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Cross-Linguistic and Multicultural Effects on Animal Fluency Performance in Persons With Aphasia

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ABSTRACT

Purpose: The current study examined the impact of cross-linguistic and cultural differences on an animal fluency task between Korean- and English-speaking persons with aphasia (PWA) and neurologically intact older adults (OAs). Specifically, we investigated the influence of zodiac animals on word retrieval, given their cultural familiarity in East Asia, hypothesizing that Korean speakers have a higher likelihood of producing zodiac animals compared to English speakers.
Method: Sixty-seven PWA (30 English-speaking, 37 Korean-speaking) and 30 OAs (15 per language group) completed an animal fluency task. Analyses focused on three approaches: total correct responses, culturally specific responses (zodiac animals and ratio of zodiac animals), and an item-level comparison of language-general and language-specific items to identify animal items that could differentiate between the language groups.
Results: Korean speakers, both with and without aphasia, produced a greater proportion of zodiac animals compared to English speakers. Conversely, English speakers demonstrated greater semantic diversity in animal responses than Korean speakers.
Conclusions: Both PWA and OA groups demonstrated differential patterns in producing zodiac animals, depending on their language and the culture. These findings shed light on the importance of considering cultural and linguistic diversity during aphasia assessment of word retrieval difficulties.
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Word retrieval impairment, or anomia, is considered the cardinal residual deficit across profiles of aphasia (Laine & Martin, 2006). Persons with aphasia (PWA) may demonstrate several word-finding behaviors as a result of anomia including pauses, word substitutions, circumlocutions, and phonological errors (Goodglass & Wingfield, 1997). Furthermore, the severity and nature of anomia may vary widely due to differences in brain injury and demographic factors such as age that are known to influence word retrieval. More recent research has suggested that phonological and semantic patterns of impairment may contribute to anomia differentially, leading to subgroups of PWA whose word-finding behaviors may be determined by their underlying profile. Regardless, PWA consistently report that anomia constrains their social participation, leading to a reduced quality of life (Hilari et al., 2003; Lam & Wodchis, 2010).

Word retrieval deficits are often assessed using various methods, with confrontation naming tasks (e.g., the Boston Naming Test) being the most common. However, confrontation naming tasks have several limitations, as the items and images used must be validated to reflect various psycholinguistic variables, such as lexical frequency, typicality, phonological complexity, and visual complexity. Given these caveats, confrontation naming measures are not ideal, especially for cross-linguistic studies in aphasia. The difficulty of items and the psycholinguistic factors associated with them in confrontation naming tasks may be heavily influenced by cultural and linguistic backgrounds (Sung, Scimeca, et al., 2024).

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Another method for examining word retrieval difficulties in aphasia is divergent naming assessments such as verbal fluency tasks. During verbal fluency tasks, participants are asked to produce as many words as possible within a limited time frame (typically 30–60 s) according to a specific rule established by an examiner. There are several types of verbal fluency tasks including semantic (or category), phonemic (or letter), and verb (or action) fluency tasks. Among these, semantic fluency tasks using categories such as animals, clothing, transportation, and vegetables are the most widely studied in aphasia; additionally, at least one category fluency task (typically animal fluency) is included in standardized aphasia batteries such as the Western Aphasia Battery (WAB; Kertesz, 2006) and the Boston Diagnostic Aphasia Examination (Goodglass et al., 2001).

Crucially, it has recently been suggested that verbal fluency tasks may offer distinct advantages when assessing word retrieval abilities in a language other than English or in bilinguals with aphasia who know more than one language. Unlike confrontation naming tests that require PWA to name items in response to preselected stimuli, verbal fluency tasks may provide more culturally appropriate testing experiences (Kiran & Roberts, 2012) given that individuals are encouraged to respond with whatever lexical items are available to them. Response rates across these tasks are heavily influenced by the psycholinguistic properties of words such as lexical frequency and typicality, especially in category fluency tasks. For example, it is well established that words with higher lexical frequency are easier to access and retrieve (Almeida et al., 2007) as are words that are judged to be more typical exemplars within a specific category (Rosch et al., 1976). However, word properties are highly variable cross-linguistically, and as a result, words are unlikely to have the same frequency of occurrence and therefore the same likelihood of retrieval in two or more languages. Indeed, previous studies have provided evidence that properties like typicality vary widely between closely related and unrelated language pairs such as English and Spanish (Schwanenflugel & Rey, 1986) and English (Kiran & Thompson, 2003) and Korean (Sung & Kim, 2011) respectively. For example, "scallion" is a highly typical vegetable in Korean but not in English; similarly, "garlic" is a more common item among English speakers and less common among Korean speakers. At present, aphasia rehabilitation research lacks studies that have investigated the potential effects of cross-linguistic word properties on verbal fluency performance.

