Research Article

The Relationship between Narrative Discourse Features and Cognitive Functions in Persian-Speaking Patients with Parkinson's Disease

Kiana Ghasrhamidi[1], Arezoo Saffarian[1], Reyhane Mohamadi[1], Seyed Amir Hasan Habibi[2], Nahid Jalilevand[1*]

[1-] Rehabilitation Research Centre, Department of Speech Therapy, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran.

[2-] Department of Neurology, School of Medicine, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran.

*** Corresponding Author:** Nahid Jalilevand, Associate professor
Rehabilitation Research Centre, Department of Speech Therapy, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran
Tel: +98 (912) 2979867
Email: jalilevand@gmail.com

ORCID ID:
Kiana Ghasrhamidi: 0009-0009-2119-9999
Arezoo Saffarian: 0000-0003-1749-2446
Reyhane Mohamadi: 0000-0003-2823-5197
Seyed Amir Hasan Habibi: 0000-0001-6896-4779
Nahid Jalilevand: 0000-0002-4158-495X

Article info:
Received: 4 Nov 2025
Accepted: 2 Feb 2026

Citation: Ghasrhamidi K, Saffarian A, Mohamadi R, Habibi SAH, Jalilevand N. The Relationship between Narrative Discourse Features and Cognitive Functions in Persian-Speaking Patients with Parkinson's Disease. Journal of Modern Rehabilitation. 2026;20(2):?-?

Running Title: Narrative Discourse and Cognition in PD

Abstract
Background: Parkinson's disease (PD) affects not only motor function but also cognition and language, including narrative discourse, which relies on linguistic processes and higher-order cognitive functions such as working memory and executive functions. So, the aim of this study was to investigate the relationship between narrative discourse features and cognitive functions in Persian-speaking PD patients.
Material and Methods: In this cross-sectional study, 26 PD patients and 26 age, sex, and education-matched healthy controls participated. Cognitive performance was assessed using the Persian Montreal Cognitive Assessment (MoCA-P), digit span, Stroop, verbal fluency, and the Persian Cognitive Reserve Index (CRIq). Narrative discourse was evaluated using the Persian

Narrative Discourse Test. Data were analyzed with the Mann-Whitney test and Spearman correlation.
Results: In PD patients, syntactic complexity correlated positively with MoCA-P ($p = 0.001$, $r_s = 0.627$), CRIq ($p = 0.012$, $r_s = 0.487$), phonological verbal fluency ($p = 0.032$, $r_s = 0.420$), and forward digit span ($p = 0.015$, $r_s = 0.472$). Lexical cohesion correlated with MoCA-P ($p = 0.012$, $r_s = 0.484$) and CRIq ($p = 0.002$, $r_s = 0.573$), while conjunctive cohesion was associated with MoCA-P ($p = 0.022$, $r_s = 0.448$) and semantic verbal fluency (fruits) ($p = 0.041$, $r_s = 0.404$).
Conclusions: The results of this study demonstrate that higher levels of global cognition, working memory, verbal fluency, and cognitive reserve are associated with increased syntactic complexity and enhanced lexical and conjunctive cohesion in the narrative discourse of patients with PD. These findings indicate that cognitive decline adversely affects narrative organization and structural integrity.
Keywords: Parkinson's disease; Narrative Discourse; Cognition; Persian Language

Introduction

Parkinson's disease (PD) is one of the most common progressive neurodegenerative disorders. In addition to motor symptoms (resting tremor, muscle rigidity, and bradykinesia (slowness of movement) it is also associated by a wide range of non-motor symptoms, such as cognitive and language impairments (1, 2). Although PD is mainly characterized by motor symptoms, cognitive deficits occur even in the early stages (1, 3, 4).

Executive functions including planning, inhibition, and working memory, are impaired in individuals with Parkinson’s disease (5). Neuroimaging studies have shown that these cognitive changes are associated with reduced activity in prefrontal areas, the anterior cingulate cortex, and subcortical structures (٦).

Language difficulties are common among individuals with PD, including word retrieval difficulties, reduced informational content, decreased syntactic complexity, semantic errors, and grammatical impairments (7, 8, 9). Narrative discourse, which requires organizing and expressing a sequence of related events coherently, depends on both linguistic processes and higher-order cognitive functions, including working memory and executive functions (10, 11). Impairments in these cognitive abilities can disrupt narrative cohesion and coherence, leading to fragmented or simplified narratives.Information about the overall structure of a narrative is derived from two underlying levels: the microstructure and the macrostructure (12). The narrative macrostructure represents the global organizational pattern of a story. Achieving coherence at this level necessitates the integration of successive utterances with each other and with the overarching theme (13). The microstructure analysis examines the linguistic details that shape the internal structure of a narrative. This level of analysis encompasses multiple distinct dimensions, including measures of productivity, lexical variety, and syntactic complexity (14).

Although evidence indicates that executive functions and working memory influence narrative discourse (15, 16, 17, 18), some aspects of language, such as intersentential cohesion, may be affected independently of general cognitive decline (18, 19). Existing findings are inconsistent (18, 19, 20), and most previous research has focused on English-speaking populations, limiting the generalizability of results to languages with different structural characteristics, such as Persian. To date, no study has systematically examined the relationship between multiple cognitive functions and both macrostructural and microstructural aspects of narrative discourse in Persian-speaking individuals with PD. This gap highlights the need for further investigation of how cognitive deficits influence narrative production within the linguistic and cultural context of Persian.

Understanding the relationship between cognitive functions and narrative discourse in PD is clinically important because narrative abilities play a fundamental role in patients' everyday communication (21). Identifying the specific cognitive components that contribute to these discourse impairments enables speech-language pathologists to differentiate between language deficits arising from purely linguistic issues and those resulting from cognitive decline. This distinction facilitates the development of more targeted intervention programs that address both the cognitive and communicative needs of individuals with Parkinson's disease. Therefore, establishing this relationship provides essential guidance for clinical assessment and treatment planning.
Therefore, the present study was designed to investigate the relationship between narrative discourse characteristics (including syntactic complexity, verbal output errors, cohesion and coherence) and cognitive functions (attention, working memory, processing speed, executive functions and cognitive reserve) in Persian-speaking with PD.

