Verbal Fluency and Information Processing Speed in Patients with Parkinson's Disease: A Study in the Algerian Clinical Setting

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***Abstract*—This study examined the relationship between verbal fluency (lexical and semantic) and information processing speed in patients with Parkinson's disease in an Algerian clinical setting. A descriptive cross-sectional correlational design was adopted. The Cardebat Verbal Fluency Test and the Paced Auditory Serial Addition Test (PASAT) were administered to a purposive sample of 10 patients. Spearman's rank-order correlation coefficients between the combined PASAT score and overall, lexical, and semantic verbal fluency were .895, .797, and .882, respectively, all $p < .01$. Higher verbal-fluency scores were associated with higher PASAT scores in the study sample. Given the small, purposively selected sample, these findings should be interpreted cautiously and do not establish causal relationships. Furthermore, the scores alone do not establish clinically significant impairment in the absence of appropriate normative data.**

Keywords—verbal fluency, lexical fluency, semantic fluency, information processing speed, Parkinson's disease

I. INTRODUCTION:

Parkinson's disease (PD) is one of the most prominent age-related neurodegenerative disorders, typically affecting middle-aged and older adults and leading to a progressive decline in central nervous system function. The disease is commonly associated with motor impairments, including tremor, rigidity, bradykinesia, and gait difficulties (Qamhiyah, 2024, p. 55). Alongside these motor manifestations, cognitive and linguistic functioning has received attention in research on the disease.

Verbal fluency and information processing speed are relevant to the investigation of cognitive–linguistic functioning in Parkinson's disease. Examining their association may help characterize how performance on these measures varies within a clinical sample.

The present study examines the associations between overall, lexical, and semantic verbal-fluency scores and performance on the Paced Auditory Serial Addition Test (PASAT) in a sample of patients with Parkinson's disease in an Algerian clinical setting.

II. PROBLEM STATEMENT

Parkinson's disease has attracted considerable research attention both nationally and internationally, with the aim of improving the care provided to affected individuals through the description of its medical and speech-language manifestations, as well as the development of assessment and therapeutic approaches. Parkinson's disease results from the progressive degeneration of specific neuronal populations in particular regions of the brain, most notably the neurons of the substantia nigra. Under the microscope, these neurons appear dark in color and produce dopamine, a neurotransmitter that enables communication between nerve cells (American Parkinson Disease Association [APDA], 2019, p. 5).

The clinical manifestations of Parkinson's disease vary from one individual to another, and early symptoms are often mild and may go unnoticed. They typically begin on one side of the body and remain more severe on that side even after the opposite side becomes affected (Salem et al., 2025, p. 119).

Tayar (2025, p. 43) reviews cognitive difficulties reported in Parkinson's disease, including slowed thinking and difficulties involving executive and visuospatial processing.

In the section authored by Sonia Michalon, slowed information processing and executive difficulties are described among the early cognitive manifestations of Parkinson's disease. The section also discusses reduced phonemic fluency and word-finding difficulties that may improve with cueing. This pattern is interpreted as suggesting difficulties in lexical-retrieval strategies rather than a primary lexical-semantic impairment (Sabadell et al., 2022, pp. 203–204).

Cooper et al. (1994), in a study of 100 patients with Parkinson's disease, examined simple and go/no-go choice reaction times while holding the motor response constant. They identified both a perceptuomotor component, which was independent

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of choice complexity, and a cognitive-analytical component, whose contribution increased as choice complexity increased. These findings suggest that slower responses in Parkinson's disease may reflect more than one underlying process.

Using a different approach to isolating processing components, Arroyo et al. (2021) compared 48 patients with Parkinson's disease, assessed in the ON state, with 53 healthy controls. Patients showed slower performance across the reaction-time tasks. After controlling for shared processing components, the analyses mainly implicated motor and perceptual-alertness components, whereas no significant group differences were detected in the remaining isolated components, including response strategy–inhibition, decision-making, visual search, and interference control.

In her theoretical review, De Boussineau (2022, p. 9) summarizes evidence suggesting that verbal-fluency performance in Parkinson's disease may be influenced by executive and linguistic processes, processing speed, task demands, and clinical characteristics.