Nevertheless, several review studies have recently been published that have conducted comparisons of PWA's performance on verbal fluency tasks across languages (e.g., Ardila, 2020; Villalobos et al., 2023). Villalobos et al. (2023) conducted an extensive review of normative data for verbal fluency tests across Indo-European, East Asian, and Semitic language families, providing a valuable resource for clinicians and researchers. The authors highlighted that sociodemographic factors such as age and education have the most significant influence on test performance. However, they also emphasized the importance of considering cultural differences and predisposition when interpreting neuropsychological test results. Ardila (2020) conducted a cross-linguistic comparison of the animal fluency task, analyzing 15 languages from a diverse range of language families. The study found minimal differences in overall performance scores related to language types and word length, while demographic factors such as age and education had a more significant impact on performance. However, the review lacked a detailed analysis of how finer aspects of linguistic and cultural diversity influenced test outcomes. As the authors noted, cross-cultural factors are often overlooked in cross-linguistic comparisons, particularly in psychometrically oriented test environments, where nonfamiliar testing situations and cultural predispositions play a role. In some cultures, exerting effort in an unfamiliar setting with an examiner they have first met may not be perceived as meaningful (Ardila, 2005, 2020). These studies highlight the need to further explore how cultural diversity affects performance on verbal fluency measures when comparing cognitive–linguistic results across different languages and cultures.

Although a relatively diverse range of studies has been conducted on cross-linguistic comparisons using verbal fluency measures in healthy adults (Acevedo et al., 2000; Eng et al., 2019; Kempler et al., 1998; Oberg & Ramírez, 2006; Pekkala et al., 2009; Rosselli et al., 2002; Wauters & Marquardt, 2018), cross-linguistic evidence is limited in aphasia. Several studies have attempted to examine verbal fluency in bilingual with aphasia (BWA), a clinical population with language impairment in one or both languages (Carpenter et al., 2020; Kiran et al., 2014). These studies have mainly focused on the relationship between bilingual cognitive control and lexical access. Depending on different contexts, bilinguals need to actively use one language while inhibiting the other language simultaneously, leading to intense engagement of bilingual inhibitory control (Green, 1998). Evidence from these studies have suggested different degrees of cognitive control in single- and dual-language contexts. For instance, as compared to neurologically intact bilinguals, BWA demonstrate poorer performance during conditions when high cognitive control is required, such as generating words in only one language or switching between the first language (L1) and the second language (L2) for every new word produced (Carpenter et al., 2020). One issue among previous bilingual aphasia studies is that direct comparisons of verbal fluency performance between L1 and L2 remain limited

(see Patra et al., 2020). Previous neurological research on category representation has demonstrated distinctive neural patterns across languages, such as English and Chinese (Liu et al., 2013). Therefore, it is crucial to investigate to what extent cross-linguistic differences may mediate lexical access in individuals with aphasia. This examination will provide insight into how lexical categories are organized in individuals with brain damage

The current study aims to investigate how cultural and linguistic differences influence performance on animal category fluency for PWA by comparing English-speaking PWA with Korean-speaking PWA. English, an Indo-European language rooted in Western culture, and Korean, a member of the Ural-Altaic language family within East Asian culture, serve as suitable counterparts for cross-cultural and cross-linguistic comparison. Among various factors associated with the semantic retrieval process for "animal" items, the current study specifically analyzes cultural aspects related to animal zodiacs in East Asia. The culture of zodiac animals is deeply intertwined with everyday life in East Asian cultures, particularly in countries such as China, Korea, and Japan. The East Asian zodiac consists of 12 animals, each representing a year in a 12-year cycle. It is common for people to exchange New Year's greetings that feature the animal of the year. Given that each year is associated with a specific zodiac animal, older generations—especially—are often skilled at estimating a persons' age based on the zodiac animal of their birth year. Considering the cultural significance of zodiac animals in East Asian culture, we hypothesize that animal fluency performance may be influenced by the semantic activation process related to zodiac cultures for Korean-PWA compared to English-PWA.