Methods:
This cross-sectional study compared cognitive and narrative discourse features between individuals with idiopathic Parkinson's disease (PD) and healthy controls at a single point in time.
The following formula was used to determine the sample size. Accordingly, a total of 26 patients with idiopathic Parkinson's disease (14 males and 12 females; mean age = 59.42 ± 8.80 years) and 26 age, sex- and education matched healthy controls (14 males and 12 females; mean age = 59.23 ± 8.42 years) participated. Participants with PD were recruited through a convenience sampling method from the Rehabilitation Clinics of the Iran University of Medical Sciences (IUMS).

$$n = \frac{2\left(z_{1-\alpha/2} + z_{1-\beta}\right)^2}{d^2} + \frac{z_{1-\alpha/2}^2}{4}$$

The diagnosis of idiopathic PD was confirmed by a neurologist, and all patients were classified as stages 1 to 3 on the Hoehn and Yahr (H&Y) scale (۲۲). .

Inclusion Criteria (applied to all participants):

- Age range: 45 to 75 years.
- Native speaker of Persian.
- Adequate visual and auditory acuity, with or without correction.
- Formal education of at least eight completed years of schooling.
- Absence of any diagnosed neurological conditions (e.g., cerebrovascular accident, head trauma).

Exclusion Criteria:

- (For the Parkinson's disease cohort): patients with PD who had undergone non-pharmacological treatments including deep brain stimulation (DBS) or language-based speech therapy interventions within the previous three months.
- Voluntary withdrawal from the study at any stage.
- Cases where the required dataset could not be fully obtained.

All participants provided written informed consent. The study was approved by the Ethics Committee of IUMS (Ethics Code: IR.IUMS.REC.1402.1127). Assessments for patients with PD were conducted during the ON-medication phase, approximately one hour after medication intake (23).

All assessments were conducted in a quiet room. At the beginning of the session, the Persian version of Montreal Cognitive Assessment (MoCA-P) (۲۴) and the Persian Narrative Discourse Test (25) were administered, followed by additional cognitive evaluations. Six sequential pictures from the Persian Narrative Discourse Assessment Test (25) were presented to each participant. The images remained visible throughout the task, reducing working memory load. Participants were asked to produce a continuous, coherent story based on the pictures. The examiner gave only minimal non-directive feedback (e.g., “Okay,” “Oh,” “Another one?”) to maintain conversational flow without influencing content. Narrations continued until the participant indicated they had nothing more to add. All narratives were audio-recorded and subsequently transcribed for analysis.

To assess sentence complexity, the ratio of the total number of dependent and independent clauses to the total number of communication units (C-units) in each speech sample was calculated (۲۶).

To calculate the total verbal output error score, the sum of all lexical errors (semantic or phonological paraphasia, incorrect word formation, deletions (27)) plus mazes (filled pauses, word repetitions, speech revisions (۲۸)) was divided by total number of C-units. Cohesion was measured as the number of complete cohesive ties (reference, conjunction, substitution, ellipsis, lexical) per C-unit according to Halliday and Hasan’s framework (۳۰) (۲۹). In addition, coherence was evaluated using the 4-point scale developed by Wright et al.(31), where each C-unit was rated from 1 (irrelevant to the topic) to 4 (fully relevant to the topic). The average coherence score was then computed for each participant. Working memory was assessed using the Forward Digit Span Test (FDST) and Backward Digit Span Tests (BDST) (۴۴,۴۵). Attention, executive functions, and processing speed were evaluated with the Stroop Test (۳۲). These tests are components of the Paper-Pencil Cognitive Assessment Package for Persian-speaking Subjects (PCAP) (۳۳), comprehensively evaluates working memory, attention, and executive functioning. The validity and reliability of these assessments have been confirmed in the Iranian population by Rezapour et al. (۳۴). Additionally, Executive functions were further assessed using verbal fluency tasks (۳۵) . In the semantic fluency test, participants named as many animals and fruits as possible within 60 seconds. In the phonological fluency test, participants generated words beginning with the letters /a/, /f/, and /s/ within the same time limit (36). In the verb fluency task, participants produced as many action verbs as possible in 60 seconds. Repetitions and proper nouns were excluded (۳۷). They also completed the Persian version of Cognitive Reserve Index Questionnaire **(**CRIq**)** to estimate their level of cognitive reserve. The CRIq developed by Nucci et al. (2012), was used to measure participants’ cognitive reserve (۳۸). This standardized instrument evaluates three subscales: education**,** occupational activities**,** and leisure time. The total CRIq score is derived from the combined scores of these subscales. The higher the CRI score, the higher the estimated cognitive reserve (CR) (۳۸). The psychometric properties of the Persian version of CRIq have been validated, with reliability coefficients of 0.76 for men and 0.79 for women (Cronbach’s alpha) and a convergent validity coefficient of 0.74 (۳۹).

All test scores were recorded and analyzed using SPSS version 16. The Shapiro–Wilk test was applied to assess the normality of data distribution. Since the data did not follow a normal distribution, the Mann–Whitney U test was used for between-group comparisons, and the Spearman correlation coefficient was employed to examine relationships among quantitative variables.

The effect size (r) was calculated for the Mann–Whitney test, with values of 0.1–0.3, 0.3–0.5, and >0.5 indicating small, medium, and large effect sizes, respectively (۴۰) . The significance level was set at $p < 0.05$.

Results

This study aimed to examine the relationship between cognition functions and narrative discourse in 26 Persian-speaking patients with PD and 26 healthy control participants. The demographic characteristics of PD patients and healthy controls are represented in Table 1.

