

# The Relationship Between Verbal Fluency and Connected Language in Probable Alzheimer's Disease

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## Background

- Alzheimer's disease (AD) results in devastating deterioration of several cognitive processes that are evident in language abilities very early in the disease progression.
- Verbal fluency is one such measure that is often impaired in those with AD because it relies on frequently compromised cognitive skills such as memory for semantic storage of words, executive functioning for search and retrieval strategies, and working memory [1].
- Connected language relies on executive functions necessary for not only accessing semantic storage of words but also for generating a message, function assignment, constituent assembly and verb inflection, as well as phonological encoding for expression [1].

## Specific Aims

- To do an in-depth examination of the relationship between verbal fluency and connected language in probable AD.
- To determine whether and how well verbal fluency and connected language composite scores discriminate mild cognitive impairment and probable AD groups.

## Methods

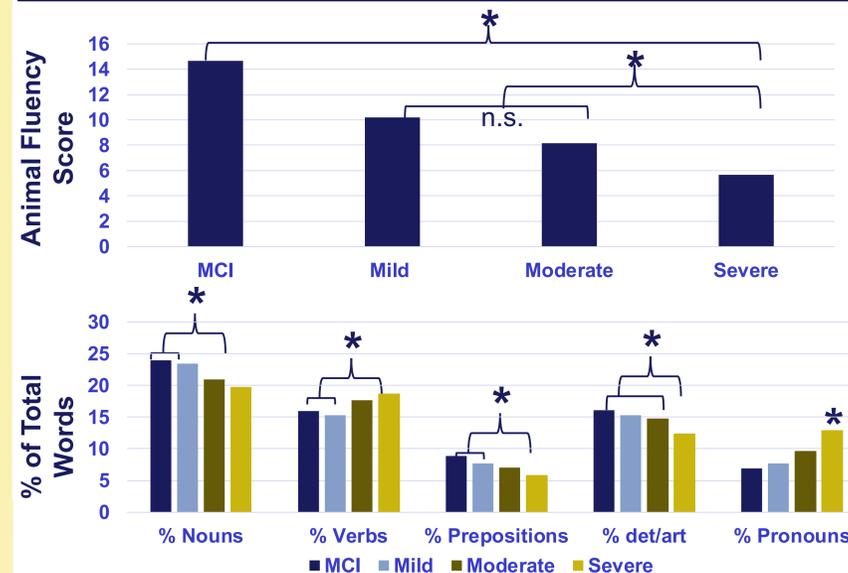
- Auditory recordings of connected language (Cookie Theft Picture Description task) [2] and verbal fluency samples (Animal Naming) were acquired from the DementiaBank Pittsburgh Corpus [3] for use in this study were used for the study.
- The Animal Naming fluency task was scored for total number of animals named, repetitions, and paraphasias [4]. Reliability across raters was excellent ( $ICC_{1,K} = 0.991$ ).
- Picture description samples were transcribed by researchers contributing to the TalkBank repository using Computer Language Analysis (CLAN) software [5]. MOR was used to characterize language metrics for each transcript [5].
- A factor analysis was conducted to evaluate which variables of connective language and verbal fluency are of importance for the differences of performance in MCI and each subgroup of probable AD.
- The factors were then investigated with linear regression to determine how well these factors predict group membership: MCI, mild MMSE, moderate MMSE, and severe MMSE subgroups.

## Participants

	MCI	MMSE Groups		
		Mild	Moderate	Severe
n	17	16	50	30
Age <sup>a</sup>	67.13	74.5	70.02	72.62
Gender (M:F) <sup>a</sup>	9:8	7:9	15:35	11:19
MMSE	27.76	25.31	20.22	13.77
Years of Education <sup>b</sup>	15	12.13	12.18	11.30
Blessed <sup>b</sup>	1.24	4.6	6.64	7.95
Hamilton Depression Scale <sup>a</sup>	3.75	5.4	6	6.4

Table 1. MMSE groupings for probable AD participants: 30-24 Mild, 23-18 Moderate, 17-0 Severe [6,7]. <sup>a</sup>No group differences for age, gender, and Hamilton Depression Scale [8] <sup>b</sup>MCI differed significantly from all other groups ( $ps < .0001$ ).

## Language Performance



The groups did not differ for any of the MLU, FREQ, duration, speed or error measures (all  $ps > .05$ ).

Nouns: MCI = Mild > Severe; Verbs: MCI and Mild < Severe; Mild < Moderate; Prepositions: MCI and Mild > Severe; MCI > Moderate; Determiners/Articles: MCI = Mild = Moderate > Severe; Pronouns: MCI < Moderate & Severe, Mild < Severe

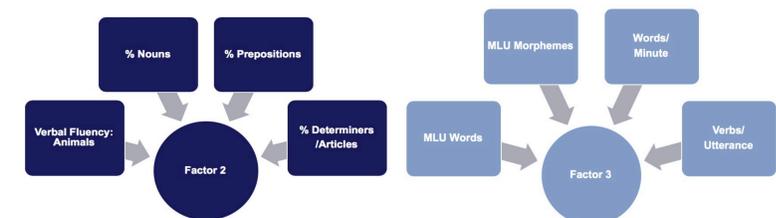
## References

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CLAN Measure	Correlation (Pearson r) with Verbal Fluency Group			
	MCI	Mild	Moderate	Severe
Words per Minute	0.595	0.063	0.306	0.209
Verbs per Utterance	0.345	-0.523	0.137	-0.026
Utterance Errors	-0.098	0.532	0.030	-0.166
Density	0.279	-0.58	-0.073	-0.072
% Nouns	0.048	0.697	0.223	-0.142
% Prepositions	-0.194	0.722	0.184	-0.034
% Pronouns	-0.235	-0.534	-0.052	0.076
% Adverbs	0.306	-0.603	-0.192	0.220
% Determiners/Articles	-0.188	0.374	-0.078	-0.060
% Third Person Singular	0.183	-0.254	0.013	0.387
% Conjunctions	-0.117	-0.197	0.159	-0.362
Repetitions	0.286	0.240	0.316	-0.073
Education	0.484	0.007	-0.066	-0.301

Table 2. Groups differed in which CLAN measures correlated with verbal fluency performance. R<sup>2</sup> values for verbal fluency score and CLAN measure relationships.



- Principal components analysis yielded 5 factors that accounted for 57% of the variance in the data.
- Linear regression was used to predict group memberships based on the PCA-derived factors. A significant regression equation was found ( $F_{2,110} = 27, p < .0001, R^2 = .33$ ) indicating that Factors 2 and 3 best predicted group membership for all subjects.
- A separate linear regression predicted MCI and Mild group membership ( $F = 16, p < .0001$ ).

## Conclusion

- Verbal fluency correlated with connected language metrics differently in each group with the Mild AD group particularly demonstrating a relationship between fluency and % nouns, prepositions, and determiners/articles.
- Principal components analysis identified 2 factors that discriminated the groups, particularly between MCI and Mild AD.
- Variables associated with lexical retrieval and semantic concepts loaded on Factor 2 while Factor 3 related to amount of language produced, each playing a significant role in discrimination between groups.
- Each grouping have varied abilities regarding lexical retrieval and production, likely due to the progression of diminishing cognitive processes.