The current study first investigates whether there are significant differences in the total number of responses between English- and Korean-speaking PWA as well as between English- and Korean-speaking older adults (OAs). In the subsequent culturally motivated analyses, we specifically focused on the number and ratio of zodiac responses from the animal verbal fluency task, as delineated above for the rationales of this comparison. We hypothesized that Korean speakers, who have been exposed to zodiac animal culture, would generate a greater number of zodiac animal items compared to English speakers. Additionally, we further examined item-level differences between the language groups and explored which items are most sensitive and specific in distinguishing between these two language groups.

Method

Participants

A total of 97 participants, comprising 67 PWA and 30 neurologically intact OAs, participated in the study. The PWA group included 30 English-speaking and 37 Korean-speaking individuals, diagnosed with aphasia based on the Western Aphasia Battery–Revised (WAB-R; Kertesz, 2006) for English speakers or the Korean version of the WAB-R (PK-WAB-R; Kim & Na, 2012) for Korean speakers. Although the English- and Korean-speaking PWA differed according to age (p = .016) and education (p = .016), they had comparable aphasia severity (p = .619) as measured by WAB-R Aphasia Quotient (AQ). The OA group consisted of 15 English-speaking and 15 Korean-speaking individuals, matched for age (p = .953) and years of education (p = .183). Table 1 summarizes the demographic and clinical data for the PWA group and the demographic data for the OA group. Supplemental Materials S1 and S2 provide detailed clinical data for English- and Korean-speaking PWA, respectively. Procedures for the study were approved by the

Table 1. Demographic information for each language group.

Variables		PWA		OA	
		English (n = 30)	Korean (n = 37)	English (n = 15)	Korean (n = 15)
Age (years)	*M*(*SD*)	63 (11)	55 (13)	67 (9)	67 (11)
		$F(1, 65) = 6.121$ $p = .016$*		$F(1, 28) = 0.004$ $p = .953$	
Education (years)	*M*(*SD*)	15.5 (2.9)	13.4 (2.8)	20.3 (4.1)	18.6 (2.4)
		$F(1, 65) = 6.121$ $p = .016$*		$F(1, 28) = 0.004$ $p = .953$	
WAB-AQ (total = 100)	*M*(*SD*)	70.56 (19.21)	68.43 (15.59)	N/A	N/A
		$F(1, 65) = 0.249$ $p = .619$		N/A	

Note. F and p values are from one-way analysis of variance. PWA = persons with aphasia; OA = older adults; WAB-AQ = Western Aphasia Battery–Aphasia Quotient; N/A = not applicable.

*$p < .05$.

institutional review board on Human Subjects of Ewha Womans University (2022-0140) and the institutional review board for the Charles River Campus at Boston University (Reference 3309E). Written informed consent was obtained from all participants.

Task

An animal fluency task was administered. Participants were instructed to produce as many words as possible in a given "animals" category within 60 s (Troyer et al., 1997).

Data Analyses

All responses were analyzed based on three approaches. First, the total number of correct animal responses was coded in a first-path general analysis. Each correctly produced animal word was coded as 1. Repeated words, words not belonging to the animal category, and nonwords were excluded and coded as 0. Additionally, only the first response was considered correct for animals within the same taxonomic category. For example, if "bear" and "polar bear" were both produced, only "bear" was counted as correct following the criteria of Troyer et al. (1997).

The second analysis focused on the cultural-specific approaches, in which two outcome measures were calculated: (a) the number of zodiac animals and (b) the ratio of zodiac animals. Zodiac animals included 12 items (rat, ox, tiger, rabbit, dragon, snake, horse, sheep, monkey, rooster, dog, and pig). The number of zodiac animals was calculated as the number of words belonging to the 12 zodiac animals. Synonyms such as "mouse" for "rat," "cow" for "ox," and "chicken" for "rooster" were accepted as correct. The ratio of zodiac animals was calculated as the number of zodiac animals divided by the total number of correct responses.

The final analysis involved item-level analyses. We created an item inventory and analyzed language-general and language-specific items for each language group in both the PWA and OA groups. Language-general items referred to items produced by both language groups, whereas language-specific items were unique to each language group.

