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THE VERBAL FLUENCY TEST AS A TOOL FOR THE DIFFERENTIAL DIAGNOSIS OF DEMENTIA AND MILD COGNITIVE IMPAIRMENT, AS AGAINST NORMAL AGEING: A RESEARCH REVIEW STUDY

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Tento článek si můžete v českém jazyce přečíst zde.

Abstract

Dementia can ultimately be understood as a linguistic, neurogenic, and cognitive disorder. With the increasing average life expectancy, the number of individuals affected by dementia continues to rise, underscoring the importance of early and accurate diagnosis. A detailed assessment of not only language processes can provide valuable information to both healthcare professionals and family members, particularly in developing an appropriate therapeutic plan. Results of the verbal fluency test reflect not only the overall level of language abilities, but also the functional integrity of executive functions and semantic memory. Due to its simplicity and time efficiency, the verbal fluency test appears to be a suitable tool for the differential diagnosis of dementia, mild cognitive impairment, and normal ageing. This review article summarizes current findings on its clinical utility, with particular attention given to clustering and switching strategies.

Keywords

verbal fluency test, clustering and switching, dementia, mild cognitive impairment

Background and Introduction

Dementia is one of the most common consequences of neurodegenerative diseases. The name comes from the Latin *de* (without) and *mens* (mind), which translates as "mindlessness". (Rusina & Matěj, 2019). According to a 2025 report by the Czech Ministry of Labour and Social Affairs (MoLSA), approximately 10% of people over the age of 65 suffer from dementia; at age 65, it is about 5%, and every following 5 years the incidence almost doubles — e.g. at the age of 80 it reaches 25–30% (Ministry of Labour and Social Affairs, 2025; Cao et al., 2020). According to the annual report of the Czech Alzheimer's Society for 2023, based on data from the Czech Statistical Office (as of December 31st, 2023), there are almost 171,000 people living with dementia in the Czech Republic, of which 54,220 are men and 116,563 are women (Czech Alzheimer's Society, o.p.s., 2024). Alzheimer's dementia accounts for the largest proportion of all dementias (up to 60%). Other types include e.g. frontotemporal dementia (Pidrman, 2007; Rusina & Matěj, 2019).

The relatively broad spectrum between normal ageing and the clinical stage of dementia is referred to in the literature as mild cognitive impairment (Oh et al., 2019). The probability of progression to dementia is up to 50%, which is why it is often referred to as a risk factor regarding its development (Bartoš & Hasalíková, 2010; Hauke, 2017). People with mild cognitive impairment are typically characterized by a deterioration in memory abilities beyond what is normal for their age. However, other studies have also noted deterioration in speech, attention, executive functions, abstract thinking, and spatio-temporal orientation (Jacobs et al., 2012; Oh et al., 2019; Malhotra, 2019). Distinguishing mild cognitive impairment from the dementia syndrome and from physiological ageing is absolutely crucial for the due initiation of follow-up care (Lužný, 2012).

Although the diagnosis of dementia is often primarily focused on memory, speech and language disorders are a significant but often neglected feature of many types

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of dementias (Zapletalová, 2023; Stanyon et al., 2016).

Language deficits in people with dementia can be classified at the level of words, sentences and discourse (Kavé & Goral, 2016; Healey et al., 2019). Phonological and semantic deficits include phonological paraphrases, anomies, neologisms, and difficulties in naming in spontaneous speech (Banovic et al., 2018; Jokel et al., 2019). Semantic paraphasia changes as the disease progresses. This leads to the substitution of concepts from the same semantic level (cohyponyms) to the use of only higher-order terms (hypernyms) (Marková et al., 2012). On a syntactic level, agrammatisms occur (Klimova & Kuca, 2016). Discourse is complicated by disparate speech and frequent repetition of content (Pistono et al., 2019). As the disease progresses, the content of the message becomes more meaningless and inadequate (Forbes-McKay et al., 2013). In addition, communication disorders in people with dementia are also greatly affected by deficits in cognitive functions. Sentence comprehension is impaired in people with dementia due to impaired attention and memory, while the understanding of more complex sentence structures deteriorates even in mild dementia (Liu et al., 2019; Hane et al., 2017). In later stages there may be a decrease in speech fluency (Forbes-McKay et al., 2013). Slower information processing complicates the recognition of the main idea of the message and the perception of intonation (Banovic et al., 2018; Marková et al., 2012; O'Brien & Thomas, 2017). Memory deficits cause difficulties with recalling words and remembering multiple instructions (Klimova & Kuca, 2016). Cognition is limited when it comes to understanding abstract concepts, humour, and social norms (Luzzi et al., 2020; Clark et al., 2015) but has been little studied in these diseases. We designed a semi-structured informant questionnaire to assess humor behavior and preferences in patients with behavioral variant of frontotemporal dementia (bvFTD; n=15. Executive function disruption reduces the ability to plan, judge, control emotions, and complete tasks (Thabtah et al., 2020; Scheltens et al., 2021; O'Brien & Thomas, 2017). These deficits are already evident in the early stages (Cheran et al., 2019).

