ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

Rehabilitation / Rehabilitasyon

Investigating the Usage of Motion Verbs in Parkinson's Disease

Fenise Selin Karalı[1], Samet Tosun[1], Abdullah Topraksoy[2], Jülide Kesebir[3], Nilgün Cınar[4]

[1] Biruni University, Faculty of Health Sciences, Department of Speech and Language Therapy, Istanbul, Türkiye

[2] İstanbul University, Faculty of Letters, Department of Linguistics, Istanbul, Türkiye

[3] Biruni University, Vocational School, Department of Occupational Therapy, Istanbul, Türkiye

[4] Maltepe University, School of Medicine, Department of Neurology, Istanbul, Türkiye

Fenise Selin KARALI
0000-0003-1513-9219

Samet TOSUN
0000-0002-9604-7430

Abdullah TOPRAKSOY
0000-0003-3240-3915

Jülide KESEBİR
0000-0002-3099-411X

Nilgün CINAR
0000-0003-3868-3137

Correspondence: Selin Karalı
Biruni University, Faculty of Health Sciences, Department of Speech and Language Therapy, Istanbul, Türkiye
Phone: +90 212 444 8 276
E-mail: skarali@biruni.edu.tr

Received: 16.12.2024
Accepted: 28.02.2025

ABSTRACT

Purpose: This study aimed to determine the quantity of motion verbs in Parkinson's Disease (PD) and their potential correlation with other parameters.

Methods: In this study, 20 participants diagnosed with Parkinson's disease (mean age 68.45±10.5; 14 males; 6 females) were included. They were recruited at the Maltepe University Hospital, Faculty of Medicine, Department of Neurology. Montreal Cognitive Assessment (MoCA), the pear film, and animated short videos were used as data collection tools.

Results: Among the participants, 60% were in the early stages of PD, and 40% were in the advanced stages, with educational backgrounds ranging from primary school to university. Statistical analysis showed no significant differences in the usage of verbs, motion verbs, and participles across PD stages, gender, or education levels ($p > 0.05$).

Conclusion: In this study, no significant difference was found in the use of motion verbs among individuals with PD. The literature suggests that motion verb impairments in PD patients are typically attributed to deficits in executive functions, and that motor cortex atrophy does not contribute to these impairments. As a result, there remains no consensus regarding the precise nature of language deficits in Parkinson's disease.

Keywords: Motion verbs; Parkinson's Disease; discourse.

ÖZET

Amaç: Bu çalışmanın amacı Parkinson Hastalığında (PH) hareket eylemlerinin niceliğini ve diğer parametrelerin hareket eylemleriyle potansiyel korelasyonunu belirlemektir.

Yöntemler: Bu çalışmaya, Parkinson hastalığı tanısı almış 20 katılımcı (ortalama yaş 68,45±10,5; 14 erkek; 6 kadın) dahil edilmiştir. Katılımcılar Maltepe Üniversitesi Tıp Fakültesi Nöroloji Anabilim Dalı'nda alınmıştır. Veri toplama aracı olarak Montreal Bilişsel Değerlendirme Ölçeği (MoCA), armut filmi ve hareketli kısa videolardan oluşan anlatılar kullanılmıştır.

Bulgular: Katılımcıların %60'ı PH erken evresinde, %40'ı ise ileri evresinde olup, eğitim düzeyleri ilkokuldan üniversiteye kadar çeşitlilik göstermiştir. Yapılan istatistiksel analizler, eylem, devinim eylemleri, eylemsi kullanımı açısından PH evreleri, cinsiyet ve eğitim düzeyleri arasında anlamlı bir fark olmadığını göstermiştir ($p > 0.05$).

Sonuç: Bu çalışmada, PH'li bireylerin devinim eylemlerinin kullanımında belirgin bir fark bulunamamıştır. Literatürde, PH hastalarında devinim eylem bozukluklarının genellikle yürütücü fonksiyonlardaki eksikliklerden kaynaklandığı ve motor korteks atrofisinin bu bozukluklara yol açmadığı ileri sürülmektedir. Sonuç olarak, Parkinson hastalarında dil bozukluklarının doğası hakkında net bir görüş birliği sağlanamamıştır.