Statistical Analyses

Statistical analyses consisted of two components: group-level analyses and item-level analyses. The group-level analyses employed linear mixed-effects models to examine differences in three dependent variables: total number of correct responses, the number of zodiac animals, and the ratio of zodiac animals. We conducted two sets of group-level analyses: within-language comparisons between PWA and OA and between-language comparisons of English versus Korean speakers within each participant group (PWA and OA). These analyses were performed using Python with the "statsmodels" library, specifically utilizing the "mixedlm" function.

For within-language group analyses comparing PWA to OA groups, we treated participant group as a fixed effect, with participants as random effects and age and years of education as covariates. The OA group served as the reference category. For between-languages analyses, conducted separately for PWA and OA groups, we specified language group as a fixed effect, indicated participants as random effects, and included age and years of education as covariates. The English-speaking group served as the reference category.

For the item-level analyses to identify animal items that could best differentiate between the language groups, we conducted Least Absolute Shrinkage and Selection Operator (LASSO) logistic regressions (Tibshirani, 1996) separately for the PWA and OA groups using R with the "glmnet" package. Considering the extensive number of predictors, with over 100 unique words produced by participants, and the relatively small sample size per group, the LASSO regression method is particularly effective for automated feature selection and minimizing the influence of less important variables, as noted by Henderson et al. (2023).

Results

Within-Language Group Comparisons Between PWA and OA

General Analyses—Total Number of Correct Responses

The PWA produced significantly fewer total number of correct responses in English ($\beta = -11.216$, $SE = 1.855$, $z = -6.046$, $p < .001$) and Korean ($\beta = -10.839$, $SE = 2.144$, $z = -5.056$, $p < .001$) when compared to OA in each language group.

Cultural-Specific Analyses—Number and Ratio of Zodiac Animals

For both English and Korean speakers, PWA groups generated significantly fewer zodiac animals (English: $\beta = -2.267$, $SE = 0.701$, $z = -3.234$, $p = .001$; Korean: $\beta = -2.700$, $SE = 0.927$, $z = -2.914$, $p = .004$). However, there were no significant differences in the ratio of zodiac animals between PWA and OA groups in either language (English: $\beta = 4.711$, $SE = 5.561$, $z = 0.847$, $p = .397$; Korean: $\beta = 10.497$, $SE = 11.097$, $z = 0.946$, $p = .344$).

Supplemental Materials S3 and S4 present the linear mixed-effects model results for within-language group comparisons in English and Korean speakers, respectively.

Between-Language Group Comparisons for Each PWA and OA Group

General Analyses—Total Number of Correct Responses

PWA. English-PWA produced significantly greater numbers of correct responses than Korean-PWA ($\beta = -3.923$, $SE = 0.980$, $z = -4.001$, $p < .001$, as detailed in Table 2 and Figure 1).

OA. No significant differences were found between the two language groups in the total number of correct responses ($\beta = -3.133$, $SE = 1.718$, $z = -1.824$, $p = .068$; see Table 2 and Figure 1).

Cultural-Specific Analyses—Number and Ratio of Zodiac Animals

PWA. There were no significant differences in the number of zodiac animals produced between the language groups ($\beta = 0.235$, $SE = 0.416$, $z = 0.566$, $p = .572$; see Table 2 and Figure 2A). In contrast, Korean-PWA generated a significantly greater ratio of zodiac animals than English-PWA ($\beta = 20.487$, $SE = 5.826$, $z = 3.516$, $p < .001$; see Table 2 and Figure 2B).

OA. The Korean-OA group produced more zodiac animals ($\beta = 1.933$, $SE = 0.491$, $z = 3.936$, $p < .001$; see Table 2 and Figure 2A) and generated a greater ratio of zodiac animals ($\beta = 17.013$, $SE = 1.132$, $z = 15.024$, $p < .001$; see Table 2 and Figure 2B) compared to the English-OA group. Summaries of the results from the linear mixed-effects models for both general and cultural-specific analyses are provided in Supplemental Material S5 for the PWA group and Supplemental Material S6 for the OA group.

Item-Level Analyses

Item Inventory

PWA. Within groups, English-PWA generated a total of 97 different animal items, while Korean-PWA produced 71 different items. Between the groups, 46 animal items were produced by both language groups (see Figure 3A), leaving 51 unique animal items produced only by English-PWA (see Figure 3B) and 25 animals produced only by Korean-PWA (see Figure 3C).