Verbal fluency

Speech fluency represents the ability to produce a continuous flow of speech, which should have appropriate pace, speed and rhythm. Normal speech fluency is considered to be 90–120 words per minute (Mumenthaler et al., 2004). The pertinent assessment is the degree of fluency of spontaneous speech production (Preiss, 2012). Its disruption may be related to intellectual disorders and reflects the ability to organize thoughts (Obereigners, 2024). What is meant by verbal fluency is the whole complex of cognitive neuronal processes in which words from long-term and semantic memory are recalled based on selected aspects. This is assessed using a verbal fluency test, which measures the ability to quickly and efficiently generate words according to specified criteria (Hummelová & Janoušová, 2014).

Verbal fluency test

The primary reference source for the test is considered to be the 1962 Thurston study. Five years later, A. L. Benton included the task of verbal fluency of the sounds F, A and S in the test battery of the Neurosensory Center Examination for Aphasia (Preiss, 1997). The verbal fluency test is among the most widely used neuropsychological methods for assessing cognitive processes (Nikolai et al., 2015). It is a practical test with a simple assignment, of short duration, but high difficulty for the test taker – they must follow the rules, generate words quickly and avoid repetition (Bartoš & Raisová, 2019). In addition to mapping speech characteristics, the test is used to diagnose deficits in executive functions, semantic memory, and psychomotor pace (Preiss, 2012). It is also part of many test batteries, such as the Assessment of neuropsychological status update (RBANS), the Addenbrook Cognitive Test (ACE-R), the Montreal Cognitive Test (MoCA), the CERAD Neuropsychological Battery, the Mattis Dementia Scale DRS-2 or the Delis-Kaplan executive function system (D-KEFS) (Nikolai et al., 2015; Preiss, 2012). In addition to clinical practice, it is also used in research. It is widely used, for example, in the examination of brain function by imaging methods. As evidenced, for example, in their study of fMRI in people with dementia and cognitively typically developing older adults (Paek et al., 2020), verbal fluency can also serve not only as a cognitive, but also as a neural marker of frontal lobe deficits observed in neurodegenerative diseases.

The verbal fluency test traditionally has two versions, the phonemic (letter) and categorical (semantic). Within phonemic, the subject has the task of listing as many words as possible in a certain period of time that start with a specific sound. Within the categorical type, their task is to list as many words as possible belonging to a certain category, for example, animals, fruits, vegetables etc. The resulting word count is compared with the norm (Mueller et al., 2015; Víchová et al., 2020). From a neuroanatomical point of view, the left precentral and inferior frontal gyrus of the frontal lobe are more involved in the phonemic version, while in the semantic version, the anterior left part of the gyrus medialis and the left occipitotemporal sulcus of the temporal lobe are active (Birn et al., 2010). Given poor performance in both verbal fluency tests, one can generally identify reduced flexibility and certain difficulties not only with the organization of speech but also with cognition (Beber et al., 2023). Words recalled at the beginning of the test inform about the availability of words in semantic memory, while words evoked later point to a strategy for successful word search in the lexicon (Preiss, 2012). All of the aforementioned difficulties are reflected not only in the overall test score, but also in perseverance and confabulations (Bartoš & Raisová, 2019; Villalobos et al., 2023). Performance in verbal fluency tasks is influenced by sociodemographic variables (Lehtinen et al., 2023; Santos Nogueira et al., 2016). Therefore, especially for phonemic verbal fluency, the adaptation of norms to the specific cultural and linguistic environment of a given country is strongly recommended (Thiele et al., 2016; Becker and Salles, 2016; Franzen et al., 2020; Villalobos et al., 2023).