Table1: Demographic Characteristics of PD Patients and Healthy Controls

Variable	Healthy (n=26)	PD (n=26)	p-value
Age, M (SD)	59.23 (8.42)	59.42 (8.80)	0.936
Gender – Male, n (%)	14 (53.8%)	14 (53.8%)	1.000
Gender – Female, n (%)	12 (46.2%)	12 (46.2%)	1.000
Education (years), M (SD)	13.62 (3.18)	12.62 (2.98)	0.247
Disease Duration (years)	—	6.12 (4.93)	—
Disease Severity (H&Y)	—	1.53	—

Note. PD = Parkinson’s disease; H&Y = Hoehn and Yahr; SD = Standard deviation.

As shown in Table 1, the mean ages of healthy and PD groups were 59.23 years (SD = 8.42) and 59.42 years (SD = 8.80), respectively. An independent *t*-test indicated no statistically significant difference in age between the two groups ($p = 0.936$). The mean years of education were 13.62 (SD = 3.18) for the healthy group and 12.62 (SD = 2.98) for the PD group, with no significant difference observed ($p = 0.247$). Spearman's correlation coefficient was utilized to analyze the relationships between narrative discourse variables and cognitive test scores among participants. Tables 2 to 8 present the correlations between syntactic complexity, verbal output errors, referential, conjunctive, lexical, Ellipsis and substitution cohesion, and coherence scores with cognitive test results. Table 2 shows the Spearman correlations between syntactic complexity measures and cognitive test scores in PD patients, healthy controls, and the total sample.

Table2: Syntactic Complexity and Cognitive tests in PD and Healthy Controls

	Healthy(n=26)		PD(n=26)		Total(n=52)	
	r_s	P	r_s	P	r_s	P
P-MoCA	-۰/۱۶۰	۰/۴۳۵	۰/۶۲۷	۰/۰۰۱	۰/۴۲۳	۰/۰۰۲
CRIq	۰/۱۵۰	۰/۴۶۴	۰/۴۸۷	۰/۰۱۲	۰/۵۳۱	<۰/۰۰۱
Verbal Fluency						
Semantic Fluency(fruits)	-۰/۰۲۷	۰/۸۹۶	۰/۲۷۸	۰/۱۶۹	۰/۲۷۱	۰/۰۵۲

Semantic Fluency(animal)	۰/۲۴۰	۰/۲۳۷	۰/۳۶۳	۰/۰۶۸	۰/۴۹۲	<۰/۰۰۱
Phonemic Fluency(letter a)	۰/۰۲۵	۰/۹۰۵	۰/۰۷۸	۰/۷۰۶	۰/۳۵۶	۰/۰۱۰
Phonemic Fluency(letter f)	۰/۰۴۲	۰/۸۴۰	۰/۴۲۰	۰/۰۳۲	۰/۴۵۳	۰/۰۰۱
Phonemic Fluency(letter s)	۰/۰۵۰	۰/۸۰۸	۰/۲۰۸	۰/۳۰۸	۰/۳۷۱	۰/۰۰۷
Verb Fluency	۰/۱۹۲	۰/۳۴۷	۰/۳۱۸	۰/۱۱۳	۰/۵۴۷	<۰/۰۰۱
Digit Span						
FDST	۰/۲۳۰	۰/۲۵۸	۰/۴۷۲	۰/۰۱۵	۰/۵۱۰	<۰/۰۰۱
BDST	۰/۰۹۳	۰/۶۵۱	۰/۳۶۱	۰/۰۷۰	۰/۴۳۶	۰/۰۰۱
Stroop Test						
Interference	-۰/۰۶۶	۰/۷۵۰	-۰/۰۷۵	۰/۷۱۵	-۰/۰۹۶	۰/۴۹۶

Note. r_s = Spearman correlation coefficient; PD = Parkinson's disease; P-MoCA: Persian Montreal Cognitive Assessment; CRIq: Cognitive Reserve Index Questionnaire; FDST: Forward Digit Span Test; BDST: Backward Digit Span Test;

Table ۳ shows the Spearman correlations between Verbal Output Errors measures and cognitive test scores in PD patients, healthy controls, and the total sample.

Table3: Verbal Output Errors and Cognitive tests in PD and Healthy Controls

	Healthy(n=26)		**PD(n=26)**		**Total(n=52)**	
	rs	**P**	**rs**	**P**	**rs**	**P**
P-MoCA	0/322	0/109	-0/174	0/396	-0/079	0/577
CRIq	0/261	0/198	-0/044	0/830	-0/225	0/109
Verbal Fluency						
Semantic Fluency(fruits)	0/463	0/017	-0/153	0/454	-0/028	0/842
Semantic Fluency(animal)	0/441	0/024	-0/147	0/473	-0/133	0/348
Phonemic Fluency(letter a)	0/099	0/630	-0/265	0/190	-0/282	0/043
Phonemic Fluency(letter f)	0/133	0/519	-0/083	0/686	-0/197	0/161
Phonemic Fluency(letter s)	-0/121	0/556	-0/173	0/399	-0/286	0/040
Verb Fluency	0/372	0/061	0/061	0/768	-0/159	0/261
Digit Span						
FDST	0/132	0/520	-0/258	0/203	-0/323	0/020
BDST	0/340	0/090	-0/279	0/168	-0/254	0/070
Stroop Test						
Interference	-0/199	0/329	-0/027	0/896	-0/038	0/791

Note. r_s = Spearman correlation coefficient; PD = Parkinson's disease; P-MoCA: Persian Montreal Cognitive Assessment; CRIq: Cognitive Reserve Index Questionnaire; FDST: Forward Digit Span Test; BDST: Backward Digit Span Test;

Table 4 shows the Spearman correlations between Referential Cohesion measures and cognitive test scores in PD patients, healthy controls, and the total sample.