Anahtar Kelimeler: Devinim eylemleri; Parkinson Hastalığı; anlatı.

Parkinson's disease (PD) is a chronic and progressive disorder marked by non-motor symptoms and linked to the degeneration of dopaminergic neurons in the substantia nigra (SN) (1). Risk factors include old age, genetic alterations, familial tendency, and chemical exposure (2). Both hereditary and environmental variables are thought to contribute to PD (3). The global prevalence of PD escalates with age, attaining 1903 cases per 100,000 for those over 80 years old (4). Parkinsonism syndromes arise from several etiological reasons, with idiopathic Parkinson's disease being the predominant kind, constituting around 80%, and its precise origin remains unidentified (5). The clinical manifestations of PD generally encompass both motor and non-motor symptoms, such as bradykinesia, rigidity, tremors, and a kyphotic posture. Repetitive motor actions become challenging in individuals due to stiffness and bradykinesia in their skeletal muscles (6). A substantial majority of persons with PD experience cognitive impairment, potentially impacting their thinking, reasoning, memory, language, and voice perception capabilities. When these challenges intensify to the extent of affecting daily functions, it is referred to as Parkinson's disease dementia (PDD) (7). In addition to prevalent mechanical speech abnormalities in PD patients, including dysarthria and hypophonia, deficits in morphosyntactic, semantic, and figurative language understanding have also been documented (8). Numerous studies have shown that PD, which impacts motor functions, also results in deficits in motor-related language. While linguistic impairments in PD are believed to arise from cognitive dysfunction, research indicates that such impairments can manifest irrespective of cognitive factors (9). Verb-specific impairments and the processing of motion-related words in patients with neurologically impaired motor reasoning skills are correlated with neural activity in brain regions associated with motor planning and execution involved presenting an action-naming task to PD patients to evaluate the accuracy of the motor-related semantic content of various verbs. The study revealed that PD had inferior performance on images with high motor content in comparison to those with low motor association. The performance of PD patients was negatively influenced by the degree of motor-related semantic content linked to each verb, providing significant insights into the relevance of brain regions involved in the planning and execution of movements for retrieving motor-related semantic content (10).

The identification of semantic-based verb deficits in Parkinson's disease remains a subject of debate. Herrera et al. (10) reported that individuals with Parkinson's disease demonstrated greater difficulty in naming action verbs associated with high motor content compared to those with low motor content.

Deficits in verb processing have been identified through verb generation tasks. In a study by Peran et al. (11), individuals with Parkinson's disease were presented with either a verb or a noun and were asked to generate a semantically related verb and noun for each stimulus. Compared to the control group, PD participants demonstrated significant impairments in verb generation, regardless of whether the cue was a noun or a verb. In contrast, their performance in generating nouns was comparable to that of the controls. These findings suggest that verb deficits in Parkinson's disease are, at least in part, attributable to disruptions at the semantic level.

Motion events, a fundamental concept in cognitive linguistics, describe situations involving movement or location changes, often structured through elements such as figure (the moving entity), ground (the reference object), path (trajectory), and manner (the way motion occurs) (12). For instance, in the sentence *"The bird flew over the mountain,"* 'the bird' is the figure, 'the mountain' is the ground, 'flew' encodes the manner of motion, and 'over' represents the path. These events are intricately tied to motion verbs, which encode the dynamic aspects of motion in language. The encoding of motion varies across languages, with satellite-framed languages like English often expressing the manner of motion in the verb and the path in additional elements, as seen in *"He ran into the building,"* where *ran* indicates the manner and *into* marks the path. In contrast, verb-framed languages like Turkish predominantly encode path within the verb and use adjuncts to indicate manner, as in *"Adam köprüden koşarak geçti"* ("The man passed under the bridge by running"). This linguistic diversity not only influences how motion is conceptualized and described but also highlights the cognitive demands of processing motion verbs, which require the integration of motor, sensory, and linguistic information.