OA. The English-OA group produced a total of 120 different animal items, whereas the Korean-OA group produced 85 different items. Between the groups, 58 animal items were produced by both language groups (see Figure 4A), leaving 62 items uniquely produced by the English-OA group (see Figure 4B) and 27 animals produced only by the Korean-OA group (see Figure 4C).

Lasso Regression

To identify which animal items are predictive of the language group classification within the PWA and OA groups, we performed LASSO logistic regression analyses. The dependent variable was language group (English-PWA vs. Korean-PWA and English-OA vs. Korean-OA), and the independent variables were individual animal items. LASSO regression applies constraints on model parameters, shrinking some regression coefficients to zero to minimize prediction error (Wang et al., 2021). Variables with zero regression coefficients were excluded from the model, indicating they were not significant predictors. Conversely, variables with nonzero coefficients were retained, as they were identified as significant predictors, reflecting their relative predictive power in distinguishing between the groups (Kristinsson et al., 2021).

The group variable was set to "binomial" to indicate the dependent variable as either belonging to the Korean group (1) or not (0; see Wang et al., 2021). We estimated the LASSO model using a within-sample fourfold cross-validation (Henderson et al., 2023).

PWA

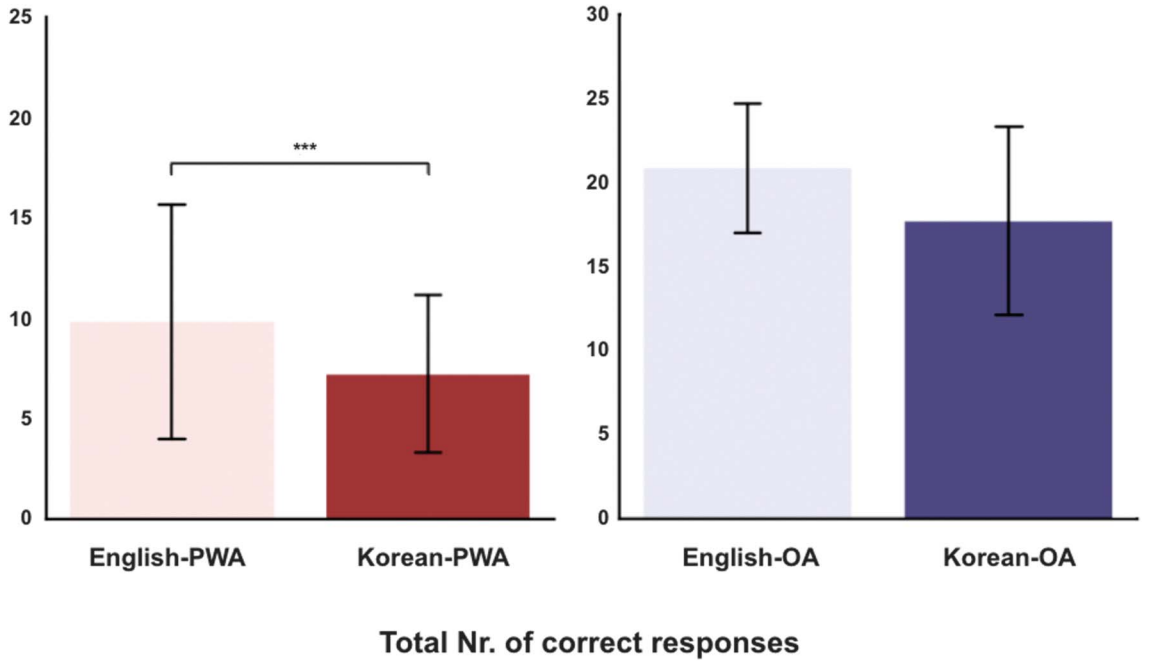
PWA. The LASSO logistic regression selected a group of animal items that together predict the PWA group classification (see Supplemental Material S7). The within-sample fourfold cross-validation accuracy for distinguishing between English-PWA and Korean-PWA was 91.04%. The animal item with the highest coefficient value was "tiger"

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

Variables	PWA		OA	
	English (n = 30)	Korean (n = 37)	English (n = 15)	Korean (n = 15)
Total number of correct responses	9.83 (5.94)	7.24 (3.97)	20.86 (3.96)	17.73 (5.78)
Number of zodiac animals	2.63 (2.05)	3.08 (1.80)	4.26 (1.48)	6.20 (2.24)
Ratio of zodiac animals	27.84 (16.44)	46.50 (24.63)	21.06 (8.00)	38.08 (15.26)

Note. Values indicate mean (standard deviation). PWA = persons with aphasia; OA = older adults.