In the Czech Republic, there are standards for the phonemic version of the word count test for the sounds N, K, P and S. Since words beginning with the sound N have a lower frequency in the Czech language, this task is generally considered to be more demanding (Kopeček and Kuncová, 2006; Víchová et al., 2020). That is why some authors use the S sound (Nikolai et al., 2015). Standards for children and adults are also offered by Preiss (2012). Nikolai et al. (2015) analysed performance in the semantic version for the animals and vegetables category. The threshold number of words within the animals, fruit and shopping list category was further dealt with by Bartoš and Raisová (2019). They compared the performance of healthy seniors with the performance of people with mild cognitive impairment and people with Alzheimer's dementia.

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As part of the instructions of the phonemic verbal fluency test, the subject has the task of listing as many words as possible for a given letter, in one minute. Names, or same word variations (with other endings) are not permissible (Preiss, 2012). In addition, Bartoš and Raisová (2019) add the restriction of not naming cities or countries, nor using words that differ in the singular and plural, and word diminutives. Conversely, they emphasize the option to use all parts of speech. The recommended practice for scoring is to discard repeating words and any words that fall outside the conditions. Words with different meanings with the same root do not count, nor do the 'listed words' taught in school, [being a list of rote-learned exceptionally spelled Czech words with 'y' after a consonant], and words formed with the prefix "ne" [negating the meaning, equivalent to "un-" or "non-" in English]. However, the evaluation of words with the negative prefix "ne" is not yet uniform. Conversely, some authors (Víchová et al., 2020) do accept words formed in this way. Rude words are not penalized (Preiss, 2012; Preiss et al., 2006). The instructions for the category words production test are similar. The subject is tasked with naming as many words as possible belonging to a certain category. Words can begin with any letter, they must not be repeated and it is not permissible to form singular and plural variants, nor diminutives. Despite the fact that both versions have a similar principle, these are tests of differing complexity and clinical importance (Bartoš & Raisová, 2019).

The use of the verbal fluency test in diagnostics is justified. It can be used both in the diagnosis of mild cognitive impairment and the initial stage of dementia, as well as in differential diagnosis, when we need to distinguish different types of dementia from one another or dementia from phatic disorders, or from impaired communication skills in depression (Qianhua & Qihao, 2013; Nikolai et al., 2015). People with mild cognitive impairment are much more likely to have impaired scores within the semantic variant of the test than with the phonemic one (Vonk et al., 2019; McDonnell et al., 2020). Bartoš & Raisová (2019) agree with this conclusion, stating that people with Alzheimer's dementia and people with mild cognitive impairment perform worse in the categorical version of the word production test than do normally ageing individuals. In addition, they report different outcomes for healthy seniors and those who develop dementia even some 20 years later. Similar results are presented by other research (Quaranta et al., 2023; Liampas et al., 2023; Vaughan et al., 2018), where the categorical version is considered a diagnostic tool capable of differentiating a group of people with progressive dementia from those with non-progressive mild cognitive impairment. In contrast, the results in the phonemic version are stable for a long time, both in the preclinical phase and in the early stage of Alzheimer's dementia (Bartoš & Raisová, 2019).

Clustering and switching in the verbal fluency test

Moreover, in both versions of the verbal fluency test, there are more comprehensive options for evaluating performance in terms of cognitive strategies. These are known as clustering and switching. Clustering is the ability to produce words within a single category, i.e. to organize words into logical units (Mueller et al., 2015; Víchová et al., 2020). One example might be the following generation of words in the animals category: whale, dolphin, goat, sheep. The first two words belong to the subcategory of marine mammals. In contrast, the other two terms belong to the subcategory of livestock (Fong et al., 2020). Another subcategory to consider would be words starting with two identical phonemes, such as the Czech words *koza* and *kohout* [goat, rooster]. From a neuroanatomical point of view, temporal lobe processes such as verbal memory and the way words are stored and recalled are responsible for the clustering ability (Fong et al., 2020; Unsworth et al., 2011). On the other hand, switching means moving between individual clusters/categories after the previous topic area is exhausted. In practice, this might lead to a list of domestic animals followed by a list of exotic animals. This involves frontal lobe processes such as search strategy, executive function, and attention (Beber et al., 2023; Patra et al., 2020). In addition, it has been found that even if the subjects give a performance consistent with the norm in word count, subsequent analysis of the clustering and switching strategy may point to deviations indicative of some deficit (Lehtinen et al., 2023).