In the context of Parkinson's disease (PD), motion verbs hold particular significance due to the motor and cognitive impairments associated with the disorder. PD affects the neural mechanisms involved in motor planning and execution, which are crucial for retrieving and processing motion-related semantic content. By investigating motion verbs in PD, researchers can gain valuable insights

into the interplay between motor and linguistic systems, potentially informing both linguistic theory and clinical interventions.

Numerous research in the literature examine motion verbs, and Bertella et al. (13) found that patients with Parkinson's disease exhibited comparatively worse performance in naming action images relative to naming objects. Researchers found that Parkinson's patients had comparatively worse performance in action word creation, naming of action pictures, and verbal fluency compared to nouns (14). In the current study, the production of motion verbs in Turkish speaking PD was assessed by a new evaluation tool. This tool was used to assess motion verbs in Turkish (15). Our objective was to determine the amount of motion verbs produced in PD and the potential association with other parameters.

Materials and Methods

This is a cross-sectional descriptive study and it was aimed to determine the motion verb usage of Turkish speaking patients with PD. Ethical approval was acquired from Biruni University Clinical Studies Ethical Approval Center (Ethical approval number: 2015-KAEK-80-23-34).

Participants

In order to evaluate motion verbs, the research recruited 20 participants with PD (mean of age 68.45±10,5; 14 men; 6 women). Participants' demographic information was presented in Table 1. The following variables were taken into account: age, gender, education level, Parkinson's disease diagnosis age, time since diagnosis, Parkinson's stage, and MoCA values. All participants were recruited at the Maltepe University Hospital, Faculty of Medicine, Neurology. All of the participants were diagnosed by one of the researchers of this study.

Table 1: Demographic Information

Age		68,45±10,5	
Gender	**Women**	6	30%
	Men	14	70%
Age of Diagnosis		61,1±11,84	
Time passed since diagnosis		7,35±5,47	
PD Stage	**Early**	12	60%
	Late	8	40%
Stage	**Tek**	5	25%
	Çift	7	35%
	Postural	4	20%
	İleri	2	10%
	Tekerlek	2	10%
Education	**Primary School**	8	40%
	Middle School	1	5%
	High School	4	20%
	University	7	35%
MoCA	19,6±4,73		

The inclusion criteria were as follows:

-Diagnosed with Parkinson's disease,

-Being capable of completing the test,

-Aged between 30 and 85 years.

The exclusion criteria were as follows:

-Presence of secondary neurological disorders aside from Parkinson's disease

-Having a history of epilepsy, or concurrent severe psychiatric disorders.

Data Collection Tools

Demographic information on age, gender, occupation, co-occurring diseases, medications, and genetic family history was gathered from patients through a voluntary consent form, an informed consent form, and a demographic information form.

The Montreal Cognitive Assessment (MoCA): MoCA is a questionnaire designed to evaluate various cognitive functions and moderate cognitive impairment (16). The test's validity and reliability have been confirmed, with tested subcategories encompassing cognitive functions including memory, concentration, recall, language, abstract reasoning, orientation, computation, visuoconstructional skills, and executive functions. The highest attainable score on the test is 30, with scores of 21 or above signifying the absence of mild cognitive impairment (17). Our study employed the MoCA to evaluate cognitive impairment in persons with Parkinson's disease and to analyze their language performance in conjunction with other cognitive abilities.

Participants were presented with a brief film called The Pear film including a 5-minute narrative and were thereafter requested to recount the storyline and their interpretations upon its conclusion. Participants with Parkinson's disease were instructed to characterize the content of 35 animated videos (15). All narrations were recorded, transcribed, and evaluated to identify the verbs and all motion-related verbs utilized by each patient, which were subsequently reported in the study results.