Figure 1. Total number of correct responses produced in an animal fluency task across groups. PWA = persons with aphasia; OA = older adults. ***$p < .01$.



(1.15). In the Korean-PWA group, 19 of 30 individuals (63.33%) produced this item, whereas in the English-PWA group, only 12 out of 30 individuals (40%) did so. This indicates a notable difference, with the Korean-PWA group showing approximately a 23.33% higher occurrence of this animal item compared to the English-PWA group.

OA

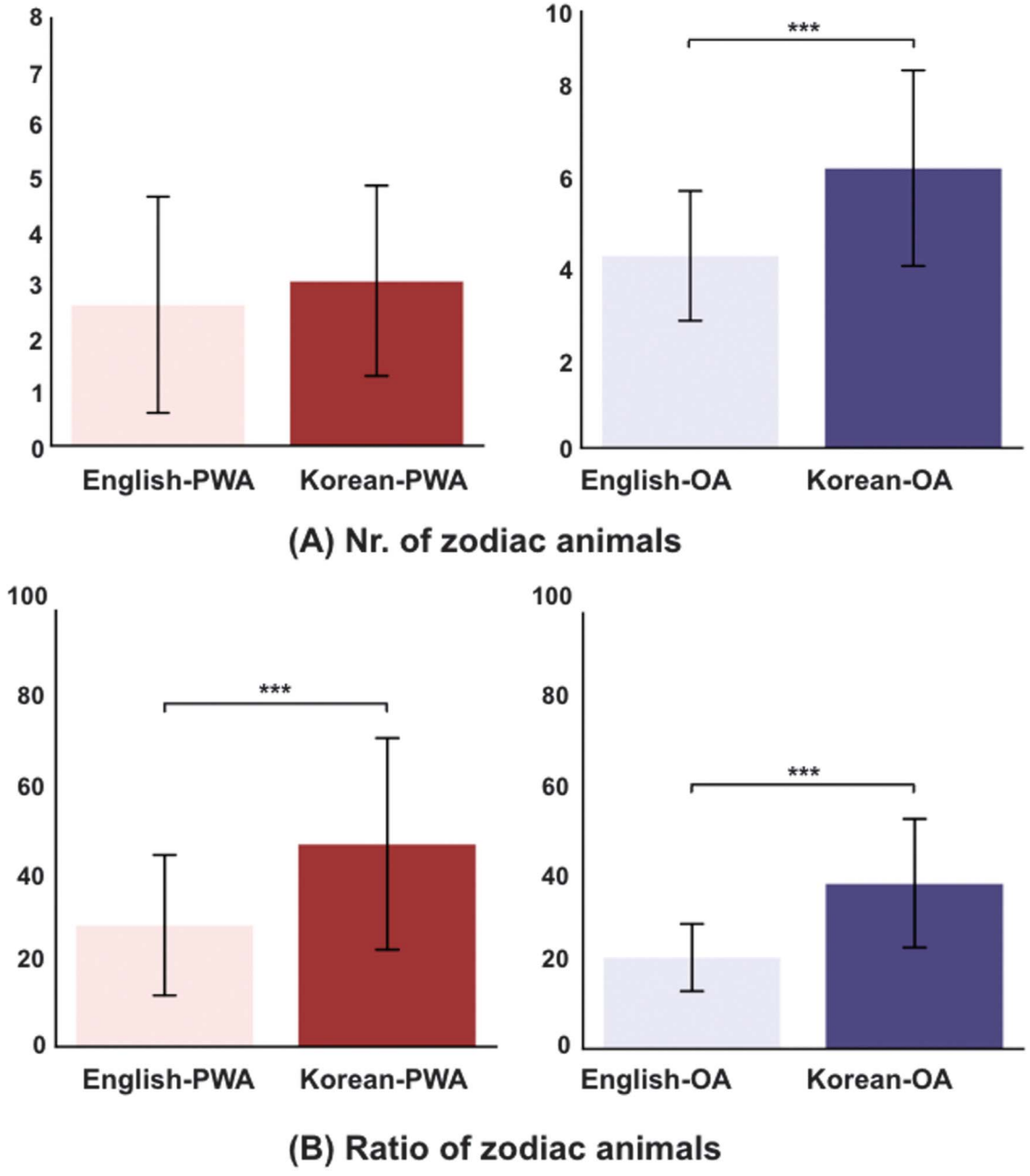
OA. For the OA group, the LASSO logistic regression identified a set of animal items that predict group classification (see Supplemental Material S7). The within-sample fourfold cross-validation accuracy for the OA group was 100% when comparing English-OA to Korean-OA. The animal item with the highest coefficient value was "chicken" (1.05). In the Korean-OA group, this item was produced by 11 of 15 individuals (approximately 73%), compared to only three of 15 individuals (20%) in the English-OA group, reflecting a notable difference of 53 percentage points between the two groups.

