The Effects of Word Class and Aging on Verbal Fluency in Korean

DAHYUN LEE*, **，HIKARU NAKAMURA*，HANSU RYU***

Abstract　The objective of this study is to examine the effects of word class and aging on verbal fluency in Korean to compare the results with our previous study in Japanese. Three types of verbal fluency tasks were administered in Korean to 35 healthy young and 35 healthy elderly. Each participant was instructed to generate as many different words as possible for the following five attributes within a 60-second period: (1) common nouns ("animal names" and "vegetable names"), (2) proper nouns ("company names" and "famous people's names") and (3) verbs (words about things people do). The results revealed that the elderly group generated significantly fewer correct responses and significantly more incorrect responses in comparison with the young group. For the verb task compared with the common noun task, there were significantly less correct responses and significantly greater incorrect responses due to aging. These poor performances in the verb fluency task because of aging were considered to be resulting from problems in executive function. Cultural influences on some of the verbal fluency performances were also considered a factor.

Ⅰ．INTRODUCTION

Verbal fluency tasks are a neuropsychological assessment of strategic search and retrieval processes from the lexicon and semantic memory[12, 13]. Participants are typically given 60 seconds to orally generate as many words as they can for a given attribute. The attribute is typically a semantic task (category fluency; e.g., animal names) or an initial letter task (letter fluency; e.g., words that begin with the letters "F"). Such verbal fluency tasks are widely employed in clinical settings for all ages as they are relatively quick and easy to administer and sensitive to a broad range of disorders. Fluency tasks are also a part of the neuropsychological test batteries that evaluate language or attentional/executive (frontal lobe) functions. A few examples of such test batteries include the Boston Diagnostic Aphasia Examination, the Western Aphasia Battery (category fluency of animal names), and the Frontal Assessment Battery (letter fluency for "S").

Conventionally, tasks that demand the release of "common nouns" have been performed. In recent years, however, tasks that demand the release of "proper nouns"[4] and "verbs"[11] have been developed. These three tasks are speculated to tap different cognitive functions, since these types of words are processed differently in the human brain. Therefore, these tasks may contribute to a determination of the nature of human cognitive functions and/or disorders.

Lee et al[10] conducted a series of fluency tasks on healthy young and healthy elderly people and were the first to report on the fluency of proper

＊ Graduate School of Health and Welfare Science, Okayama Prefectural University
111 Kuboki, Soja, Okayama 719-1197, Japan
＊＊ Department of Structure and Function of Neural Network, Korea Brain Research Institute
61 Cheomdan-ro, Dong-gu, Daegu 41068, Rep. of Korea
＊＊＊ School of Social and Child Welfare, Woosong University, Korea
171 Dongdaejeon-ro, Dong-gu, Daejeon 34606, Rep. of Korea

nouns and verbs in Japanese. The tasks comprised "animal names" and "vegetable names" tasks as the common noun fluency task, "company names" and "famous people's names" tasks as the proper noun fluency task, and "words about things people do" tasks as the verb fluency task. The main results were as follows: (1) the elderly group generated significantly fewer correct responses and significantly more incorrect responses compared with the younger group; (2) both groups generated significantly fewer correct responses in the verb task; (3) in comparison with the common noun task, correct responses for the verb task were significantly less and incorrect responses were significantly greater with aging in the elderly group. We discussed that the third finding was a reflection of the decline in the elderly people's executive functions.

However, because the execution of verbal fluency tasks depends on language, the task performances may have been influenced by the participants' language and/or culture. Therefore, the above observations were possibly unique to native Japanese speakers. Therefore, confirming whether such observations could be reproduced in another language was thought to be necessary. If the results were the same in two different languages, we could regard the results as having a biological/cognitive origin. On the other hand, if the results were different, it could be a consequence of language and/or cultural distinctions.

In this study, we conducted the same verbal fluency tasks as in Lee et al[10] on healthy young and healthy elderly. The aim of this study was to examine the effects of word class and aging on verbal fluency in native Korean speakers to confirm the results of the previous report or to discover new findings.

Ⅱ．METHODS
1．Participants

The participants were 35 healthy young people (18–23 years) and 35 healthy elderly people (65–79 years), all of who were native Korean speakers. Those who had obvious hearing or articulation impairments were excluded; those who self-reported histories of neurological or psychiatric diseases were also excluded. For the healthy elderly, the Mini-Mental State Examination (MMSE) was administered and only those who scored >26 were included. This was because it has been found that very few patients with dementia have been shown to score over 27[9]. Table 1 lists characteristics of the groups. Informed consent was obtained from the participants.