The Pear Film (Movie Narration Task): The Pear Film, created by a team of scholars led by Prof. Wallace Chafe at the University of California, Berkeley, was designed to gather linguistic data from diverse languages worldwide (18). This silent movie, containing only natural background sounds and no dialogue, serves as a versatile elicitation tool applicable to any language. It was produced to explore how participants narrate and encode motion events in their language. In brief, the movie depicts a man harvesting pears, which are partially stolen by a boy riding a bike toward a pear tree. Along the way, the boy encounters a group of children and has some adventures with them. Meanwhile, the farmer eventually realizes his pears are missing, and the film concludes with this discovery. The purpose of this task is to examine how motion events are expressed in Turkish PD patients, focusing on the use of verbs in their narrations and to identify patterns in how participants encode spatial relations, especially via verbs and verbal expressions.

Assessment procedure: Participants watched the film individually and were asked to describe the movie. They provided verbal descriptions thereafter. The narratives were transcribed and analyzed for the production of motion verbs.

Short Animated Videos (Monitoring-Narration Task): This task is based on the 'Motion Verb Stimulus' developed by Bohnemeyer and Levinson (19) in the Language and Cognition research group at the Max Planck Institute for Psycholinguistics. It was designed to elicit linguistic descriptions of motion events by comparing them with other animations in the same set. The task features 35 brief (4-seconds each) 3D animations that are straightforward, easily replayable, and can be presented in different sequences for contrastive analysis. Each clip depicted dynamic scenes requiring participants to describe the motion of objects or figures. The purpose of this task was to complement the findings from the Pear Film by exploring participants' linguistic strategies in a controlled setting with distinct and focused motion events. It also aimed to observe consistency or variation in the encoding of motion events across different contexts and stimuli. An example of the videos researchers used were shown in Figure 1.