Table 4: Referential Cohesion and Cognitive tests in PD and Healthy Controls

	Healthy(n=26)		**PD(n=26)**		**Total(n=52)**	
	rs	**P**	**rs**	**P**	**rs**	**P**
P-MoCA	۰/۰۱۸	۰/۹۳۰	-۰/۱۰۶	۰/۶۰۸	۰/۰۳۷	۰/۷۹۷
CRIq	۰/۰۸۱	۰/۶۹۴	۰/۰۳۸	۰/۸۵۶	۰/۱۷۴	۰/۲۱۸
Verbal Fluency						
Semantic Fluency (fruits)	-۰/۱۰۴	۰/۶۱۴	-۰/۰۴۴	۰/۸۳۲	۰/۰۲۷	۰/۸۴۷
Semantic Fluency(animal)	-۰/۰۰۹	۰/۹۶۴	۰/۱۸۶	۰/۳۶۲	۰/۲۰۲	۰/۱۵۰
Phonemic Fluency (letter a)	-۰/۱۲۶	۰/۵۳۹	-۰/۰۰۹	۰/۹۶۷	۰/۰۸۸	۰/۵۳۶
Phonemic Fluency (letter f)	۰/۰۳۹	۰/۸۵۱	۰/۰۶۱	۰/۷۶۸	۰/۱۷۶	۰/۲۱۱
Phonemic Fluency (letter s)	۰/۱۶۰	۰/۴۳۵	۰/۰۱۷	۰/۹۳۵	۰/۱۵۱	۰/۲۸۴
Verb Fluency	۰/۳۱۳	۰/۱۱۹	-۰/۰۷۹	۰/۷۰۰	۰/۲۷۱	۰/۰۵۲
Digit Span						
FDST	۰/۰۶۶	۰/۷۴۸	-۰/۰۴۸	۰/۸۱۵	۰/۱۲۴	۰/۳۸۰
BDST	-۰/۲۱۰	۰/۳۰۳	-۰/۰۵۲	۰/۸۰۰	۰/۰۲۶	۰/۸۵۲
Stroop Test						
Interference	۰/۱۸۹	۰/۳۵۶	۰/۲۵۲	۰/۲۱۴	۰/۱۹۴	۰/۱۶۷

Note. r_s = Spearman correlation coefficient; PD = Parkinson's disease; P-MoCA: Persian Montreal Cognitive Assessment; CRIq: Cognitive Reserve Index Questionnaire; FDST: Forward Digit Span Test; BDST: Backward Digit Span Test;

Table 5 shows the Spearman correlations between Ellipsis and substitution Cohesion measures and cognitive test scores in PD patients, healthy controls, and the total sample.

Table5: Ellipsis and substitution Cohesion and Cognitive tests in PD and Healthy Controls

	Healthy (n=26)		**PD (n=26)**		**Total (n=52)**	
	rs	**P**	**rs**	**P**	**rs**	**P**
P-MoCA	-۰/۰۸۴	۰/۶۸۲	0/010	۰/۹۶۰	۰/۲۱۳	۰/۱۲۹
CRIq	-۰/۲۵۰	۰/۲۱۸	-۰/۰۴۵	۰/۸۲۶	۰/۳۳۴	۰/۰۱۵
Verbal Fluency						

Semantic Fluency (fruits)	-۰/۱۹۵	۰/۳۴۰	-۰/۰۱۴	۰/۹۴۵	۰/۱۷۶	۰/۲۱۱
Semantic Fluency (animal)	-۰/۲۲۷	۰/۲۶۶	۰/۳۲۵	۰/۱۰۶	۰/۳۵۳	۰/۰۱۰
Phonemic Fluency (letter a)	۰/۰۴۴	۰/۸۳۱	۰/۱۵۸	۰/۴۴۲	۰/۴۸۵	<۰/۰۰۱
Phonemic Fluency (letter f)	-۰/۰۳۶	۰/۸۶۲	۰/۱۸۲	۰/۳۷۴	۰/۴۰۴	۰/۰۰۳
Phonemic Fluency (letter s)	۰/۰۵۲	۰/۷۹۹	۰/۱۷۵	۰/۳۹۳	۰/۴۶۱	۰/۰۰۱
Verb Fluency	-۰/۳۵۵	۰/۰۷۶	-۰/۰۳۵	۰/۸۶۷	۰/۲۸۴	۰/۰۴۱
Digit Span						
FDST	۰/۱۹۵	۰/۳۳۹	-۰/۰۱۷	۰/۹۳۶	۰/۳۸۲	۰/۰۰۵
BDST	-۰/۰۹۷	۰/۶۳۷	-۰/۱۰۸	۰/۶۰۱	۰/۲۷۱	۰/۰۵۲
Stroop Test						
Interference	-۰/۲۵۷	۰/۲۰۵	-۰/۲۰۵	۰/۳۱۶	-۰/۱۹۹	۰/۱۵۷

Note. r_s = Spearman correlation coefficient; PD = Parkinson’s disease; P-MoCA: Persian Montreal Cognitive Assessment; CRIq: Cognitive Reserve Index Questionnaire; FDST: Forward Digit Span Test; BDST: Backward Digit Span Test;

Table 6 shows the Spearman correlations between Conjunctive Cohesion measures and cognitive test scores in PD patients, healthy controls, and the total sample.