Pierrot (2019) conducted an exploratory case-based study involving three patients with Parkinson's disease, comparing their performance with reference data from 17 control participants. The study identified difficulties in verbal fluency and other language tasks, alongside impairments in working memory and executive functioning. Language difficulties generally appeared more pronounced when cognitive difficulties were also present; however, this pattern varied across tasks and required cautious interpretation. These findings highlight the importance of examining specific language–cognition relationships rather than assuming that all language difficulties reflect a common cognitive deficit.

Henry and Crawford (2004), in a meta-analysis of 68 studies involving 2,644 patients with Parkinson's disease and 2,000 healthy controls, found moderate deficits in both phonemic and semantic verbal fluency. The semantic-fluency deficit was slightly but significantly greater than the phonemic-fluency deficit. However, neither fluency deficit was disproportionately greater than deficits in current verbal intelligence or psychomotor speed, cautioning against interpreting reduced verbal fluency alone as evidence of a specific executive deficit.

Cholerton et al. (2021) compared 122 participants with Parkinson's disease without mild cognitive impairment or dementia with 122 healthy volunteers. Patients performed worse on Digit Symbol and semantic-fluency measures. In the main analysis, the semantic-fluency group difference remained significant after adjustment for processing speed, indicating that slower processing alone did not fully account for the difference. This group comparison does not directly establish the within-patient association examined in the present study.

Foley et al. (2017) assessed 28 patients with Parkinson's disease before and after deep brain stimulation. Decline in category fluency was associated with deterioration in processing-speed measures. After adjustment for processing speed, associations between changes in verbal fluency and several language and executive measures were no longer significant. Higher baseline apathy was also associated with greater subsequent decline in category fluency, and this association remained significant after controlling for processing speed. These findings suggest that processing speed was not the only factor associated with fluency decline. However, the study involved a surgical cohort, which limits direct generalization to the present sample.

Taken together, these studies suggest that verbal-fluency performance and processing speed are related aspects of cognitive functioning in Parkinson's disease, but their relationship cannot be reduced to a single mechanism. The studies reviewed differ in their measures, designs, and clinical populations: reaction-time studies address components of slowing, group comparisons examine differences between patients and healthy participants, and postoperative studies examine changes following deep brain stimulation. These differences limit direct comparison with the present study. Accordingly, the present study examines the associations between overall, lexical, and semantic verbal-fluency scores and combined PASAT performance within an Algerian clinical sample.

In light of the foregoing discussion, the present study seeks to address the following research questions:

A. Research Questions

B. General Research Question

- Is there a statistically significant correlation between verbal fluency and information processing speed in patients with Parkinson's disease?

C. Specific Research Questions

- Is there a statistically significant correlation between lexical fluency and information processing speed in patients with Parkinson's disease?
- Is there a statistically significant correlation between semantic fluency and information processing speed in patients with Parkinson's disease?

D. Research Hypotheses

E. General Hypothesis

- There is a statistically significant correlation between verbal fluency and information processing speed in patients with Parkinson's disease.

F. Specific Hypotheses

- There is a statistically significant correlation between lexical fluency and information processing speed in patients with Parkinson's disease.
- There is a statistically significant correlation between semantic fluency and information processing speed in patients with Parkinson's disease.

III. Objectives of the Study

- To investigate the relationship between verbal fluency and information processing speed in patients with Parkinson's disease.
- To examine the relationship between lexical fluency and information processing speed in patients with Parkinson's disease.
- To examine the relationship between semantic fluency and information processing speed in patients with Parkinson's disease.
- To describe verbal-fluency and PASAT scores in the study sample.

IV. Significance of the Study

- This study provides exploratory evidence concerning the associations between verbal-fluency scores and PASAT performance in patients with Parkinson's disease.
- It contributes descriptive and correlational data from an Algerian Arabic-speaking clinical sample.
- It may inform future research using larger samples, culturally appropriate normative data, and more comprehensive cognitive assessment.