2．Materials and Procedures

All procedures were the same as that in our previous study[10] on native Japanese speakers, except for a minor change of the proper noun task (see below). The test was performed in a quiet room in a one-to-one setting with the examiner and the participant. The presentation order of the five verbal fluency tasks was randomized for each participant. The procedure for each task was as follows.

For the animal names task, each participant was instructed to orally generate the names of as many different animals as they could in a 60-second period, with the word "dog" given as

Table 1. Characteristics of the participant groups

	Healthy young	Healthy elderly
Age (years)	20.7±1.9	69.4±3.8
Sex (M/F)	17/18	17/18
MMSE	-	28.0±1.0

Data are presented as mean ± standard deviation or number.

an example. Each participant was then asked to provide another example of an animal name. If participants had difficulty understanding what was required, the instructions were repeated. Thereafter, the participants started the task. The procedures for the other four tasks were fundamentally the same. For the vegetable names task, each participant was asked to generate the names of vegetables, with the word "potato" given as an example. For the company names task, each participant was asked to generate the names of companies, with the word "Samsung" ("Toyota" in Lee et al[10]) given as an example. The participants were also instructed that both domestic and foreign companies were acceptable. For the famous people's names task, each participant was asked to generate the names of famous people, with the word "PARK Geun-hye" ("ABE Shinzo" in Lee et al[10]) given as an example. The participants were also instructed that both Korean and foreign names were acceptable, and that expressions such as "President Park" and "Geun-hye" were also acceptable if the name of person mentioned had been validated by the authors. The instructions for the verb task were the same as those in Piatt et al[11]. Each participant was asked to generate words for "things that people do.", with the word "eat" given as an example. They were also instructed that different forms of the same verb (e.g., eating,

eaten) were not acceptable.

3. Analyses

The number of correct and incorrect responses for each participant within the 60-second period was counted. The average of the two common noun tasks and the two proper noun tasks were also calculated. These values were analyzed using a two-way repeated-measures analysis of variance (ANOVA) with age (healthy young and healthy elderly) as the between-subjects factor and word class (common noun, proper noun and verb) as the within-subjects factor. The Greenhouse-Geisser correction was applied when the data violated the assumption of sphericity. Post-hoc adjustments for interaction comparisons and multiple comparisons were performed using Bonferroni's correction. The level of significance was defined as $p < 0.05$ for all tests.

Ⅲ. RESULTS

Table 2 shows the mean and standard deviation for the correct and incorrect responses for the five tasks. Figure 1 shows the mean and standard deviation for the correct responses for the three word classes. Figure 2 shows the mean and standard deviation for the incorrect responses for the three word classes.

For the correct responses, the ANOVA revealed

Table 2. Mean (± standard deviation) number of responses for each task

	Number of correct responses		Number of incorrect responses	
	Healthy young	**Healthy elderly**	**Healthy young**	**Healthy elderly**
Animal	18.9±4.2	13.0±4.4	0.6±0.8	2.1±1.6
Vegetable	11.0±3.0	11.1±3.2	0.9±1.0	1.8±1.8
Company	11.0±3.8	4.7±3.3	0.6±1.1	2.0±1.6
Famous people	13.7±4.6	6.3±4.2	0.5±0.7	0.8±1.1
Verb	14.0±5.4	5.6±3.7	1.2±1.2	6.7±3.6

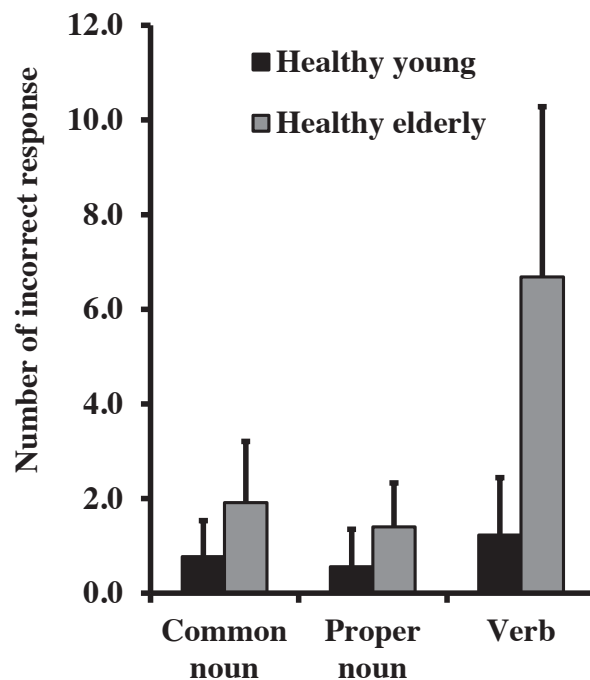Figure1. Number of correct responses by word class and age. Error bars are standard deviation.

