Word Class-Based Clustering and Switching Analyses of Phonemic Fluency in Alzheimer's Disease

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Introduction

- Verbal fluency tasks are well known to sensitively detect cognitive-linguistic declines in Alzheimer's disease(AD)(Murphy et al., 2006).
- Some researchers focused on qualitative aspects of verbal fluency measures using clustering and switching analyses (Troyer et al., 1997; 1998). Clustering involves the number of items within either a semantic or phonemic subcategory, and switching refers to the frequency of shifts between clusters (Troyer, 2000).
- Most clustering analyses have focused on the subcategories either under the semantic or phonemic perspectives. However, the phonemic fluency measure allows more freedom than the semantic fluency task to explore different aspects such as word class-based analyses.
- The word production task starting with a specific phoneme is possible to elicit different types of word class, whereas the semantic fluency task allows the analyses predominantly only on the nouns, given that a noun-based semantic category is already given such as 'animals'.
- Word class dissociations have been a critical issue in research on cognitive and linguistic deficits of neurological diseases. Many researchers have reported dissociations between nouns and verbs in relation to lesion sites, suggesting that noun retrieval relies on the temporal lobe whereas verb retrieval on frontal areas (Laiacona & Caramazza, 2004). However, no studies examined whether word class dissociations can be identified in phonemic verbal fluency in AD and how the word class-based analyses of clustering and switching behaviors affected overall performance on the fluency measures.

Purposes of the Study

- The current study investigated whether the word class dissociations emerged in the phonemic fluency task and explored the best predictors to account for the number of correct responses among word class-based clustering and switching behaviors in addition to demographic variables of AD.

Methods

- Participants were 58 individuals with probable AD from the dementia bank project, Pitt Corpus(Becker et al., 1994). Table 1 provides demographic information of participants.
- Participants generated words beginning with f for 60 seconds. We categorized the word class for each item from the phonemic fluency task and analyzed word class-based mean cluster size and number of switching following Troyer (1997) definition on the clustering and switching behaviors.

<Table 1> Demographic information of participants

	Age (yr)	Onset age	Education	MMSE	Gender (male : female)
Mean (SD)	72.20 (±8.80)	68.09 (±8.53)	11.71 (±2.70)	19.07 (±4.04)	16 : 42
Range	56-88	52-85	6-20	10-27	

MMSE= Mini Mental Status Examination (Folstein et al., 1975).

References

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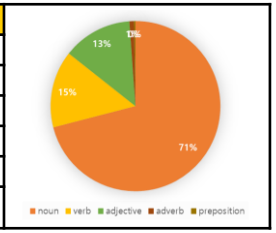
Results

Word Class Analyses

- Nouns were the most frequently generated word class, consisting of 71% of the total words, followed by verbs (15%) and adjectives (13%) (Table 2).
- The proportions of adverbs and prepositions were less than 1%, which were excluded from the following regression analyses. Word class-based mean cluster size and number of switches were 2.38 and 2.41, respectively.

<Table 2> Descriptive statistics for each word class

	Frequency per word class	Proportion (%) of each word class	Mean frequency per individual (SD)
Noun	247	70.98	4.26 (±2.67)
Verb	51	14.66	0.88 (±1.11)
Adjective	46	13.22	0.79 (±1.28)
Adverb	3	0.86	0.02 (±0.13)
Preposition	1	0.29	0.05 (±0.22)
Total numbers of correct responses	348	100	6.00 (±3.54)



Multiple Regression Analyses

- To examine the best predictors for the number of correct responses, we conducted stepwise multiple regression analyses with word class-based mean cluster size, the number of switches, and demographic variables as predictors.
- The results revealed that the models with the number of switches, $F(1, 56)=61.946$, $p<.0001$, $R^2=.525$, and with the number of switches and mean cluster size, $F(2, 55)=44.911$, $p<.0001$, $R^2=.620$, significantly predicted the number of correct responses, suggesting that the number of switches is the most influential predictor for correct responses, accounting for 52.5% of the total variance.
- To examine significant predictors for the number of switches as a dependent variable with the numbers of nouns, verbs and adjectives, demographic variables as independent variables.
- The models with the number of verbs, $F(1, 56)=61.060$, $p<.0001$, $R^2=.522$, with the numbers of verbs and adjectives, $F(2, 55)=98.468$, $p<.0001$, $R^2=.782$, with the numbers of verbs, adjectives and nouns, $F(3, 54)=76.270$, $p<.0001$, $R^2=.809$, and with the numbers of verbs, adjectives, nouns and education, $F(4, 53)=62.071$, $p<.0001$, $R^2=.824$, significantly predicted the number of switches. Results indicate that the most influential variables are the number of verbs, which explains 52.2% of the variance.

Discussion

- The current results revealed a strong advantage for nouns over verbs or adjectives in line with previous findings showing that individuals with AD have more difficulties in retrieving verbs than nouns (Cappa et al., 1998; Cotelli et al., 2006).
- Switching contributed most to increasing the correct responses. Although the nouns are the most frequently generated word class, verbs turned out to be the most crucial factor for facilitating switching, indicating that the abilities to generate more verbs are related to elicit more switching behaviors.
- Given that phonemic fluency switching is a critical index for the frontal lobe function (Troyer et al., 1998), the current results suggest that qualitative analysis based on word classes could also be a useful and alternative methodology to examine frontal lobe functions in AD.

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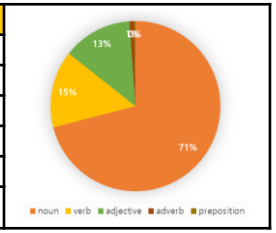

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