Table6: Conjunctive Cohesion and Cognitive tests in PD and Healthy Controls

	Healthy(n=26)		PD(n=26)		Total(n=52)	
	r_S	P	r_S	P	r_S	P
P-MoCA	-۰/۰۱۵	۰/۹۴۱	۰/۴۴۸	۰/۰۲۲	۰/۳۰۰	۰/۰۳۱
CRIq	۰/۱۲۹	۰/۵۳۱	۰/۱۵۰	۰/۴۶۴	۰/۲۲۷	۰/۱۰۶
Verbal Fluency						
Semantic Fluency (fruits)	۰/۰۸۳	۰/۶۸۸	۰/۴۰۴	۰/۰۴۱	۰/۲۸۳	۰/۰۴۲
Semantic Fluency (animal)	۰/۱۲۱	۰/۵۵۷	۰/۳۲۹	۰/۱۰۱	۰/۳۱۵	۰/۰۲۳
Phonemic Fluency (letter a)	۰/۱۸۱	۰/۳۷۶	-۰/۲۴۲	۰/۲۳۴	۰/۱۱۲	۰/۴۲۸
Phonemic Fluency (letter f)	۰/۰۹۴	۰/۶۴۷	۰/۰۹۱	۰/۶۵۷	۰/۲۱۴	۰/۱۲۸
Phonemic Fluency (letter s)	۰/۳۹۲	۰/۰۴۷	۰/۲۰۲	۰/۳۲۲	۰/۳۱۶	۰/۰۲۲
Verb Fluency	۰/۲۹۳	۰/۱۴۶	۰/۳۲۳	۰/۱۰۷	۰/۳۵۶	۰/۰۱۰
Digit Span						
FDST	۰/۵۷۷	۰/۰۰۲	۰/۳۲۷	۰/۱۰۳	۰/۴۲۹	۰/۰۰۱
BDST	۰/۰۱۱	۰/۹۵۸	۰/۲۷۳	۰/۱۷۶	۰/۲۱۴	۰/۱۲۸
Stroop Test						
Interference	۰/۱۹۱	۰/۳۵۰	۰/۱۰۸	۰/۵۹۹	۰/۱۱۷	۰/۴۱۰

Note. r_s = Spearman correlation coefficient; PD = Parkinson's disease; P-MoCA: Persian Montreal Cognitive Assessment; CRIq: Cognitive Reserve Index Questionnaire; FDST: Forward Digit Span Test; BDST: Backward Digit Span Test;

Table 7 shows the Spearman correlations between Lexical Cohesion measures and cognitive test scores in PD patients, healthy controls, and the total sample.

Table7: Lexical Cohesion and Cognitive tests in PD and Healthy Controls

	Healthy (n=26)		**PD (n=26)**		**Total (n=52)**	
	rs	**P**	**rs**	**P**	**rs**	**P**
P-MoCA	۰/۵۶۱	۰/۰۰۳	۰/۴۸۴	۰/۰۱۲	۰/۵۶۶	<۰/۰۰۱
CRIq	۰/۱۲۱	۰/۵۵۶	۰/۵۷۳	۰/۰۰۲	۰/۴۹۳	<۰/۰۰۱
Verbal Fluency						
Semantic Fluency (fruits)	۰/۲۷۲	۰/۱۷۹	۰/۰۱۹	۰/۹۲۵	۰/۲۷۷	۰/۰۴۶
Semantic Fluency (animal)	۰/۱۰۱	۰/۶۲۲	۰/۲۶۹	۰/۱۸۴	۰/۳۷۵	۰/۰۰۶
Phonemic Fluency(letter a)	۰/۳۱۱	۰/۱۲۲	۰/۳۴۴	۰/۰۸۵	۰/۴۳۵	۰/۰۰۱
Phonemic Fluency(letter f)	-۰/۰۲۴	۰/۹۰۸	۰/۲۷۶	۰/۱۷۲	۰/۳۵۴	۰/۰۱۰
Phonemic Fluency(letter s)	۰/۲۱۴	۰/۲۹۴	-۰/۰۶۵	۰/۷۵۳	۰/۲۹۰	۰/۰۳۷
Verb Fluency	-۰/۲۲۰	۰/۲۷۹	۰/۲۲۷	۰/۲۶۵	۰/۲۸۰	۰/۰۴۵
Digit Span						
FDST	۰/۲۳۸	۰/۲۴۲	۰/۳۱۲	۰/۱۲۱	۰/۴۱۳	۰/۰۰۲
BDST	۰/۲۰۵	۰/۳۱۶	۰/۱۶۸	۰/۴۱۱	۰/۳۵۴	۰/۰۱۰
Stroop Test						
Interference	۰/۰۸۴	۰/۶۸۵	۰/۰۸۰	۰/۶۹۷	۰/۰۷۶	۰/۵۹۱

Note. r_s = Spearman correlation coefficient; PD = Parkinson's disease; P-MoCA: Persian Montreal Cognitive Assessment; CRIq: Cognitive Reserve Index Questionnaire; FDST: Forward Digit Span Test; BDST: Backward Digit Span Test;

Table 8 shows the Spearman correlations between Coherence measures and cognitive test scores in PD patients, healthy controls, and the total sample.

Table 8: Coherence and Cognitive tests in PD and Healthy Controls

	Healthy (n=26)		**PD (n=26)**		**Total (n=52)**	
	rs	**P**	**rs**	**P**	**rs**	**P**
P-MoCA	-۰/۰۴۴	۰/۸۳۲	۰/۳۶۱	۰/۰۷۰	۰/۴۵۲	۰/۰۰۱
CRIq	۰/۰۸۹	۰/۶۶۶	۰/۰۳۹	۰/۸۴۸	۰/۶۰۸	<۰/۰۰۱
Verbal Fluency						
Semantic Fluency (fruits)	۰/۰۵۹	۰/۷۷۴	۰/۱۱۵	۰/۵۷۶	۰/۳۶۹	۰/۰۰۷
Semantic Fluency(animal)	-۰/۲۵۶	۰/۲۰۶	۰/۲۷۲	۰/۱۷۸	۰/۴۸۰	<۰/۰۰۱

Phonemic Fluency (letter a)	-۰/۱۶۴	۰/۴۲۲	۰/۱۸۸	۰/۳۵۷	۰/۵۷۱	<۰/۰۰۱
Phonemic Fluency (letter f)	-۰/۳۸۰	۰/۰۵۵	۰/۱۲۶	۰/۵۴۱	۰/۴۵۶	۰/۰۰۱
Phonemic Fluency (letter s)	۰/۰۹۸	۰/۶۳۳	-۰/۰۸۶	۰/۶۷۷	۰/۵۱۶	<۰/۰۰۱
Verb Fluency	-۰/۲۹۳	۰/۱۴۷	۰/۳۱۲	۰/۱۲۱	۰/۵۰۰	<۰/۰۰۱
Digit Span						
FDST	۰/۱۸۷	۰/۳۶۰	۰/۳۷۳	۰/۰۶۱	۰/۵۷۲	<۰/۰۰۱
BDST	-۰/۱۱۴	۰/۵۷۸	۰/۱۹۶	۰/۳۳۷	۰/۴۳۷	۰/۰۰۱
Stroop Test						
Interference	۰/۰۹۴	۰/۶۴۹	-۰/۰۷۵	۰/۷۱۵	-۰/۰۲۸	۰/۸۴۳