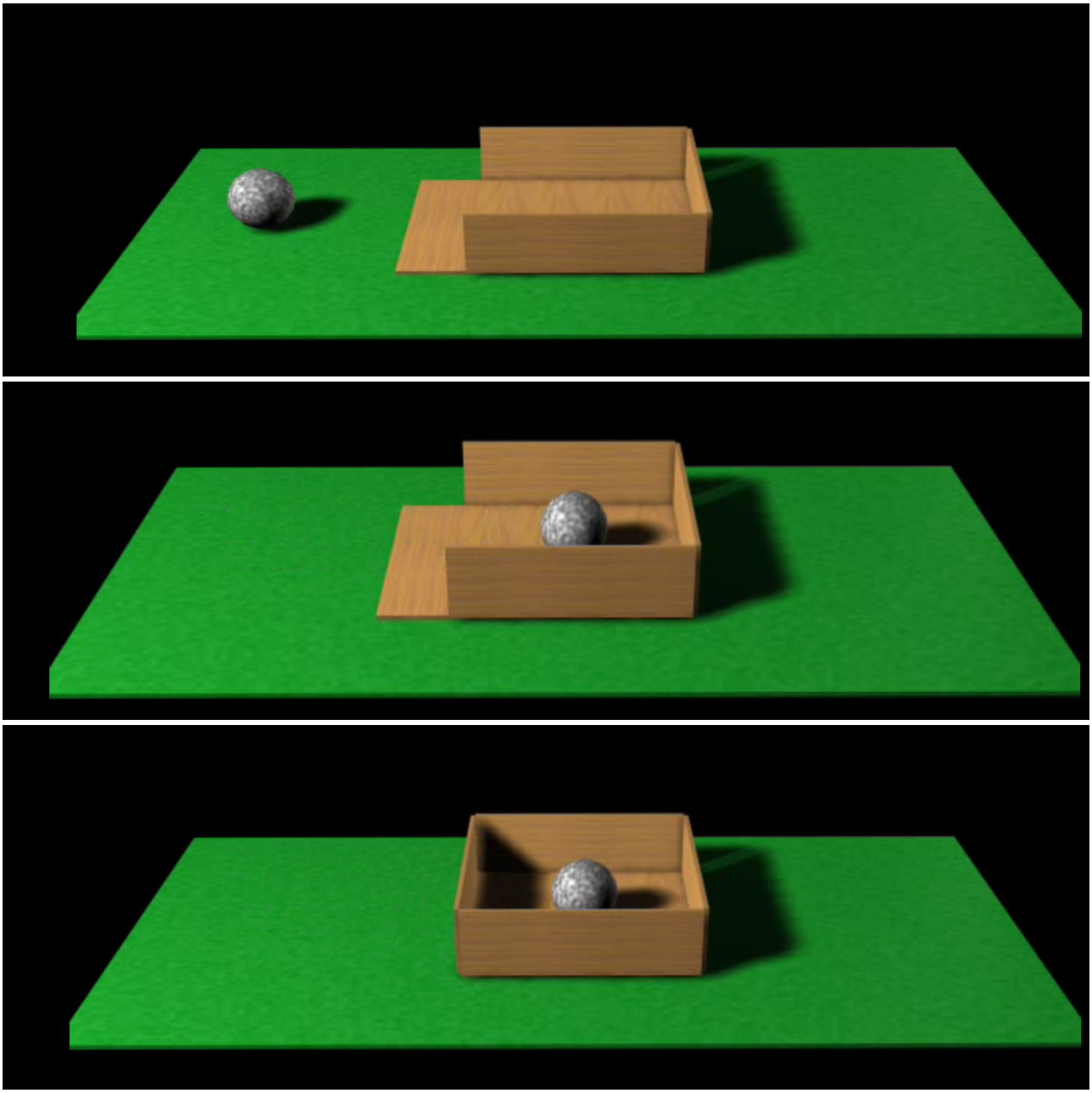

Figure 1: Excerpts from the video 5.

Assessment procedure: Participants viewed each animated clip and described what they saw. Their descriptions were recorded, transcribed, and analyzed for linguistic features similar to the Pear Film.

Results

The study included 6 female participants (30%) and 14 male participants (70%). The mean age of the participants was 68.45 ± 10.5 years. The average age at Parkinson's disease (PD) diagnosis was 61.1 ± 11.84 years, and the mean duration since diagnosis was 7.35 ± 5.47 years. The stages of Parkinson's disease among the participants, categorized as early or advanced stages, are detailed in Table 1. Twelve participants (60%) were in the early stages of PD, while 8 participants (40%) were in the advanced stages.

When analyzed by PD stages, 5 participants (25%) were in stage 1, 7 participants (35%) in stage 2, 4 participants (20%) in stage 3, 2 participants (10%) in stage 4, and 2 participants (10%) in stage 5. The educational levels of the participants were as follows: 8 primary school graduates (40%), 1 middle school graduate (5%), 4 high school graduates (20%), and 7 university graduates (35%). The mean Montreal Cognitive Assessment (MoCA) score of the participants was 19.6 ± 4.73.

Table 2: Mean values, max and minimum scores.

	Mean (S.D)	Max	Min
Verb Number	14,80±5,19	8,00	24,00
Motion Number	7,75±3,47	0,00	14,00
Participle	2,8±2,85	0,00	10,00
Short Story Participle	9,95±10,04	0,00	38,00
Short Story Motion	28,6±3,69	20,00	35,00
Ratio	0,52±0,21	0,00	0,80

The usage of verbs, motion verbs and participles in short stories, as well as all ratios, mean values, and maximum-minimum scores, are presented in Table 2. The mean number of all verbs used was 14.80 ± 5.19 (max: 24, min: 8). The mean number of all motion verbs used was 7.75 ± 3.47 (max: 14, min: 0), while the mean number of all participles was 2.8 ± 2.85 (max: 10, min: 0). In the short story narration, the mean number of participles used was 9.95 ± 10.04 (max: 38, min: 0), while the mean number of motion verbs used was 28.6 ± 3.69 (max: 35, min: 20). The overall group comparison ratio was 0.52 ± 0.21 (max: 0.8, min: 0), as detailed in Table 2.

