Aging Effects on the Verb Fluency Measures Using the Semantic Weight-Based Analysis

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Introduction
The verb fluency task is a sensitive tool for discriminating aging-related neurodegenerative disease(Alegret et al., 2018). The current study focused on the semantic dimension of verbs by categorizing verbs based on the semantic weight(heavy vs. light) from a verb fluency task. The purpose of the study is to investigate whether normal elderly adults demonstrated any differentially greater difficulties depending on the verb types compared to the young group. We further examined clustering and switching behaviors of verbs based on the semantic weight.

Methods
A total of 115 Korean-speaking individuals(55 young, 60 elderly) participated in this study. All participants performed within the normal range on The Korean version of Mini-Mental State Examination(K-MMSE; Kang, 2006) and Seoul Verbal Learning Test(SVLT; Kang et al., 2012).
Participants were asked to produce as many verbs as possible within 60 seconds. The performance was analyzed according to semantic weight of verb(heavy vs. light), the number of cluster, mean cluster size and the number of switching. Scores of digit span task were administered as working memory measures.

Results
1. Total numbers of correct verbs
Two-way mixed ANOVA (group x verb type) revealed that the two-way interaction was significant, $F(1,113)=31.259$, $p<.0001$, $\eta^2 partial =.217$, indicating that the elderly group produced fewer numbers of heavy than light verbs.
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2. Number of clusters and Mean cluster size
For the number of clusters, two-way mixed ANOVA revealed that the main effects were significant for verb type(Heavy > Light), $F(1,113)=78.498$, $p<.0001$, $\eta^2 partial =.410$, and group(Young > Old), $F(1,113)=5.182$, $p=.025$, $\eta^2 partial=.044$.
For the mean cluster size, the two-way interaction was significant, $F(1,113)=31.178$, $p<.0001$, $\eta^2 partial =.216$, indicating that elderly adults presented smaller mean cluster size in the heavy than light verbs.

3. Number of Switches
One-way between-subject ANOVA revealed that the elderly group(Mean=1.95, SD=2.34) demonstrated significantly fewer switching than younger adults(Mean=2.95, SD=2.46), $F(1,114)=5.006$, $p=.027$.

4. Stepwise Regression Analyses

We performed stepwise regression analyses for each dependent measure of verb types with age, years of education, and scores of K-MMSE, digit span, SVLT as independent variables. The years of education was the significant predictor that was included into all dependent measures across the board for the heavy verbs(Table 1).

Conclusions

Elderly adults demonstrated differentially greater difficulties in generating heavy than light verbs compared to the younger group. Considering that heavy verbs carry more semantically complex features than light verbs, it is likely that more semantic units need to be activated to retrieve the verbs with heavy semantic weight. Education was the significant predictor that was included into all dependent measures across the board for the heavy verbs. Education is one of the critical factors that are associated with cognitive reserve(Stern, 2006), suggesting that individuals with greater cognitive research are less vulnerable to cognitive decline. The current results indicate that the abilities to retrieve semantically heavy verbs are more vulnerable to aging and education may account for their decreased abilities as a cognitive reserve. Semantic-based analyses can provide additional qualitative analyses of the verbal fluency task to detect the aging effects and their related demographic factors.

References

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(A)

	Light verb	Heavy verb
Young	2.17 (SD=2.27)	17.47 (SD=4.92)
Old	1.47 (SD=1.47)	10.64 (SD=5.79)

(B)

	Light verb	Heavy verb
Young	1.55 (SD=1.26)	2.40 (SD=1.3)
Old	1.16 (SD=1.34)	1.76 (SD=1.2)

(C)