Note. r_s = Spearman correlation coefficient; PD = Parkinson's disease; P-MoCA: Persian Montreal Cognitive Assessment; CRIq: Cognitive Reserve Index Questionnaire; FDST: Forward Digit Span Test; BDST: Backward Digit Span Test;

Among Persian-speaking patients with Parkinson's disease (PD), a significant positive correlation was found between sentence complexity score and the CRIq (p = 0.012, r_s = 0.487), and MoCA-P scores (p = 0.001, r_s = 0.627), additionally, between phonological verbal fluency (letter F) (p = 0.032, r_s = 0.420), and FDST (p = 0.015, r_s = 0.472) scores. Furthermore, conjunctive cohesion scores were positively correlated with MoCA-P (p = 0.022, r_s = 0.448) and semantic verbal fluency (fruits) scores (p = 0.041, r_s = 0.404). Moreover, lexical cohesion scores were positively associated with MoCA-P (p = 0.012, r_s = 0.484) and CRIq (p = 0.002, r_s= 0.573) scores. In contrast, verbal output errors did not show a significant correlation with any of the cognitive functions ($p>0.05$). In the healthy control group, a positive correlation was observed between verbal output errors and both semantic verbal fluency (fruits) (p = 0.017, r_s = 0.463) and semantic verbal fluency (animals) scores (p = 0.024, r_s = 0.441). Additionally, a positive correlation was found between conjunctive cohesion and Forward Digit Span Test scores (p = 0.002, r_s = 0.577), as well as between lexical cohesion and MoCA-P scores (p = 0.003, r_s = 0.561). Overall, both groups showed correlations between narrative discourse measures and cognitive performance. Notably, certain correlations (e.g., sentence complexity with MoCA-P and CRIq) were stronger or only present in PD patients, whereas others (e.g., verbal output errors with semantic fluency) were observed only in healthy controls.

Discussion

The present study aimed to examine the relationship between narrative discourse features and cognitive functions in Persian-speaking patients with Parkinson's disease (PD). The findings revealed that aspects of narrative discourse such as sentence complexity, lexical cohesion, and conjunctive cohesion were positively and significantly associated with higher-level cognitive functions, including working memory, verbal fluency, and cognitive reserve. align with previous research highlighting the critical role of executive functions and working memory in discourse production (18, 41). Previous studies have shown that narrative discourse production relies on complex interactions between multiple linguistic levels (phonological, lexical, syntactic) and higher- order cognitive processes such as planning, organizing, and inhibiting irrelevant responses (41, 42).

In the present study, the significant correlations between sentence complexity and MoCA-P, CRIq scores, and the Forward Digit Span Test in patients with PD suggests that the production of complex syntactic structures depends on working memory and cognitive reserve (43, 44, 45). This finding is consistent with theoretical models proposing that working memory plays a central role in the generation and maintenance of complex syntactic constructions (۴۶). The observed correlation between syntactic complexity and CRIq suggests that individuals with higher cognitive reserve are able to produce more complex syntactic structures in their discourse. Delage et al. (2019) reported that individuals with higher cognitive reserve scores tend to use more complex syntactic constructions, such as dependent clauses and compound sentences (46). Furthermore, the relationship between syntactic complexity and Forward Digit Span Test (FDST) scores reinforces the role of working memory in generating complex syntactic structures, consistent with previous findings (47, 48, 49).

Lexical and conjunctive cohesion are also found to be associated with cognitive performance. This relationship can be explained by the dependence of discourse cohesion on higher-order cognitive functions such as attention, working memory, and cognitive flexibility (17, 50). A higher score on the MoCA-P reflect better overall cognitive health including attention, memory, and executive functions (24) which are essential for establishing logical and semantic connections within discourse (51).

Additionally, the correlation between conjunctive cohesion and semantic verbal fluency likely arises from the ability to efficiently access and retrieve lexical information, a process that involves activating the semantic representations of concepts (52). This capacity enables individuals to effectively link related concepts and maintain the semantic organization of discourse (53, 54). Previous research has shown that discourse cohesion plays a vital role in effective communication (18). The process of comprehension and expression of narratives require the continuous integration and organization of information into a coherent structure (۵۵). Within this framework, individuals with greater cognitive reserve exhibit a superior ability to employ complex linguistic devices to maintain coherence. These results align with cognitive-linguistic models proposing that the processing of coherent discourse depends on the integration of linguistic and cognitive resources (45, 56).

In contrast, lexical errors and verbal mazes did not show a significant relationship with cognitive performance in this study. This finding may be attributed to the fact that such errors are influenced primarily by basic linguistic processes or individual speaker characteristics rather than by cognitive deficits (42, 57) .

This study has several limitations. First, the sample size was relatively small (n = 26), which may limit the generalizability of the findings. Second, all participants were Persian-speaking, introducing potential linguistic and cultural specificity that may not apply to speakers of other languages. Third, the cross-sectional design of the study limits the ability to infer causal relationships between narrative discourse features and cognitive functions, as only associations at a single point in time were examined. Finally, all PD participants were assessed in the “ON” medication state, and the study did not control for the effects of different dopaminergic medications or ON/OFF medication status, which may influence both cognitive and linguistic performance.

Conclusion

In conclusion, the findings of this study highlight the clinical importance of assessing narrative discourse in patients with Parkinson’s disease. Cognitive deficits, including impairments in executive functions, working memory, and cognitive reserve, can affect the cohesion and complexity of speech, ultimately influencing everyday communication. Incorporating narrative discourse assessments alongside standard cognitive tests may provide a more comprehensive understanding of patients' functional abilities. Furthermore, interventions targeting executive functions and working memory may help improve sentence complexity and discourse cohesion, supporting more effective communication.