Figure2. Number of incorrect responses by word class and age. Error bars are standard deviation.
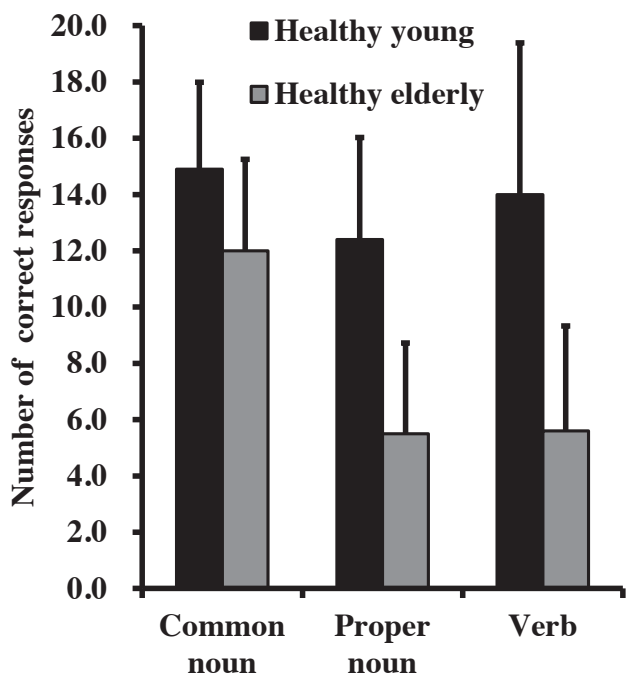
a significant main effect for age (F (1, 68) = 78.59, p < 0.001) and word class (F (2, 124) = 43.54, p < 0.001). The ANOVA also revealed a significant interaction between the two factors (F (2, 124) = 14.96, p < 0.001). Interaction comparisons revealed significant interactions between the common noun and proper noun tasks (F (1, 68) = 18.66, p < 0.001) and between the common noun and verb tasks (F (1, 68) = 30.78, p < 0.001). That is, correct responses for the proper noun and verb tasks noticeably declined in comparison with the common noun task because of age. Multiple comparisons revealed that for the young group there were significantly fewer correct responses for the proper noun task than those for the common noun task (p < 0.05). In the elderly group, there were significantly fewer correct responses for the proper noun task and the verb task than those for the common noun task (p < 0.001).

For the incorrect responses, the ANOVA revealed a significant main effect for age (F (1, 68) = 81.70, p < 0.001) and word class (F (1, 82) = 72.23, p < 0.001). The ANOVA also revealed that

there was a significant interaction between the two factors (F (1, 82) = 45.59, p < 0.001). Interaction comparisons revealed that interactions were significant between the common noun and verb tasks (F (1, 68) = 48.83, p < 0.001) and between the proper noun and verb tasks (F (1, 68) = 53.84, p < 0.001). That is, there was a noticeable increase in the number of the incorrect responses for the verb task in comparison with the common noun task and the proper noun task with aging. Multiple comparisons revealed that in the elderly group, there were significantly more incorrect responses for the common noun task than those for the proper noun task (p < 0.05), and there were significantly more incorrect responses for the verb task than those for the common noun and proper noun tasks (p < 0.001).

Ⅳ. DISCUSSION

These results revealed that performances in the verb fluency task exhibited a significant decline (a decrease in the number of correct responses and an increase in the number of incorrect responses)

because of aging in comparison with the common noun fluency task, which agreed with the results in Lee et al[10]. Therefore, we consider that this finding has a biological/cognitive origin.

There were strong implications of a relationship between verb fluency and the frontal executive function. Piatt et al[11] found that verb fluency performances had significant correlations with performances in the Wisconsin Card Sorting Test and the Trail Making Test B that were typical tools to measure executive functions. Davis et al[2] reported that patients with subcortical dementia or frontal dementia exhibited poor verb fluency rather than common noun (animal names) fluency in comparison with patients with AD. Delbeuck et al[3] reported the same discrepancy in fluency between patients with dementia with Lewy bodies (DLB) and AD. They claimed that these discrepancies were due to the more severe executive dysfunction in patients with subcortical and frontal dementia and DLB because of damage in the frontal-subcortical circuits. Functional MRI have revealed frontal lobe activation in response to verb generation tasks, which has been discussed in relation to executive functions[5-7]. Therefore, we believe that the reduction in verb fluency in the elderly, which was observed in both the Korean and Japanese studies, reflects a decline in their executive function.

This study also revealed that because of aging, the number of correct responses for the proper noun task was significantly less compared with those for the common noun task, which was not consistent with the results of Lee et al[10]. This may have been because of language and/or cultural differences between the two studies.