Qualitative evaluation of the test was addressed by Pešek (2023). In his work, he proposed using vector analysis to create qualitative indices of semantic verbal fluency in people with Alzheimer's dementia. A significant difference between the control group and people with Alzheimer's dementia was found in all qualitative indices, for the vegetables category. These indices were the total number of clusters, the average number of words in the cluster, and the total number of switches. Bairami et al. (2023) report progressively impaired performance in switching as well as clustering between healthy individuals, those with mild cognitive impairment, and those with Alzheimer's dementia. The same results were found by Zhao et al., (2013), who also included people with vascular dementia; they performed better on the test than those with Alzheimer's dementia, but worse than those with mild cognitive impairment. The importance of using verbal fluency tests for preclinical Alzheimer's dementia is also emphasized by Mueller et al. (2015), who report lower scores in both the semantic and phonemic versions of the test among those with mild cognitive impairment compared with healthy individuals. Increased interest in the quantitative and qualitative analysis of the above tests is also declared by research that, among other things, provides normative data for the verbal fluency test for phonemes (M, A, B) and categories (animals, fruits and vegetables) for people of Lebanese origin (El-Hayeck et al., 2023).

A categorical version of the test in people with presymptomatic and prodromal frontotemporal dementia was discussed by Jiskoot et al. (2023) in their longitudinal study. The results suggest a relationship between the loss of grey matter in the temporal areas of the brain and of words more frequently used (based on language corpora) and words previously acquired. Conversely, correlating with a lower number of clusters, their size and switching between them was the loss of grey matter in the frontal cortex area. The amount of switching between clusters is seen by Oh et al. (2019) as an even more sensitive predictor of the existence of mild cognitive impairment than is the mere number of correctly evoked words.

Interesting research was carried out by Beber et al. (2023), who analysed clustering and switching in a verbal fluency test focused on verbs, in people with Alzheimer's dementia. The instruction made clear only verbs were permissible, and these were subsequently classified into categories of movement (run, climb, fall), routine actions (sweep, bathe, dream, drink, exercise), actions with objects (sell, buy, sew, paint) and psychological phenomena and states (laugh, love, speak, think). The results showed significant differences

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in performance in the number of switches between clusters and in the total number of correctly worded words to the detriment of participants with dementia.

Adapting clustering and switching rules to the Czech environment

Although the assessment of clustering and switching in verbal fluency tests is a common procedure abroad, almost no attention is paid to it in the Czech environment. Accordingly, there were no systematized rules for their classification until recently. The first to address this was Velkoborská (2013), who in her master thesis presented a possible localisation of the phonemic cluster evaluation rules, in the phonemic version of the test.

The above-mentioned procedure for assessing clustering and switching in both versions of the verbal fluency test with respect to the Czech environment was then proposed by Víchová et al. (2020). These were based mainly on the adaptation of studies abroad, by Troyer et al. (1997), Abwender et al. (2001) and Tallberg et al. (2011). In the thesis, she presents rules for the evaluation of *phonemic clusters*, where a cluster is considered to exist for words that (a) begin with two identical letters (*koza–kopyto*) (b) rhyme (*noha–nota*) or (c) have the same first and last phoneme (*puk–pak*). Not included in the same category are words that differ in (a) the number of vowels (*kápě–kámen–kamarád–kalhoty* would be two separate clusters) (b) diphthongs (*poukaz–pórek* do not belong to one cluster). Giving proper names and words that differ only in their ending is not permissible. Words that contain the negating prefix *ne-* are not penalized.

The rules for evaluating *semantic clusters* in the *animals* category are as follows: animals belonging to a certain category (reptiles, rodents). A cluster is also considered to be (a) a superior term followed by a list of members (*bird–eagle–titmouse* is considered a cluster of two), (b) both sexes of the animal (*tomcat–cat*). In the case of the *supermarket/shop* category, two consecutive words that belong to a certain category are considered a cluster. Víchová (2020) lists all categories, such as food, beverages and drugstore items. Additional categories were included such as household, as well as an abstract category that covers words that are intangible, experiential or abstract. The same applies to clusters in the *fruit* category, where the variety is classified into a specific category, such as pomes (fleshy fruit with a core), drupes (fruit with a skin and a central stone), tropical fruits, and others. (Víchová et al., 2020).

Conclusion

The verbal fluency test is a simple, time-saving tool that proves useful in diagnosing dementia, mild cognitive impairment and physiological ageing. In addition to overall language performance, it provides important information about executive functions and semantic memory, especially through the analysis of clustering and switching strategies. Due to the increasing prevalence of dementia and its impact on language and cognitive functions, more attention needs to be paid to early diagnosis. At the same time, speech therapy practice lacks tools that would effectively take into account language and cognition. The verbal fluency test has considerable potential in this regard. Further research and adaptation of the assessment methodology for the Czech environment can support its wider use in clinical practice.

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