Ethical consideration

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Iran University of Medical Sciences (Code: IR.IUMS.REC.1402.1127).

Funding

This study was conducted as part of a master's thesis at Iran University of Medical Sciences.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgments

The authors would like to express their gratitude to all participants for their cooperation in this study.

Authors' contributions

Conceptualization and study design: Arezoo Saffarian, Kiana Ghasrhamidi, Reyhane Mohammadi; Data acquisition: Kiana Ghasrhamidi, Seyed Amir Hassan Habibi; Data analysis and interpretation: Arezoo Saffarian, Reyhane Mohammadi, Kiana Ghasrhamidi, Seyed Amir Hassan Habibi; Statistical analysis: Nahid Jalilevand; Initial draft preparation: Kiana Ghasrhamidi, Nahid Jalilevand, Arezoo Saffarian, Reyhane Mohammadi; Review, editing and final approval: All authors.

References

1. Aarsland D, Batzu L, Halliday GM, Geurtsen GJ, Ballard C, Ray Chaudhuri K, et al. Parkinson disease-associated cognitive impairment. Nat Rev Dis Primers. 2021;7(1):47.
2. Kalia LV, Lang AE. Parkinson's disease. The lancet. 2015;386(9996):896-912.
3. Cooper JA, Sagar HJ, Jordan N, Harvey NS, Sullivan EV. Cognitive impairment in early, untreated Parkinson's disease and its relationship to motor disability. Brain. 1991;114(5):2095-122.
4. Levin BE, Llabre MM, Weiner WJ. Cognitive impairments associated with early Parkinson's disease. Neurology. 1989;39(4):557-.
5. Kudlicka A, Clare L, Hindle JV. Executive functions in Parkinson's disease: Systematic review and meta-analysis. Movement disorders. 2011;26(13):2305-15.
6. Mak E, Su L, Williams GB, O'Brien JT. Neuroimaging correlates of cognitive impairment and dementia in Parkinson's disease. Parkinsonism Relat Disord. 2015;21(8):862-70.
7. Altmann LJ, Troche MS. High-Level Language Production in Parkinson′ s Disease: A Review. Parkinson's disease. 2011;2011(1):238956.

8. Smith KM, Caplan DN. Communication impairment in Parkinson’s disease: Impact of motor and cognitive symptoms on speech and language. Brain and language. 2018;185:38-46.
9. D’Ascanio S, Piras F, Banaj N, Assogna F, Pellicano C, Bassi A, et al. Narrative discourse production in Parkinson’s disease: Decoupling the role of cognitive-linguistic and motor speech changes. Heliyon. 2023;9(8).
10. Marini A, Andreetta S, del Tin S, Carlomagno S. A multi-level approach to the analysis of narrative language in aphasia. Aphasiology. 2011;25(11):1372-92.
11. Trabasso T, van den Broek P. Causal Thinking and the Representation of Narrative Events. Journal of Memory and Language. 1985;24:612-30.
12. Gagarina N, Klop D, Kunnari S, Tantele K, Välimaa T, Bohnacker U, et al. MAIN: Multilingual assessment instrument for narratives–Revised. ZAS papers in linguistics. 2019;63:20-.
13. Hickmann M. Children's discourse: person, space and time across languages: Cambridge University Press; 2002.
14. Košutar S, Kramarić M, Hržica G. The relationship between narrative microstructure and macrostructure: Differences between six-and eight-year-olds. Psychology of Language and Communication. 2022;26(1):126-53.
15. Holtgraves T, Fogle K, Marsh L. Pragmatic language production deficits in Parkinson¡¯s disease. Advances in Parkinson's Disease. 2013;Vol.02No.01:6.
16. Ash S, McMillan C, Gross RG, Cook P, Morgan B, Boller A, et al. The organization of narrative discourse in Lewy body spectrum disorder. Brain and language. 2011;119(1):30-41.
17. Ash S, Xie SX, Gross RG, Dreyfuss M, Boller A, Camp E, et al. The organization and anatomy of narrative comprehension and expression in Lewy body spectrum disorders. Neuropsychology. 2012;26(3):368-84.
18. Ellis C, Crosson B, Gonzalez Rothi LJ, Okun MS, Rosenbek JC. Narrative discourse cohesion in early stage Parkinson’s disease. Journal of Parkinson's disease. 2015;5(2):403-11.
19. Ash S, Jester C, York C, Kofman OL, Langey R, Halpin A, et al. Longitudinal decline in speech production in Parkinson's disease spectrum disorders. Brain Lang. 2017;171:42-51.
20. Lewis FM, Lapointe LL, Murdoch BE, Chenery HJ. Language impairment in Parkinson's disease. Aphasiology. 1998;12(3):193-206.
21. Silveira KA, Souza GB, Carpenedo CM, Rieder CRM, Beber BC. Associations between quality of life in communication and sociodemographic and clinical aspects of Parkinson's disease. Codas. 2025;37(5):e20240298.
22. Goetz CG, Poewe W, Rascol O, Sampaio C, Stebbins GT, Counsell C, et al. Movement Disorder Society Task Force report on the Hoehn and Yahr staging scale: status and recommendations the Movement Disorder Society Task Force on rating scales for Parkinson's disease. Movement disorders. 2004;19(9):1020-8.
23. Wong MN, Murdoch BE, Whelan B-M. Lingual Kinematics in Dysarthric and Nondysarthric Speakers with Parkinson′ s Disease. Parkinson’s disease. 2011;2011(1):352838.
24. Badrkhahan SZ, Sikaroodi H, Sharifi F, Kouti L, Noroozian M. Validity and reliability of the Persian version of the Montreal Cognitive Assessment (MoCA-P) scale among subjects with Parkinson’s disease. Applied Neuropsychology: Adult. 2019.