The proper noun task comprised two subtasks, and reduced fluency in the Korean elderly was mainly found in the company names task. That is, in the famous people's name task, the rate of correct responses for the elderly compared to the young was 59% for native Japanese speakers (Lee et al[10]) and 37% for native Korean speakers (this study). On the other hand, in the company names task the rate was 77% for Japanese and 37% for Korean, which was a wide discrepancy. Benito-Cuadrado et al[1] and Kempler et al[8] reported significant differences in verbal fluency task performances in native Spanish speakers from different countries, which may indicate that culture influences verbal fluency performance. In South Korea, oligopolies dominate the market, and some conglomerates manage a range of industrial products, such as electronics, automobiles, clothing, and supermarkets. Therefore, the elderly people tended to identify domestic conglomerate names only as they did not know much about international companies. On the other hand, young people might be less affected by such oligopolies and could generate well-known foreign company names, such as Microsoft and Starbucks.

In this study, we thought that poor performances in verb fluency compared with common noun fluency indicated problems in executive function. However, there was no direct evidence that supported this claim. Further studies that conduct both a variety of fluency tasks and neuropsychological tests for executive function and then examine the relationship between the performances in the aforementioned tasks may be needed.

ACKNOWLEDGEMENTS

REFERENCES

1 ）Benito-Cuadrado M M, Esteba-Castillo S, Böhm P, et al（2002）. Semantic verbal fluency of animals: A normative and predictive study in a Spanish population. J Clin Exp Neuropsychol, 24（8）：1117-1122.

2 ）Davis C, Heidler-Gary J, Gottesman R F, et al（2010）. Action versus animal naming fluency in subcortical dementia, frontal dementias, and Alzheimer's disease. Neurocase, 16（3）：259-266.

3 ）Delbeuck X, Debachy B, Pasquier F, et al（2013）. Action and noun fluency testing to distinguish between Alzheimer's disease and dementia with Lewy bodies. J Clin Exp Neuropsychol, 35（3）：259-268.

4 ）Fine E M, Delis D C, Paul B M, et al（2011）. Reduced verbal fluency for proper names in nondemented patients with Parkinson's disease: A quantitative and qualitative analysis. J Clin Exp Neuropsychol, 33（2）：226-233.

5 ）Holland S K, Plante E, Byars A W, et al（2001）. Normal fMRI brain activation patterns in children performing a verb generation task. Neuroimage, 14（4）：837-843.

6 ）Holland S K, Vannest J, Mecoli M, et al（2007）. Functional MRI of language lateralization during development in children. Int J Audiol, 46（9）：533-551.

7 ）Horowitz-Kraus T, Vannest J J, Gozdas E, et al（2014）. Greater utilization of neural-circuits related to executive functions is associated with better reading: A longitudinal fMRI study using the verb generation task. Front Hum Neurosci, 8.

8 ）Kempler D, Teng E L, Dick M, et al（1998）. The effects of age, education, and ethnicity on verbal fluency. J Int Neuropsychol Soc, 4（6）：531-538.

9 ）Kukull W A, Larson E B, Teri L, et al（1994）. The Mini-Mental State Examination score and the clinical diagnosis of dementia. J Clin Epidemiol, 47（9）：1061-1067.

10）Lee D, Sawada Y, Nakamura H, et al（2013）. Effects of Word Class and Aging on Verbal Fluency. High Brain Funct Res, 33（4）：421-427.（in Japanese）

11）Piatt A L, Fields J A, Paolo A M, et al（1999）. Action（verb naming）fluency as an executive function measure: Convergent and divergent evidence of validity. Neuropsychologia, 37（13）：1499-1503.

12）Rodríguez-Sánchez J M, Crespo-Facorro B, Iglesias R P, et al（2005）. Prefrontal cognitive functions in stabilized first-episode patients with schizophrenia spectrum disorders： A dissociation between dorsolateral and orbitofrontal functioning. Schizophr Res, 77（2）：279-288.

13）Sauzéon H, Lestage P, Raboutet C, et al（2004）. Verbal fluency output in children aged 7–16 as a function of the production criterion：Qualitative analysis of clustering, switching processes, and semantic network exploitation. Brain Lang, 89（1）：192-202.

韓国語における言語流暢性課題での品詞と加齢の影響

李多暳 *, **　中村光 *　柳漢守 ***

* 岡山県立大学大学院保健福祉学研究科　〒 719-1197　岡山県総社市窪木 111
** 韓国脳研究院脳神経網研究部　　　　　〒 41068　韓国大邱広域市東区先端路 61
*** 韓国又松大学校社会福祉児童学部　　〒 34606　韓国大田広域市東区東大田路 171

キーワード：言語流暢性，加齢，動詞，遂行機能

韓国語における言語流暢性課題での品詞と加齢の影響