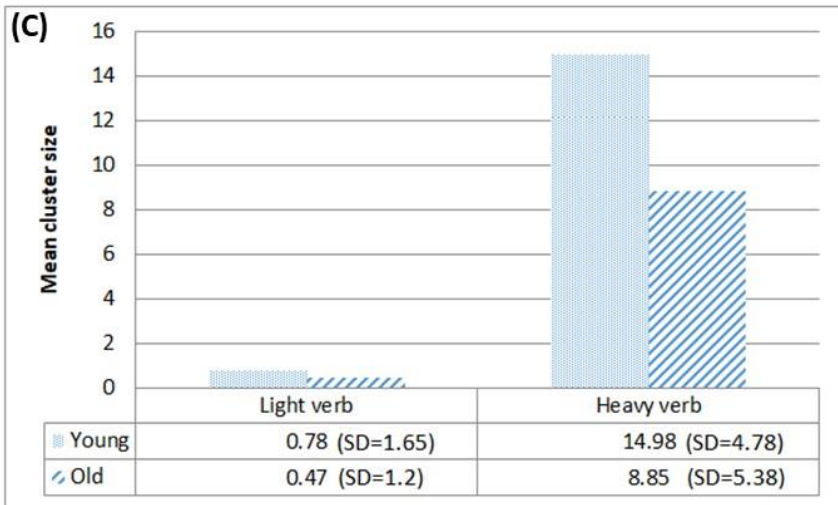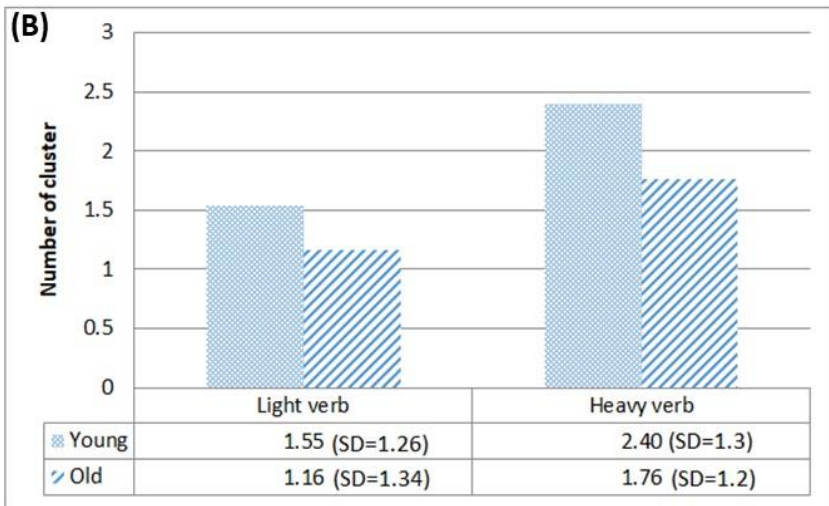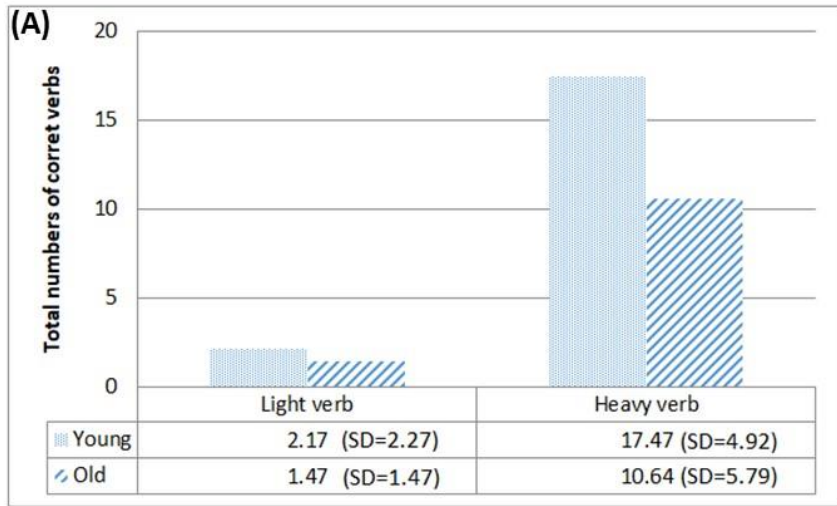|	Light verb	Heavy verb
Young	0.78 (SD=1.65)	14.98 (SD=4.78)
Old	0.47 (SD=1.2)	8.85 (SD=5.38)

Figure 1. Total numbers of correct verbs (A), number of clusters (B), and mean cluster size (C) for heavy and light verb in both group.

Table 1. Summary of results from the stepwise regression analyses

	The number of correct response (Heavy verb)	The number of cluster (Heavy verb)	Mean cluster size (Heavy verb)	Switching
Significant Predictors	Age Years of education SVLT-immediate	Years of education	Age Years of education SVLT-immediate Digit forward span	Years of education
R-square (Adj. R-square)	473(.452)	1(.088).	461(.432)	1(.088).
Statistical value	p<.0001	p=.005	p <.0001	p=.005