3.11	5.39	4.78	4.70	8.16	7.24
Adjectives:	Males	0.46	0.73	1.49	2.19	3.45	7.04	0.61	0.95	1.94
	Females	1.60	3.24	2.35	1.42	1.87	2.09	1.86	3.78	2.75
Connectors:	Males	9.48	11.20	14.35	5.91	6.98	8.94	5.22	6.17	7.91
	Females	8.32	12.00	16.13	6.10	8.84	11.85	8.28	8.70	11.62
Total:	Males	22.54	25.61	37.30	17.53	20.63	31.79	13.04	14.98	22.06
	Females	21.79	34.88	36.50	15.04	23.08	25.33	20.62	29.80	30.27

TABLE 2
Average Total Number of Words Used to Describe the Cookie Theft Picture in the Different Subgrups

	Males	Females	Average
Age			
16–30 yrs	28.48	31.06	29.77
31–50 yrs	23.32	21.15	22.23
51–65 yrs	16.69	26.90	21.79
Educational level			
3–7 yrs	17.70	19.15	18.42
8–12 yrs	20.41	29.25	24.83
>12 yrs	30.38	30.70	30.45

TABLE 3
F-values and Significance Level for the Total Number of Words

	Sum of Squares	*df*	Mean Square	*F*	*p*
MAIN EFFECTS					
A. Age	4608.67	2	2304.33	4.05	.02
B. Educational level	49876.74	2	24938.37	43.78	.001
C. Sex	6771.20	1	6771.20	11.89	.001
TWO-WAY INFRACTIONS					
A × B	2840.89	4	710.22	1.24	NS
A × C	6881.43	2	3440.71	6.04	.005
B × C	1835.23	2	917.61	1.61	NS
THREE-WAY INTERACTIONS					
A × B × C	1878.13	4	469.53	0.82	NS

language changes across age-groups was sex-dependent. No other interaction reached a statistical level of significance.

The ratios between different grammatical elements (nouns, verbs, adjectives, and connectors), and the total number of words were calculated (Table 4). The average description of the Plate # 1 of the Boston Diagnostic Aphasia Examination in the general population was composed by 24.60 words, including 6.94 nouns, 6.14 verbs, 2.21 adjectives, and 9.32 connectors. Different word classes did not change with age, education and sex.

DISCUSSION

This research study may present three important shortcomings that should be taken into consideration: (1) the sample was relatively small. It might be that the U-shaped distribution observed for females was an artefact of small number of subjects. A substantial individual variability in performance of narrative discourse production tasks in general has been observed, and between-subject variability is specially pronounced in the elderly (Albert, 1988; Bayles & Kaszniak, 1987). Consequently, the number of subjects may have been not large enough to neutralize this effect. (2) Only one single method for eliciting spontaneous language was used, and it may be introducing specific biases. However, when open ended questions are used (e.g., "Please, tell me about your job") very often only a

TABLE 4
Ratio between Different Phrase Elements and the Total Number of Words (TNW)

	Nouns/TNW	Verbs/TNW	Adjectives/TNW	Connectors/TNW
AGE				
16–30 yrs	0.271	0.274	0.055	0.400
31–50 yrs	0.287	0.213	0.135	0.364
51–65 yrs	0.291	0.252	0.091	0.366
EDUCATIONAL LEVEL				
3–7 yrs	0.295	0.239	0.074	0.392
8–12 yrs	0.288	0.256	0.094	0.362
>12 yr	0.268	0.250	0.096	0.386
SEX				
males	0.287	0.251	0.092	0.371
females	0.277	0.248	0.088	0.387

very limited amount of language is obtained (e.g., "it's O.K."), complicating any analysis. Using a complex picture and a compelling question ("Please, tell me *all* that is happening in this picture") a larger language sample can be expected. Analysis becomes easier. (3) Taking into consideration that a cross-sectional design was used, it is impossible to determine whether the changes observed are cohort effects or true age-associated changes.

However, despite these possible shortcomings, several points in our results deserve consideration.

A reduction in spontaneous language was observed across age groups. The number of words used by the oldest groups was only 63% of the total number of words used by the 16–30 year-old subjects. It may be expected that, if taking even older subjects, the decrease in spontaneous language production might been even more pronounced. Decrement in spontaneous language is already observed in 31–50 year-old subjects.

Spontaneous language was strongly educational level-dependent. The total number of words used to describe the Cookie Theft picture was about 50% higher in individuals with postsecondary education, than in low-schooled subjects. Within the ranges of the current research, educational level was an even more significant variable than age.

It is noteworthy that educational attainment correlates to a high degree with scores on standard tests of intelligence. This correlation ranges from about .60 to .70 (Matarazzo, 1979), and in consequence, it could be considered that correlations with educational level are in fact correlations with IQ. Correlations with verbal intelligence subtests are usually notoriously higher than correlations with performance intelligence subtests. However, it could be argued that psychometric measures of intelligence are strongly biased by our current schooling system. Albert and Heaton (1988) reported that, when education is controlled, there is no longer evidence of an age-related decline in verbal intelligence. In a country like Colombia, low educational levels are more often the result of economic limitations than academic failures, and it can be assumed that the correlation between educational attainment and general intelligence should be lower than it has been reported in more developed countries. However, not only psychometric, but also functional criteria of intelligence must be always considered (Pirozzolo, 1985).

According to our current results, it seems evident that language changes associated with aging follow a different pattern in males and females. While males presented a steady and permanent decrease in spontaneous language production, evident since the 31–50 year-old

range, language production in females was abundant even at the 51–65 year-old range. As mentioned above, it has been established that language acquisition is sex-dependent. Girls acquire language faster than boys (e.g., Bradshaw & Nettleton, 1983). Furthermore, language acquisition defects are more frequently observed among male populations (e.g., Bradshaw & Nettleton, 1981; Languis & Naour, 1985).

However, to the best of our knowledge, it has not been pointed out that language evolution across life-span, and language changes during aging are also strongly sex-dependent. Spontaneous language production was roughly equivalent until the 50s; whereas spontaneous language production at 51–65 year-old range was about 62% higher in women than in men. However, It would have been critical to include a fourth group of normal subjects (over 65 years of age) to determine whether the apparent sex difference in spontaneous language production observed in our third age group would still be observed in a group of older individuals.

Interpretation of sex differences in language decline does not seem easy. They can result from biological (i.e., different patterns of cerebral involution) and/or cultural factors (i.e., different sex roles in elderly, different linguistic environments, etc.). Not only biological, but also cultural variables are involved in spontaneous language production. As a whole, it could be stated that language production (i.e., to talk) represents a cultural value in Hispanic culture, might be stronger in females than in males. Anyhow, if language acquisition is sex-dependent, it seems reasonable that language evolution can also be sex-dependent. Further cross-cultural studies are obviously required.

Finally, our main result, i.e., that language evolution and patterns during aging are sex-dependent, must necessarily be replicated under different conditions and using different cultural contexts, before it can be considered a truly reliable observation.

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