Cross-cultural differences in animal fluency between Korean- and English-speaking individuals with Alzheimer's disease

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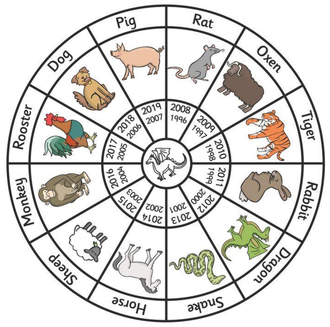
Introduction

- Verbal fluency tasks, widely used to assess word retrieval, reveal how speakers' cultural-linguistic backgrounds influence their lexical access patterns[1,2].
- Sung et al.[3] compared animal fluency performance between Korean and English-speakers with and without aphasia, finding that Korean-speakers in both groups generated a higher proportion of zodiac animals than English-speakers. These findings underscore the importance of considering cultural-linguistic diversity when assessing word retrieval and remain questions about whether these culture-specific patterns extend to other neurogenic communication disorders.
- Research has demonstrated that individuals with AD exhibit limited semantic access and inefficient semantic search strategies, as evidenced by their clustering and switching behaviors based on Troyer et al[4]'s traditional criteria for classifying animal subcategories[5-7].
- However, these criteria are rooted in Western-cultural animal prototypes, which may limit their ability to capture cultural variations across languages.
- We examined cultural differences in animal fluency task performance between Korean- and English-speakers with AD, by analyzing clustering and switching patterns within both traditional animal categories[4] and zodiac animals[3], and their potential for predicting cognitive function.



12 zodiac animals in a cycle

Methods

- A total of 36 participants diagnosed with Alzheimer's disease (AD), comprising 18 Korean-speaking individuals with AD (Korean-AD) and 18 English-speaking individuals with AD (English-AD).
- The English-AD group was selected from the DementiaBank, supported by the NIH-NIDCD grant R01-DC008524, a widely used linguistic database for research on language and cognition in neurodegenerative diseases.

Table 1. Demographic information for each language group.

	Korean-AD (n=18)	English-AD (n=18)	*t-tests results*
Age (years)	78.83 (7.94)	76.67 (4.91)	t(34)=.984, *p*=.331
Sex (female:male)	13:5	9:9	t(34)=1.364, *p*=.181
Education (years)	5.75 (5.19)	9.38 (2.25)	t(34)=2.725, *p*=.010
MMSE	17.44 (4.43)	18.11 (4.22)	t(34)=-.461, *p*=.647

Note. Mean (standard deviation). AD=Alzheimer's disease; MMSE=Mini-Mental State Examination.

- We analyzed participants' responses using two approaches:

1. **Culture-agnostic analyses**: Based on the traditional criteria[10], we analyzed **(1)total number of correct responses, (2)number of switches(NOS), and (3)mean cluster size(MCS).**
2. **Culture-specific analyses**: Following previous work[3], we coded 12 animals(i.e., mouse, cow, tiger, rabbit, dragon, snake, horse, sheep, monkey, rooster, dog, pig) as zodiac category. Three dependent variables were examined**: (1)ratio of zodiac animals to total responses(zodiac ratio), (2)number of zodiac switches(NOZS), and (3)mean zodiac cluster size(MZCS).** In the sequence, for example, "cow, sheep, bear, horse, dog, cat, tiger, snake," seven out of eight responses were zodiac animals(ratio=0.875). Two zodiac switches occurred between three zodiac clusters("cow-sheep," "horse-dog," and "tiger-snake"), with mean zodiac cluster size of 1.0 (each cluster size minus one).

Word 1	Word 2	Word 3	Word 4	Word 5	Word 6	Word 7	Word 8
Ox	**Horse**	**Pig**	**Dog**	Elephant	**Rabbit**	**Rat**	**Sheep**
Zodiac cluster 1 Cluster size = 4-1 = 3					Zodiac cluster 2 Cluster size = 3-1 = 2		

Nr. of Zodiac switches = 1

Mean zodiac cluster size = (3+2)/2 = 2.5

Results

Statistical analyses

- Generalized linear mixed models were performed to examine group differences in all dependent variables, with education as a covariate.
- To identify the best predictor of general cognitive function(MMSE) among strategy-focused dependent variables(NOS, MCS, NOZS, MZCS), stepwise multiple regression analyses were performed separately for each group.

1. Culture-agnostic analyses

Descriptive statistics are presented in Table 2. No significant differences were found between the language groups in total number of correct responses(*p*=.397), NOS(*p*=.397), or MCS(*p*=.397).

