A normative study of lexical verbal fluency in an educationally-diverse elderly population

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Verbal fluency tests (VFTs)

- A person's capacity for generating suitable words
  - For a given category or subcategory
  - In a limited amount of time.
- The most widely employed measures
  - For assessing cognitive functioning following neurological damage
  - Involve associative exploration and word retrieval.

VFT performance

- VFT performance declines in patients
  - Frontotemporal lobar degeneration
  - Parkinson's disease
  - Subcortical vascular dementia
  - Alzheimer's disease
- Useful for identifying individuals
  - Early Alzheimer's disease
  - Who were at risk of dementia
    - Age-associated memory impairment
    - Mild cognitive impairment

Two forms of VFT

- Two forms of VFT
  - The categorical verbal fluency test (CVFT)
    - Generate a list of words within a specific category (e.g., animals, fruits and vegetables, or shopping items)
  - The lexical verbal fluency test (LVFT)
    - Generate a list of words beginning with a specific alphabet letter.
- Functional imaging studies of CVFTs and LVFTs
  - CVFT heavily relies on left temporal regions (Pihlajamaki et al., 2000)
  - LVFT relies more on left frontal regions (Audenaert et al., 2000)

Verbal fluency and demographic characteristics

- Verbal fluency is influenced by demographic characteristics

- Age and VFT performance
  - VFT performance declines with advancing age
  - Some studies have shown significant differences in LVFT performance across age groups
  - Others have failed to detect any age-related differences

- Gender and education on LVFT performances
  - Inconsistent (Ardila et al., 2000; Capitani et al., 1998).

- In a large, non-demented, non-depressed sample of elderly Koreans having wide age- and educational level-ranges
- Investigate the influence of age, gender, and education on the LVFT performance.
- Provide normative data of the LVFT for Korean elders aged 60 years or older.

Methods

- Participants
  - All participants were community-dwelling persons, aged 60 or over
    - The Korean Longitudinal Study on Health and Aging (KLOSHA; (Park et al., 2007),
    - The Ansan Geriatric study (AGE; (Han et al., 2009),
    - The Gwangju Dementia and Mild Cognitive Impairment Study (GDEMCIS; (Lee et al., 2009).

Methods

- Assessments
  - Neuropsychological testing battery
    - CERAD-K for the KLOSHA and the AGE
    - SNSB-D for the GDEMCIS.
  - Global dementia severity using the Clinical Dementia Rating
  - Depressive symptoms using the Korean version of the Geriatric Depression Scale (GDS).

- Lexical verbal fluency test (LVFT)
  - The Korean letter " ㄱ “
  - Ask to generate as many words beginning with a specific letter as possible within one minute
  - Scored the LVFT by counting the number of acceptable words produced
  - Unacceptable responses
    - a participant repeats a previous response (i.e., a perseveration), includes a word starting with the wrong letter, or commits another violation of the rules stated in the manual (Ruff et al., 1996).

Methods

- Inclusion and exclusion criteria
  - Enrolled participants who had neither dementia nor major psychiatric disorders according to DSM-IV
  - Exclude participants with serious medical or neurological disorders that could affect mental functioning.
  - Include individuals with minor physical abnormalities (e.g., diabetes with no serious complications, essential hypertension, or mild hearing loss).

Statistical analysis

- Multiple linear regression analysis with stepwise variable selection
  - To assess the relative contributions of age, education, and gender to LVFT scores
- ANOVA with post-hoc contrasts using Scheffé's method
  - To determine any main effects or interactions on LVFT performance
    - Age group (60-69, 70-74, 75-79, and ≥ 80 years)
    - Educational level group (0-3, 4-6, 7-9, 10-12, and ≥ 13 years)
    - Gender
- Overlapping strata for developing the normative data
  - The procedures described by Pauker (Pauker, 1988)
  - To maximize the data's quantity and clinical usefulness

Results and discussion

Participant demographic characteristics

Variable	Men	Women	Total
Number[a]	736 (43.9)	940 (56.1)	1676
Age (years)[b]	70.2 ± 5.5	69.8 ± 5.9	70.0 ± 5.8
60-64[a]	130 (17.7)[b]	193 (20.5)	323 (19.3)
65-69[a]	225 (30.6)	306 (32.6)	531 (31.7)
70-74[a]	220 (29.9)	250 (26.6)	470 (28.0)
75-79[a]	120 (16.3)	121 (12.9)	241 (14.4)
80≤[a]	41 (5.6)	70 (7.4)	111 (6.6)
Education (years)[b]	9.8 ± 4.3	5.7 ± 4.4*	7.5 ± 4.8
0-3[a]	48 (6.5)	310 (33.0)	358 (21.4)
4-6[a]	180 (24.5)	342 (36.4)	522 (31.1)
7-9[a]	151 (20.5)	126 (13.4)	277 (16.5)
10-12[a]	191 (26.0)	116 (12.3)	307 (18.3)
13≤[a]	166 (22.6)	46 (4.9)	212 (12.6)