Discussion

This study first examined whether there are significant differences in the total number of responses between English- and Korean-speaking PWA as well as between English- and Korean-speaking OA. The results demonstrated that English-PWA produced significantly greater numbers of correct responses than Korean-PWA. In the OA group, the language group difference was not statistically significant, although English-speaking participants produced more items than Korean-speaking counterparts. These findings of the OA group are partially consistent with previous studies that have reported similar performance on the animal fluency task across different language backgrounds in aging populations. For example, Pekkala et al. (2009) observed comparable performance on the "animal" and "clothes" fluency tasks between English-speaking and Finnish-speaking OAs, despite their differing sociocultural contexts. Similarly, Eng et al. (2019) found no significant differences in animal fluency task performance between Mandarin- and English-speaking young groups, further suggesting that animal fluency tasks may not be strongly influenced by language group differences. Acevedo et al. (2000) compared normative data on semantic category fluency tasks with animals, vegetables, and fruits, between English and Spanish speakers. They found that while both groups performed similarly on the animal fluency task, English speakers produced more vegetable items than Spanish speakers, indicating that the type of semantic category can lead to differential performance depending on linguistic and cultural backgrounds.

In contrast, there are studies that reported cross-linguistic differences in the verbal fluency tasks. As a seminal study on cross-linguistic comparisons in verbal fluency tasks among aging populations, Kempler et al. (1998) compared performance across five different ethnic groups including Chinese, Hispanic, Vietnamese, English-speaking White, and English-speaking African American healthy

Figure 2. Cultural-specific analyses in an animal fluency task across groups. (A) Number of zodiac animals. (B) Ratio of zodiac animals. PWA = persons with aphasia; OA = older adults. ***$p < .01$.



OAs, all of whom performed the animal fluency task in their native language. They found significant differences depending on the language backgrounds, with Vietnamese speakers generating the highest number of animal items and Spanish speakers producing the fewest. The authors argued that these differences were attributed to the length of syllables in animal names, noting that Spanish generally uses longer syllables (two- or three-syllable), while Vietnamese predominantly used single-syllable words. In contrast, the effects of syllable length effects did not yield significant differences depending on the language backgrounds, as seen in the comparison between Finnish and English speakers in Pekkala et al. (2009), despite Finnish words generally being longer than the English words.

There seems to be stronger evidence that the "animal" category is relatively less culturally biased compared to other semantic categories such as "vegetable" for aging

Figure 3. Word clouds depicting the animal fluency task inventory of English- and Korean-speaking individuals with aphasia. (A) Language-general items, (B) English-specific items, and (C) Korean-specific items.

populations. However, when we incorporated zodiac animal analyses, the language group differences emerged for both the OA and PWA groups. Korean speakers, both with and without aphasia, produced a higher proportion of zodiac animals compared to their English-speaking counterparts. These findings suggest that while there may not be significant differences in the total number of correct responses between the language groups among OAs, culturally driven analyses reveal qualitative differences in performance on the animal fluency task. This indicates that the semantic components associated with animals can be influenced by cultural backgrounds, particularly when the variables of analyses adequately address these cultural differences. We specifically focused on the "zodiac" culture associated with the "animal" category based on the assumption that the animal zodiac serves as a salient feature that effectively reflects cultural differences between East Asian and Western societies. We hypothesized that exposure to different environments and cultural backgrounds might substantially influence the establishment of semantic networks. The consistent findings of significant differences in the usage of zodiac-related items during the animal fluency task between the two language groups, regardless of language impairments, confirmed our speculations.