V. Delimitations of the Study

A. Temporal Delimitations

The fieldwork was conducted from 15 April 2026 to 29 April 2026, with data collection sessions held every Wednesday from 8:30 a.m. to 12:00 p.m.

B. Spatial Delimitations

The field study was conducted at the Mohi Eddine Polyclinic, affiliated with Mustapha Pacha University Hospital (CHU Mustapha Pacha), specifically within the Neurology Outpatient Department, where patients with Parkinson's disease attend specialized follow-up consultations every three months on Wednesdays.

VI. Definition of Terms

A. Parkinson's Disease

Most researchers attribute the first accurate clinical description of Parkinson's disease to the British physician James Parkinson in 1817 in his classic work An Essay on the Shaking Palsy. He described the disorder, which he termed the shaking palsy, as a condition characterized by tremor, muscular rigidity, postural instability, and reduced motor ability. He also observed that these symptoms progressively worsen over time and may negatively affect the quality of life of affected individuals (Oliveira, 2024, p. 23).

Parkinson's disease is the second most common neurodegenerative disorder. It results from the progressive degeneration of neurons responsible for monitoring and programming body movements, leading to the gradual loss of both motor and cognitive functions.

B. Verbal Fluency

It is defined as the ability to retrieve the greatest possible number of appropriate verbal responses, such as alternatives or synonyms, in response to a verbal cue within a specified time limit. Verbal fluency is considered a voluntary retrieval process involving previously learned words and concepts and is primarily expressed in two forms: phonemic verbal fluency and semantic verbal fluency (Lamouri & Riabi, 2021, p. 441).

Verbal fluency, also known as word fluency, is assessed in the context of spoken language or verbal expression and is measured by the speed of word generation under specific production constraints (Al-Zuaini & Al-Kafaji, 2017, p. 224). Verbal fluency tests require participants to produce as many words as possible according to a specified criterion within a limited period, allowing the assessment of semantic lexical storage as well as lexical search and retrieval processes from memory (Haras & Macia, 2014, p. 10).

C. Information Processing Speed

A cognitive task requires an individual to encode stimuli, transform them into meaningful information, relate this information either to itself or to previously stored knowledge in memory, compare it, and finally generate a measurable response.

Carroll (1993, as cited in Alasali, 2014, p. 134) defined information processing speed as the rate at which elementary cognitive processes—such as perception, encoding, information retrieval, and comparison—are carried out.

VII. Methodology

A. Study Design

A descriptive cross-sectional correlational design was adopted to examine the relationships between verbal-fluency scores and PASAT performance in a purposive sample of 10 patients with Parkinson's disease.

B. Study Sample

The study sample consisted of 10 patients with Parkinson's disease of both sexes, selected through purposive sampling according to the following criteria: participants were between 44 and 73 years of age; they had no history of other neurological or neurodegenerative disorders or any medical condition that could produce Parkinsonian symptoms or affect verbal fluency and information processing speed. All participants were native speakers of Algerian Arabic and were judged by the speech-language pathologist to have basic literacy and numeracy skills.

Authorization to conduct the study was obtained from the clinical institution where the research took place, in coordination with the speech-language pathologists involved. Participants provided informed consent before taking part in the study. Confidentiality was maintained by using participant codes instead of names and excluding personally identifying information from the presentation of the findings.

The following table presents the characteristics of the study sample.

TABLE I.
Characteristics of the Study Sample

Case	Age	Sex	Age at Disease Onset	Spoken Language	Clinical Symptoms
1	44 years	Male	43 years	Algerian Arabic	Bilateral tremor; balance impairment
2	63 years	Female	53 years	Algerian Arabic	Mild balance impairment with preserved postural reflexes
3	47 years	Female	40 years	Algerian Arabic and French	Resting tremor; postural instability while standing or walking
4	73 years	Male	65 years	Algerian Arabic and French	Bilateral tremor; memory impairment; balance instability
5	66 years	Female	51 years	Algerian Arabic and French	Resting tremor; postural and balance disturbances with preserved postural reflexes
6	63 years	Female	57 years	Algerian Arabic	Bilateral tremor; memory impairment; sleep disturbance
7	54 years	Female	49 years	Algerian Arabic and French	Bilateral hand tremor; memory impairment
8	45 years	Female	38 years	Algerian Arabic and French	Bilateral hand tremor
9	57 years	Male	50 years	Algerian Arabic	Tremor, rigidity, and bilateral bradykinesia
10	70 years	Male	60 years	Algerian Arabic and French	Bilateral tremor; sleep disturbance