Table 3: Variables Based on PD stage

Variable	Stage	N	Mean Rank	Summary of Ranks	U	p
Ratio	Early	12	10,17	122,00	44,000	,792
	Late	8	11,00	88,00		
Number of Verbs	Early	12	10,21	122,50	44,500	,792
	Late	8	10,94	87,50		
Number of Motion	Early	12	9,96	119,50	41,500	,624
	Late	8	11,31	119,50		
Participle	Early	12	12,17	146,00	28,000	,135
	Late	8	8,00	64,00		
Short Story Participle	Early	12	11,71	140,50	33,500	,270
	Late	8	8,69	69,50		
Short Story Motion	Early	12	9,46	113,50	35,500	,343
	Late	8	12,06	96,50		

The variables related to PD stages are outlined in Table 3. In participants with early-stage and advanced-stage PD, no significant correlation was observed in the ratios between the two groups ($p = 0.792$). When the total number of verbs used was examined, a value of $p = 0.792$ was obtained for the early stage. For motion verbs, the early-stage value was $p = 0.624$, while the value for verbals was $p = 0.135$. The total number of verbals used in the short story narration by early-stage PD participants was $p = 0.270$, while the statistical ratio for motion verbs in the same narration was $p = 0.343$.

Table 4: Variables Based on Gender					
Variable	**Gender**	**N**	**Mean Rank**	**KruskallWallis**	**Sig.**
Verb Number	Women	6	10,67	,007	0,934
	Men	14	10,43		
Motion Number	Women	6	12,17	,688	0,407
	Men	14	9,79		
Participle	Women	6	11,58	,297	0,585
	Men	14	10,04		
Short Story Participle	Women	6	7,17	2,746	0,098
	Men	14	11,93		
Short Story Motion	Women	6	10,92	,043	0,835
	Men	14	10,32		

Gender-related variables are presented in Table 4. The analysis of total verb usage ($p = 0.934$), motion verb usage ($p = 0.407$), and verbal usage ($p = 0.585$) revealed similar changes across groups, with no significant differences in the overall statistics ($p > 0.05$). When examining the number of verbals ($p = 0.098$) and motion verbs ($p = 0.835$) used in short story narration, no significant differences were found between the two groups ($p > 0.05$).

Table 5: Variables Based on Education					
Variable	**Education**	**N**	**Mean Rank**	**KruskallWallis**	**Sig.**
Verb Number	Primary	8	10,50	1,328	0,722
	Middle	1	17,00		
	High School	4	9,88		
	University	7	9,93		
Motion Number	Primary	8	11,38	1,357	0,716
	Middle	1	15,00		
	High School	4	10,63		
	University	7	8,79		
Participle	Primary	8	9,63	5,469	0,140
	Middle	1	19,00		
	High School	4	6,25		
	University	7	12,71		
Short Story Participle	Primary	8	9,31	1,969	0,579
	Middle	1	9,50		
	High School	4	8,75		
	University	7	13,00		
Short Story Motion	Primary	8	10,94	,138	0,987
	Middle	1	11,00		
	High School	4	10,63		
	University	7	9,86		

Education-related variables are detailed in Table 5. Among middle school graduates, the use of all verbs, motion verbs, and participles showed significant differences within the group compared to primary school, high school, and university graduates. However, these results were not statistically significant overall ($p > 0.05$). In short story narration, the number of verbs used was more significantly different within the university graduate group, while the number of motion verbs used was more significant within the middle school graduate group. However, these results were not statistically significant overall, and no superiority was observed between the groups ($p > 0.05$).

Discussion

The clinical signs of Parkinson's disease typically include both motor and non-motor symptoms, such as bradykinesia, rigidity, tremors, and a kyphotic posture. Repetitive motor acts become difficult for individuals due to rigidity and bradykinesia in their skeletal muscles (6). A significant majority of individuals with Parkinson's disease exhibit cognitive impairment, which may affect their thinking, reasoning, memory, language, and speech perception abilities (7). Verb-specific impairments and the processing of motion-related lexicon in patients with compromised motor reasoning abilities correlate with neural activity in brain regions linked to motor planning and execution, as assessed through an action-naming task administered to Parkinson's Disease patients to evaluate the precision of the motor-related semantic content of diverse verbs. The current study examined the usage of motion verbs in PD patients.