Cultural differences were also evident from the item-level analyses. We observed notable differences in the size of the item inventory between the two language groups. While Korean speakers produced more zodiac animals, English speakers exhibited a greater diversity in their item inventory across both the OA and PWA groups. This can be interpreted in several ways. First, the size and structure of the semantic network related to "animals" may differ between the two language groups. For instance, the semantic network of Korean populations, traditionally exposed to zodiac culture, may be shaped by more limited access to culturally salient animal items. Additionally, differences in geographical and ecological, and educational backgrounds—factors that are closely intertwined with cultural aspects—may also play a role. These interconnected cultural and ethnographic factors likely influence how access to semantic information is organized (Ardila, 2005; Pekkala et al., 2009).

Our findings from the LASSO regression analyses further support this hypothesis, suggesting that the most distinguishable animal items, with the highest coefficients, all belong to zodiac animals (e.g., "tiger" for PWA and "chicken" for OA). LASSO regression, a form of

Figure 4. Word clouds depicting the animal fluency task inventory of English- and Korean-speaking older adults. (A) Language-general items, (B) English-specific items, and (C) Korean-specific items.

regularization technique that enhances prediction accuracy by selecting a subset of the most relevant variables, allowed us to pinpoint which animal items most effectively differentiate between the language groups. This analysis reinforced our conclusion that cultural factors influenced semantic retrieval processes in both Korean-speaking PWA and OA.

The study highlights the importance of considering cultural and linguistic backgrounds when assessing semantic fluency in PWA. Clinicians should be aware that traditional animal fluency tasks may yield different results depending on the cultural context of the client with aphasia. For instance, Korean-speaking PWA may have stronger recall of zodiac animals due to cultural exposure but with a relatively less diverse item inventory compared to other language groups, which could influence the interpretation of their performance. This suggests that assessments should be culturally adapted to ensure accuracy and relevance.

The findings indicate that cultural factors can shape semantic networks, meaning that interventions for PWA should be tailored to the individual's cultural and linguistic context. For example, therapy that incorporates culturally familiar concepts or items might be more effective in enhancing semantic retrieval processes in PWA. Clinicians might consider integrating culturally relevant material into therapeutic activities to improve engagement and outcomes. The study provides insights into how semantic networks are organized differently across cultures. This understanding can help clinicians better predict and address the specific challenges PWA might face when retrieving certain types of words, particularly those influenced by cultural factors. It also suggests that clinicians should explore not just the quantity of words retrieved but also the types of words and their cultural relevance.

As a follow-up to our current findings, our research group is further advancing the analysis of the semantic networks by exploring how these networks differed across languages and cultures (Sung, Shin, et al., 2024). In addition, we are examining cross-linguistic and cross-cultural differences in semantic retrieval strategies, focusing on switching and clustering behaviors during verbal fluency tasks between Korean-PWA and English-PWA (Shin et al., 2024). Future studies need to expand the scope of cross-linguistic comparisons to include additional languages and cultural contexts, particularly those underrepresented in the current literature. This would help to determine whether the observed differences in semantic retrieval strategies are consistent across a wider array of languages andcultures.

In summary, performance across widely used assessments for word retrieval difficulties such as verbal fluency tasks may be influenced by the cultural–linguistic backgrounds of neurologically intact aging controls and PWA. Across both the neurologically intact aging and poststroke aphasia groups, English speakers produced more unique animals and more responses to the task overall. Additionally, the Korean-speaking participants produced more animals in cultural-specific subcategories (relative to all animals) that appeared to serve as a retrieval strategy to increase the number of task responses. These differences in performance between the language groups constitute strong evidence for cultural effects in semantic fluency tasks. Although this study directly compared English and Korean, the results should be considered replicable for other language comparisons. Ultimately, the clinical implications of this study should guide and improve word retrieval assessment for monolingual speakers of languages other than American English and bilingual speakers with aphasia.

Author Contributions

Jee Eun Sung: Conceptualization, Supervision, Writing – original draft. **Junyoung Shin:** Formal analysis, Writing – original draft. **Michael Scimeca:** Writing – original draft. **Ran Li:** Writing – original draft. **Swathi Kiran:** Conceptualization, Supervision, Writing – review & editing.

Data Availability Statement

The data sets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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