Source: Prepared by the authors

C. Study Instruments

The following instruments were used in the present study:

D. First: Cardebat Verbal Fluency Test (Test de Fluence Verbale de Cardebat)

The verbal-fluency tasks were based on the protocol described by Cardebat et al. (1990). Participants were required to generate words according to a specified initial letter in the lexical-fluency task and a specified category in the semantic-fluency task. Responses were recorded separately for the first and second minutes. The score for each task was calculated by summing the valid responses produced during the two minutes, excluding repetitions and responses that violated the task rules. Lexical- and semantic-fluency scores were calculated separately, and the overall verbal-fluency score was obtained by summing the two task scores.

E. Second: Paced Auditory Serial Addition Test (PASAT)

The Paced Auditory Serial Addition Test (PASAT) was described by Gronwall (1977) as a measure of information-processing rate used in assessing recovery from concussion. An Algerian adaptation of selected BCcogSEP tests, including PASAT, has been attributed to Ghazali (2012, as cited in Boucha & Haciane, 2023). The task requires participants to add each newly presented digit to the immediately preceding digit. Digits are presented at fixed intervals of two or three seconds, depending on the version administered. In the present study, the PASAT was administered according to the instructions of the version used. Performance was scored as the number of correct responses across 60 addition operations per trial, and the combined PASAT score was calculated by summing the scores obtained across the two trials.

F. Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics. Means and standard deviations were calculated to summarize the study variables. Two-tailed Spearman’s rank-order correlations were used to examine the associations between verbal-fluency scores and the combined PASAT score.

VIII. Presentation, Analysis, and Discussion of the Statistical Results

A. Descriptive Statistics:

Descriptive statistics were calculated to summarize verbal-fluency and PASAT performance in the study sample. Table 2 presents the means and standard deviations for overall, lexical, and semantic verbal fluency, as well as the combined PASAT score and the scores obtained in each trial.

TABLE II.
Descriptive Statistics for Verbal-Fluency and PASAT Scores

Measure	n	Mean	SD
Overall verbal fluency	10	22.30	5.33
Lexical fluency	10	9.90	3.03
Semantic fluency	10	12.40	4.08
PASAT combined score	10	24.00	7.67
PASAT Trial 1	10	10.10	4.81
PASAT Trial 2	10	13.90	5.95

As shown in Table 2, the mean overall verbal-fluency score was 22.30 (SD = 5.33). Mean lexical- and semantic-fluency scores were 9.90 (SD = 3.03) and 12.40 (SD = 4.08), respectively. The mean combined PASAT score was 24.00 (SD = 7.67), with mean scores of 10.10 (SD = 4.81) for the first trial and 13.90 (SD = 5.95) for the second trial.

B. Presentation, Analysis, and Discussion of the General Hypothesis

To examine the general hypothesis, which states that "there is a statistically significant correlation between verbal fluency and information processing speed in patients with Parkinson’s disease," Spearman’s rank-order correlation coefficient was employed to determine the relationship between participants' scores on the Cardebat Verbal Fluency Test and the information processing speed measure (PASAT) used in the present study. The results obtained are presented in the following table.

TABLE III.
Correlation Between Overall Verbal Fluency and PASAT Performance

Variables	n	Spearman’s r_s	p
Overall verbal fluency and combined PASAT score	10	.895	< .01

TABLE

III.

SHOWS A STATISTICALLY SIGNIFICANT POSITIVE CORRELATION BETWEEN OVERALL VERBAL FLUENCY AND PASAT PERFORMANCE. HIGHER OVERALL VERBAL-FLUENCY SCORES WERE ASSOCIATED WITH HIGHER COMBINED PASAT SCORES. ACCORDINGLY, THE RESULTS SUPPORTED THE GENERAL HYPOTHESIS IN THE STUDY SAMPLE.

