



Disorders of Verbal Fluency in Individuals with Cognitive Dysfunctions from a Neuropsycholinguistic Perspective

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Abstract

Language is the most important source of interpersonal communication. Therefore, studies on language functions are crucial in assessing various clinical groups, especially patients with cognitive function disorders. In patients in the early stages of dementia, there are numerous disturbances in verbal functions, including verbal fluency disorders. The analysis of verbal fluency in patients with different dysfunctions, such as damage to the right, left, or both hemispheres of the brain [1], has found application in the differential diagnosis of neurological disorders in children and adolescents [2], as well as in neuropsychological diagnostics [3], [4], [5] which has been systematically explored for several years. However, few studies on verbal fluency disorders in patients with cognitive impairments focus on comprehensive interdisciplinary neuropsycholinguistic analysis [6]. Therefore, it was decided to analyze the specifics of verbal fluency disorders in patients in the early stage of dementia, at the mild cognitive impairment stage, as well as in patients with clinical manifestations of dementia-related diseases. The aim of this research project is to examine and analyze verbal fluency in individuals with cognitive dysfunction at the level of mild cognitive impairment and dementia, including those with Alzheimer's disease. The results of verbal fluency test (MMSE) studies in patients showing similar disorders will be subjected to analysis. Using tools for corpus data analysis [7], [8], [9] the most frequently occurring words extracted from patient studies through the Mini-Mental State Examination (MMSE) scale for assessing mental status will be examined.

Keywords: *verbal fluency tests, MMSE, functional disorders, cognitive disorders, corpus analysis*

Verbal fluency, also known as semantic fluency, is a specialized medical term referring to the capacity to choose words that have been encoded and stored through language acquisition [4], [1]. In the context of fluency tasks, possessing categorical knowledge is essential. The concept of a semantic category pertains to the minimal meaning found within human consciousness, which forms the foundation of their reference knowledge [5]. This typology prompts the necessary semantic associations required to recall the appropriate words from one's mental lexicon. The effectiveness of swapping words that align with a specific criterion is made possible through the semantic network that connects concepts into distinct sets, along with mechanisms of lexical activation and fundamental skills like understanding the content of verbal messages [6].

In older individuals, difficulties in comprehending words can result in a reduced frequency of word usage and occurrence, consequently leading to a significant simplification of their verbal fluency [7]. The quality of linguistic processes and the state of semantic memory are influenced by how verbal fluency tasks are carried out. This encompasses factors such as the quantity of concepts generated based on a specific criteria, the alignment of these concepts with the chosen criteria, the presence of clusters or groups of related words, the nature of errors, which may include newly coined words and repeating the same words, as well as the use of words that do not fit into the specified category [1], [8].

Both early and contemporary research in the fields of neuropsychology and psychiatry extensively describe and underscore the numerous factors that directly and indirectly affect the performance levels in verbal fluency tasks. These studies highlight the multifaceted nature of the mechanisms linked not only to psychology but also neural processes relevant to this area of investigation. It's worth noting that there is a scarcity of scientific literature addressing the adaptation of verbal fluency techniques to the specific context of research conducted in Polish settings. Several significant factors were identified as influencing the execution of verbal fluency tasks, including age, gender, and



education. Furthermore, there is a particular emphasis on the cognitive abilities of the subjects under examination, as well as their emotional and personality-related conditions. This is evident through elevated levels of anxiety, depression, compulsiveness, and the emergence of comorbidities, all of which are relevant to the study [1].

In this research, the corpus method of linguistic analysis was employed, which involves the automated extraction of the mentioned terms and their grouping based on how often they appear. This technique of electronic concordances facilitates the rapid identification of keywords and expressions that are distinctive within the subject matter being studied. As corpus tools have advanced, it has become increasingly convenient to pinpoint phrases, clusters, or sets of related words. A fundamental aspect of text analysis and the extraction of these lexical bundles or individual terms is their frequency, as it indicates how often these linguistic items tend to appear.