The correlation between action and the motor system is an intensively researched field of interest (20; 21). Research findings from neuromodulation, neuroimaging, and behavioral paradigms (both interference and facilitation) in healthy adults have prompted several scholars to assert that the motor system plays a role in the representation of physical action concepts (22; 23; 24). Researchers have utilized Parkinson's Disease (PD) as a model to investigate the disruption of the motor and language systems in relation to action concepts and verb processing (10; 25).

Deficits have been identified through verb generating activities. In Peran et al. (11), participants with Parkinson's Disease were presented with a verb or a noun and created a semantically relevant verb and noun for each stimulus. In comparison to controls, participants with Parkinson's disease exhibited deficits in verb generation tasks, irrespective of whether the cue was a noun or a verb. Conversely, the performance of PD participants in producing nouns was comparable to that of the control group. This study indicates that verb deficits in Parkinson's disease partially stem from disturbances at the semantic level.

In both Herrera et al. (10) and Bocanegra et al. (25), participants with Parkinson's Disease exhibited greater impairment in naming action verbs with high motor content (e.g., dig) than those with low motor content (e.g., sleep). This finding indicates that persons with Parkinson's disease, even without identifiable cognitive impairment, are attuned to distinctions in movement features among action verbs. These investigations have been employed to validate grounded cognition theories. Nonetheless, the discovery of semantic-based verb deficits in Parkinson's Disease is controversial.

In our study, we were not able to find out a difference between the number of verbs and the number of motion verbs. Several studies have shown that verb impairments in Parkinson's Disease (PD) stem from deficits in executive function (26; 27) and contend that the absence of significant motor cortex atrophy renders it improbable that PD verb deficits are attributable to compromised motor schema representations (28). Consequently, ambiguity persists concerning the precise nature of PD word impairments.

Conclusion

Employing linguistic resources for the analysis of motion events is advantageous, and through experiments involving content abundant in motion, novel insights were revealed, highlighting the utilization of path and manner verbs in Turkish to articulate motion structures, further reinforced by subordinate clauses and case markers (15). The assessment utilized in this study was insufficient in capturing the challenges faced by Parkinson's disease patients in producing motion verbs. Therefore, it is crucial to develop a novel measurement instrument specifically designed to evaluate and characterize these difficulties in PD patients.

Limitations

This research has numerous limitations which must be noted. The sample size of the patient subgroups, particularly at varying levels of PD, was somewhat small.

Additionally, a control group was not included to form normative data. Furthermore, as the illness advances, further research should assess how the patients' language skills and neuroanatomical alterations correlate by using alternative assessment tools. Because this assessment method might be complicated for the target population.

Declarations

Authors Disclosure (Conflict of Interest) Statement

The authors do not declare any conflict of interest

Funding Statement

The authors do not declare any funding.

Ethics Approval

Ethical approval (2015-KAEK-80-23-34) was obtained from the ethical committee of Biruni University.