2. Culture-specific analyses

Korean-AD produced a significantly greater zodiac ratio(*p*<.001), NOZS(*p*=.011), and MZCS(*p*=.002) compared to English-AD (Figure 1).

3. Predictor of general cognitive function for each language group

The stepwise regression model identified NOZS as the strongest predictor of MMSE for the Korean-AD(*p*=.009, R^2=.354), while no variables predicted MMSE for the English-AD(Figure 2).

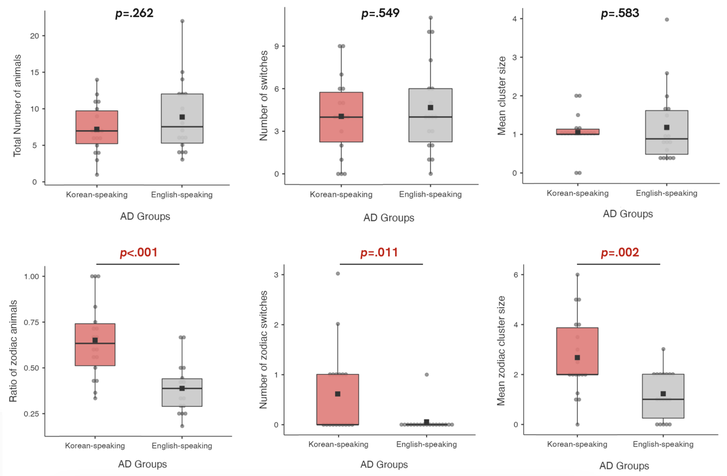


Figure 1. Box plots comparing (A) cultural-agnostic analyses (total responses, number of switches, mean cluster size) and (B) cultural-specific analyses (ratio of zodiac animals to total responses, number of zodiac switches, mean zodiac cluster size) between Korean- and English-speaking individuals with Alzheimer's disease.

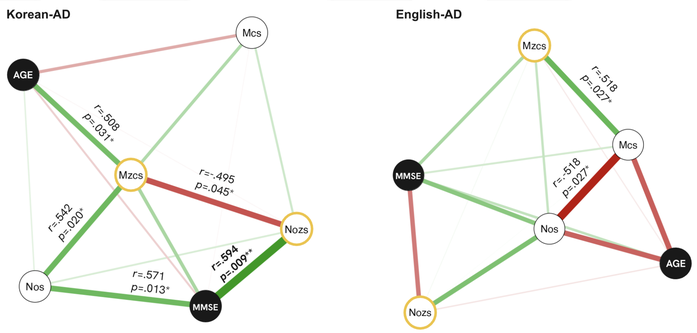


Figure 2. Graphical Gaussian plots showing correlation structures between MMSE and animal fluency variables for (A) Korean- and (B) English-speaking individuals with Alzheimer's disease, controlling for education. Green and red colors indicate positive and negative partial correlations, respectively. MMSE = Mini-Mental State Examination; NOS = number of switches; MCS = mean cluster size; NOZS = number of zodiac switches; MZCS = mean zodiac cluster size.

Table 2. Descriptive statistics for animal fluency task variables by language group.

Cultural-agnostic analyses		
Variables	Korean-AD (n=18)	English-AD (n=18)
Total number of correct responses	7.22 (3.38)	8.83 (4.94)
Number of switches	4.16 (2.64)	4.66 (3.27)
Mean cluster size	1.04 (0.50)	1.48 (0.49)
Cultural-specific analyses		
Variables	Korean-AD (n=18)	English-AD (n=18)
Ratio of zodiac animals	0.65 (0.20)	0.38 (0.13)
Number of zodiac switches	0.61 (0.84)	0.05 (0.23)
Mean zodiac cluster size	2.84 (1.97)	1.22 (0.94)

Conclusion

- While both groups demonstrated comparable performance in the culture-agnostic analysis, Korean-AD produced significantly more zodiac animals with larger zodiac cluster sizes and more frequent zodiac switches than English-AD.
- These findings underscore that animal fluency performance, although based on universal semantic categories, may elicit culturally-distinct retrieval patterns in AD. Furthermore, the number of zodiac switches emerged as a significant predictor of general cognitive function exclusively in the Korean group.
- These results indicate that the culturally-sensitive analyses of verbal fluency may provide clinically meaningful insights into cognitive decline in AD, aligning with previous findings in stroke aphasia study[3].

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Acknowledgments

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