Foley et al. (2017) reported an association between reduced processing speed and postoperative decline in category fluency following deep brain stimulation. Their findings provide an indirect comparison for the present association, but the surgical context limits direct generalization to the current sample.

C. Presentation, Analysis, and Discussion of the First Specific Hypothesis

To examine the first specific hypothesis, which states that there is a statistically significant correlation between lexical fluency and information processing speed in patients with Parkinson's disease, Spearman's rank-order correlation coefficient was used to determine the relationship between the scores obtained on the lexical verbal fluency test and the information processing speed test (PASAT) employed in the present study. The obtained results are presented in the following table.

TABLE IV.

CORRELATION BETWEEN LEXICAL FLUENCY AND PASAT PERFORMANCE

Variables	n	Spearman's r_s	p
Lexical fluency and combined PASAT score	10	.797	< .01

As shown in Table 4, lexical fluency was positively and significantly correlated with PASAT performance. Higher lexical-fluency scores were associated with higher combined PASAT scores. These results supported the first specific hypothesis.

D. Presentation, Analysis, and Discussion of the Second Specific Hypothesis

To examine the second specific hypothesis, which states that there is a statistically significant correlation between semantic fluency and information processing speed in patients with Parkinson's disease, Spearman's rank-order correlation coefficient was used to determine the relationship between the scores obtained on the semantic verbal fluency test and the information processing speed test (PASAT) employed in the present study. The results are presented in the following table.

TABLE V.

CORRELATION BETWEEN SEMANTIC FLUENCY AND PASAT PERFORMANCE

Variables	n	Spearman's r_s	p
Semantic fluency and combined PASAT score	10	.882	< .01

TABLE V.

INDICATES A STATISTICALLY SIGNIFICANT POSITIVE CORRELATION BETWEEN SEMANTIC FLUENCY AND PASAT PERFORMANCE. HIGHER SEMANTIC-FLUENCY SCORES WERE ASSOCIATED WITH HIGHER COMBINED PASAT SCORES. THESE RESULTS SUPPORTED THE SECOND SPECIFIC HYPOTHESIS.

Cholerton et al. (2021) found lower processing-speed and semantic-fluency performance in participants with Parkinson's disease without mild cognitive impairment or dementia. The semantic-fluency group difference remained significant after adjustment for processing speed, suggesting that slower processing alone did not fully account for the difference. Their findings provide relevant context but do not directly establish the within-patient association examined in the present study.

E. Overall Discussion

The three positive correlations indicate that participants with higher verbal-fluency scores also tended to obtain higher combined PASAT scores. However, the present analyses do not determine which processes account for these associations or whether the lexical and semantic correlations differ significantly from one another. The findings should therefore be interpreted as exploratory associations within the study sample rather than evidence of a single underlying mechanism.

IX. CONCLUSION

The present study examined the relationship between verbal fluency and information processing speed in patients with Parkinson's disease in an Algerian clinical setting. The Cardebat Verbal Fluency Test and the Paced Auditory Serial Addition Test (PASAT) were administered to a purposive sample of 10 patients using a descriptive cross-sectional correlational design.

Spearman's rank-order correlations indicated statistically significant positive associations between PASAT performance and overall, lexical, and semantic verbal fluency. Participants with higher verbal-fluency scores tended to obtain higher PASAT scores. However, these associations do not establish causal relationships or identify the specific mechanisms underlying the observed performance.

These findings provide exploratory data on cognitive–linguistic functioning in Parkinson's disease within the Algerian clinical setting. The small, purposively selected sample limits the generalizability of the results. In addition, the absence of normative data appropriate to the administered versions and participant characteristics prevents the scores

alone from establishing clinically significant impairment.

Future research should prioritize the development and validation of assessment tools adapted to the linguistic and cultural characteristics of the Algerian context. Further research in speech-language pathology may also help inform assessment and rehabilitation approaches for people with neurodegenerative disorders. Larger studies using appropriate normative data and longitudinal designs are needed to examine the clinical and predictive value of jointly assessing verbal fluency and PASAT performance

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