Stepwise multiple linear regression regarding age, education, and gender effects on LFTs scores

Lexical Verbal Fluency Test				
	B	SE(B)	β	R^2
Education	0.40	0.02	0.51*	28.5
Age	−0.10	0.01	−0.15*	5.42
Gender	−0.05	0.18	−0.01	4.84

Age and education associated with LVFT performance but gender did not.

- Education may have the most influence of any demographic factor on LVFT performance.
  - Age and education have a much greater effect on fluency than does gender
  - The influence of age on LVFT performance was much smaller than was that of education

- In some previous studies, age was not associated with LVFT performance.
  - Verbal intelligence might confound the association between age and LVFT performance if those studies included only participants with high verbal intelligence. (Loonstra and Tarlow, 2001)
  - Reportedly, level of educational attainment influences verbal intelligence (Dori and Chelune, 2004).

The analysis of variance for main effects and interactions among age, education, and gender on the Lexical Verbal Fluency Test

Main effect		Interaction	
Variable	F	**Variable**	F
Education	42.15*	**Age x Education**	1.54
Age	18.99*	**Age x Gender**	2.05
Gender	3.77	**Education x Gender**	0.59

- The main effects of age and educational level were significant, but that of gender was not
  - Ages into four (60-69, 70-74, 75-79, and 80 years or older),
  - Education into five (0-3, 4-6, 7-9, 10-12, and ≥ 13 years),
  - Gender into two (men and women).

Normative data for the Lexical Verbal Fluency Test in Korean elders

Education		0–3	4–6	7–9	10–12	≥13
60–69[a]	Number	249	418	229	258	170
	Mean ± SD	2.56 ± 2.88	4.70 ± 3.23	5.97 ± 3.07	7.12 ± 3.82	8.76 ± 3.85
	5–95 percentile	0.00–8.00	0.00–10.00	1.00–12.00	2.00–14.05	3.00–16.00
70–74[b]	Number	275	396	189	221	161
	Mean ± SD	2.11 ± 2.67	4.51 ± 3.19	5.79 ± 3.08	6.82 ± 4.00	8.03 ± 3.58
	5–95 percentile	0.00–7.00	0.00–10.00	1.00–12.00	1.10–15.00	3.00–15.00
75–79[c]	Number	211	245	109	137	102
	Mean ± SD	1.61 ± 2.32	4.06 ± 3.04	5.46 ± 3.20	6.34 ± 3.72	7.51 ± 3.60
	5–95 percentile	0.00–6.00	0.00–9.00	0.00–11.00	1.00–13.20	1.00–14.00
80–90[d]	Number	109	104	48	49	42
	Mean ± SD	1.01 ± 1.73	3.93 ± 2.98	4.94 ± 2.65	5.82 ± 3.53	6.86 ± 3.43
	5–95 percentile	0.00–5.00	0.00–9.00	0.00–9.00	0.00–11.00	1.00–13.00

Limitations

Employed only a single letter for evaluating lexical fluency.

- LVFT performance reportedly varies according to the letter employed
- Most previous studies on lexical fluency have commonly used letter triads (FAS, CFL, PRW).
- Neuropsychological test batteries for cognitive disorders have also widely adopted lexical fluency tests using a single letter

The sample sizes for some normative data cells were relatively small

- Increased standard errors
- Reduced the stability of the estimated results.

Median and fifth percentiles score were zero in the low education cell

- Might be due to the floor effect in those elderly with little education.

Conclusions

Background:

- Investigate the influences of age, gender, and education on lexical verbal fluency in an educationally-diverse, elderly Korean population
- provide normative information.

Methods:

- Administered the lexical verbal fluency test (LVFT) to 1676 community-dwelling, cognitively normal subjects aged 60 years or over.

Results:

- Education and age had significant effects on LVFT scores but gender did not
- Normative data of the LVFT stratified by age (60-69, 70-74, 75-79, and ≥ 80 years) and education (0-3, 4-6, 7-9, 10-12, and ≥ 13 years).

Conclusions:

- The LVFT norms should provide clinically useful data for evaluating elderly people and help improve the interpretation of verbal fluency tasks and allow for greater diagnostic accuracy.