25. Ghayoumi Anaraki Z, Marini A, Yadegari F, Mahmoodi Bakhtiari B, Fakharian E, Rahgozar M, et al. Narrative discourse impairments in persian-speaking persons with traumatic brain injury: A pilot study. Folia Phoniatrica et Logopaedica. 2015;66(6):273-9.
26. Hay E, Moran C. Discourse formulation in children with closed head injury. 2005.
27. Lê K, Mozeiko J, Coelho C. Discourse analyses: Characterizing cognitive-communication disorders following TBI. The ASHA Leader. 2011;16(2):18-21.
28. Fiestas C, Bedore L, Peña E, Nagy VJ, Cohen J, McAlister KT, et al. Use of mazes in the narrative language samples of bilingual and monolingual 4-to 7-year old children. Proceedings of the 4th International Symposium on Bilingualism. 2005:730-40.
29. Kachroo B. Textual cohesion and translation. Meta. 1984;29(2):128-34.
30. Halliday MAK, & Hasan, R. (1976). Cohesion in English (1st ed.). Routledge. https://doi.org/10.4324/9781315836010. Cohesion in English. 1st ed. london1976.
31. Wright HH, Capilouto GJ, Koutsoftas A. Evaluating measures of global coherence ability in stories in adults. Int J Lang Commun Disord. 2013;48(3):249-56.
32. MacLeod CM. Half a century of research on the Stroop effect: an integrative review. Psychological bulletin. 1991;109(2):163.
33. Rezapour T, Soltani Nezhad Z, Ekhtiari H. Administration and Scoring Manual Persian Paper and Pencil Cognitive Assessment Package (PCAP). Tehran: Mehrsa Publication. 2013.
34. Rezapour T EH, Soltaninejad Z. [procedure and scoring of persian paper and pencil cognitive assessment package (PCAP)]. Tehran:, Persian. M.
35. Amunts J, Camilleri JA, Eickhoff SB, Heim S, Weis S. Executive functions predict verbal fluency scores in healthy participants. Scientific reports. 2020;10(1):11141.
36. Ebrahimipour M, Shahbeigi S, Jenabi M, Amiri Y, Kamali M. Verbal fluency performance in patients with multiple sclerosis. Iranian Journal of Neurology. 2008;7(21):138-42.
37. Mousavi SZ, Mehri A, Maroufizadeh S, Koochak SE. Comparing Verb Fluency With Verbal Fluency in Patients With Alzheimer's Disease. Middle East Journal of Rehabilitation and Health. 2014;1(1).
38. Nucci M, Mapelli D, Mondini S. Cognitive Reserve Index questionnaire (CRIq): a new instrument for measuring cognitive reserve. Aging clinical and experimental research. 2012;24(3):218-26.
39. Hatami J, Feizi Khajeh A, Rahiminezhad A, Farahani H, Rezapour T. Validation of Persian Version of Cognitive Reserve Index Questionnaire (CRIq). Journal of Applied Psychological Research. 2020;11(1):87-99.
40. Cohen JSPAftBSneRhdo. Statistical Power Analysis for the Behavioral Sciences (2nd ed.). Routledge. 1988.
41. Ash S, McMillan C, Gross RG, Cook P, Morgan B, Boller A, et al. The organization of narrative discourse in Lewy body spectrum disorder. Brain Lang. 2011;119(1):30-41.
42. Marini A, Boewe A, Caltagirone C, Carlomagno S. Age-related differences in the production of textual descriptions. Journal of psycholinguistic research. 2005;34:439-63.
43. Cooke A, Zurif EB, DeVita C, Alsop D, Koenig P, Detre J, et al. Neural basis for sentence comprehension: Grammatical and short-term memory components. Human brain mapping. 2002;15(2):80-94.
44. Martín-Aragoneses MT, Mejuto G, Del Río D, Fernandes SM, Rodrigues PF, López-Higes R. Task demands and sentence reading comprehension among healthy older adults: The

complementary roles of cognitive reserve and working memory. Brain Sciences. 2023;13(3):428.
45. Caplan D, Waters GS. Verbal working memory and sentence comprehension. Behavioral and brain Sciences. 1999;22(1):77-94.
46. Delage H, Frauenfelder UH. Syntax and working memory in typically-developing children: Focus on syntactic complexity. Language, Interaction and Acquisition. 2019;10(2):141-76.
47. Ivanova I, Ferreira VS. The role of working memory for syntactic formulation in language production. J Exp Psychol Learn Mem Cogn. 2019;45(10):1791-814.
48. Yang CL, Perfetti CA, Schmalhofer F. Event-related potential indicators of text integration across sentence boundaries. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2007;33(1):55.
49. Gordon PC, Hendrick R, Johnson M. Memory interference during language processing. Journal of experimental psychology: learning, memory, and cognition. 2001;27(6):1411.
50. Murray LL. Attention and other cognitive deficits in aphasia: Presence and relation to language and communication measures. 2012.
51. Coelho CA, Liles BZ, Duffy RJ. Impairments of discourse abilities and executive functions in traumatically brain-injured adults. Brain injury. 1995;9(5):471-7.
52. Siew CS, Wulff DU, Beckage NM, Kenett YN. Cognitive network science: A review of research on cognition through the lens of network representations, processes, and dynamics. Complexity. 2019;2019(1):2108423.
53. De Deyne S, Navarro DJ, Storms G. Better explanations of lexical and semantic cognition using networks derived from continued rather than single-word associations. Behavior research methods. 2013;45(2):480-98.
54. Morris J, Hirst G. Lexical cohesion computed by thesaural relations as an indicator of the structure of text. Computational linguistics. 1991;17(1):21-48.
55. Song H, Park B-y, Park H, Shim WM. Cognitive and neural state dynamics of narrative comprehension. Journal of Neuroscience. 2021;41(43):8972-90.
56. Kintsch W. The role of knowledge in discourse comprehension: a construction-integration model. Psychological review. 1988;95(2):163.
57. Ou J, Law S-P, Fung R. Relationship between individual differences in speech processing and cognitive functions. Psychonomic bulletin & review. 2015;22(6):1725-32.