Kjellmer (1994) highlights in the initial sections of the Dictionary of English Collocations (DEC) that the presence of repetition should be regarded as an essential requirement for recognizing a linguistic entity as a collocation [10]. In contrast, Krenn (2000) asserts that research findings confirm the limitations of statistical measures when it comes to identifying lexical bundles in data containing a significant proportion of infrequently occurring items. Krenn suggests that this necessitates the development of methods capable of identifying bundles based on data with low occurrence frequencies, as such words are prevalent in language corpora [11].

On the other hand, Gablasov, Brezina, and McEnery (2017) stress the importance of considering the distance between words that appear together and the desired proximity of units when identifying lexical bundles. This can be accomplished through the identification of lexical bundles or through the use of n-grams, which are single tokens that capture these word associations.

In the initial phase of the analysis, as per the standard procedure in scientific research, the effectiveness of the research tools employed with the elderly participants was evaluated. Given the characteristics of the variables under examination and the requirements for a specific type of analysis, the Alpha-Cronbach index was utilized to assess the verbal fluency test and the MMSE (Mini-Mental State Examination). It was assumed that an alpha index exceeding 70 indicates a high level of consistency within the analyzed scales. The results of these analyses indicated that the subscales of the verbal fluency test and the MMSE in the group of elderly individuals being studied displayed strong internal consistency, as evidenced by notably high Cronbach's alpha values ranging from 0.73 for the MMSE to 0.80 for the letter fluency test and 0.82 for the fluency tests involving "animals" and "sharp objects." Moreover, in the factor analysis, it was observed that all the subtests of the fluency test and the MMSE could be explained by a single factor. This suggests a common underlying etiopathogenetic mechanism that accounts for cognitive disorders in the areas under investigation. A similar approach to the analysis of neurocognitive tests, including fluency tests, is commonly applied in modern research concerning elderly individuals with cognitive impairments [12].

The group of 100 elderly individuals analyzed in this study exhibited a high degree of homogeneity. When considering their age and the results of the MMSE test, there were no notable differences between men and women within this group. In the verbal fluency test, women outperformed men in the letter-based assessment, whereas the results in the categorical tests involving "animals" and "sharp objects" were similar. It's important to note that these findings should be interpreted in the context of this particular study, as there is not a universal consensus on this matter in global research. For instance, in studies involving elderly individuals in Spanish-speaking populations, gender-based differences in verbal fluency test performance were generally not significant, except for the "animals" subtest [13]. However, another study within this language group did not find such substantial gender differences [14]. In research conducted by Polish authors, significant differences were identified in the performance of fluency tests among younger people. Men performed slightly better in the semantic fluency test, but there were no variations in verbal strategy. The authors proposed a hypothesis that these findings might reflect disparities in the lexical system related to social roles. Nevertheless, this hypothesis is not particularly convincing, especially considering that the study was not conducted on a representative group that would permit broad generalizations [15].

One recent meta-analysis revealed that the most influential factor affecting performance in fluency tests among the elderly is age, with gender playing a less significant role [43]. However, the results of



the correlation analysis conducted in this study do not entirely align with this observation. No substantial correlations were identified between the respondents' age and their performance in the verbal fluency test and the MMSE test. Similarly, there were no significant correlations between age and the frequency of incorrectly inserted words in the fluency test.

The analysis did reveal a negative correlation between the duration of neurocognitive dysfunction and the number of words generated in the verbal fluency test. This suggests that overall fluency test performance tends to worsen with a longer duration of cognitive impairment. These findings are consistent with American studies, which clearly indicate that the decline in verbal fluency, especially in phonemic and semantic fluency tests, serves as a predictor of general cognitive deterioration over time [16]. Furthermore, in this study, a clear relationship was established between the effectiveness of cognitive functions, as measured by the MMSE test, and the performance in verbal fluency tests. The greater the decline in cognitive functions observed in the MMSE, the poorer the results obtained by the respondents in all fluency tests.

The findings derived from this study hold substantial importance from both clinical and cognitive perspectives, as disturbances in verbal fluency are likely indicative of more profound structural and functional alterations within the brain.

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