References

1. Jankovic J. Parkinson's disease: clinical features and diagnosis. J Neurol Neurosurg Psychiatry. 2008;79(4):368-376. doi:10.1136/jnnp.2007.131045
2. Beitz JM. Parkinson's disease: a review. Front Biosci (Schol Ed). 2014, 6:65-74. 10.2741/s415
3. Durmus H, Gokalp MA, Hanagasi HA. Prevalence of Parkinson's disease in Baskale, Turkey: a population based study. Neurol Sci 2015;36:411-413.
4. Pringsheim T, Jette N, Frolkis A, et al., The prevalence of Parkinson's disease: a systematic review and meta-analysis. Mov disord. 2014;29(13):1583-90.
5. Özekmekçi S. Parkinson Hastalığı ve Diğer Parkinsonizm Tabloları. İçinde Apaydın H, editör. Nöroloji Ders Kitabı, İstanbul: İÜ Cerrahpaşa Tıp Fakültesi Yayınları; 2009. s. 565-603.
6. Morris ME. Movement disorders in people with Parkinson's disease: a model for physical therapy. Phys Ther 2000; 80: 578–597.
7. Diaz NL, Waters CH. Current strategies in the treatment of Parkinson's disease and a personalized approach to management. Expert Rev Neurother. 2009;9(12):1781-1789. doi:10.1586/ern.09.117
8. Bayram E, Akbostancı MC. Hareketle İlişkili Dilin Nöral Temelleri: Parkinson Hastalığında Yapılan Çalışmalar. Turkish Journal of Neurology/Turk Noroloji Dergisi, 2018; 24(1).
9. Cardona JF, Gershanik O, Gelormini-Lezama C, et al. Action-verb processing in Parkinson's disease: new pathways for motor-language coupling. Brain Struct Funct. 2013;218(6):1355-1373. doi:10.1007/s00429-013-0510-1
10. Herrera E, Rodríguez-Ferreiro J, Cuetos F. The effect of motion content in action naming by Parkinson's disease patients. Cortex. 2012;48(7):900-904. doi:10.1016/j.cortex.2010.12.007
11. Péran P, Rascol O, Démonet JF, et al. Deficit of verb generation in nondemented patients with Parkinson's disease. Mov Disord. 2003;18(2):150-156. doi:10.1002/mds.10306
12. Talmy L. The semantics and syntax of motion. In: Kimball J, ed. *Syntax and Semantics.* Vol 4. New York: Academic Press; 1975:181-238
13. Bertella L, Albani G, Greco E, Priano L, Mauro A, Marchi S, et al. Noun verb dissociation in Parkinson's disease. Brain and cognition, 2002;48, 277-280.
14. Signorini M, Volpato C. Action fluency in Parkinson's disease: a follow-up study. Mov Disord 2006;21:467-472.
15. Topraksoy, A.. Motion Predicates in Turkish: A Morpho-Syntactic Treatment, Ph.D. Dissertation, Ankara; 2022
16. Nasreddine ZS, Phillips NA, Bédirian V, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment [published correction appears in J Am Geriatr Soc. 2019 Sep;67(9):1991. doi: 10.1111/jgs.15925]. J Am Geriatr Soc. 2005;53(4):695-699. doi:10.1111/j.1532-5415.2005.53221.x
17. Selekler K, Cangöz B, Uluç S Montreal bilişsel değerlendirme ölçeği (MOBİD)'nin hafif bilişsel bozukluk ve alzheimer hastalarını ayırt edebilme gücünün incelenmesi. Türk Geriatri Dergisi. 2010; 13(3): 166 - 171.
18. Chafe WL. The Pear Stories: Cognitive, Cultural, and Linguistic Aspects of Narrative Production. Norwood, NJ: Ablex; 1980.
19. Bohnemeyer, J., Eissenbeiss, S., & Narasimham, B. Event triads. In S. C. Levinson, & N. J. Enfield (Eds.), Manual for the field season 2001 (pp. 100-114). Nijmegen: Max Planck Institute for Psycholinguistics. doi:10.17617/2.874630.
20. García AM, Ibáñez A. A touch with words: Dynamic synergies between manual actions and language. Neurosci Biobehav Rev. 2016;68:59-95. doi:10.1016/j.neubiorev.2016.04.022.
21. Mahon BZ. What is embodied about cognition?. Lang Cogn Neurosci. 2015;30(4):420-429. doi:10.1080/23273798.2014.987791
22. Andres M, Finocchiaro C, Buiatti M, Piazza M. Contribution of motor representations to action verb processing. Cognition. 2015;134:174-184. doi:10.1016/j.cognition.2014.10.004
23. Pulvermüller F, Hauk O, Nikulin VV, Ilmoniemi RJ. Functional links between motor and language systems. Eur J Neurosci. 2005;21(3):793-797. doi:10.1111/j.1460-9568.2005.03900.x
24. Tettamanti M, Buccino G, Saccuman MC, et al. Listening to action-related sentences activates fronto-parietal motor circuits. J Cogn Neurosci. 2005;17(2):273-281. doi:10.1162/0898929053124965
25. Bocanegra Y, García AM, Lopera F, et al. Unspeakable motion: Selective action-verb impairments in Parkinson's disease patients without mild cognitive impairment. Brain Lang. 2017;168:37-46. doi:10.1016/j.bandl.2017.01.005
26. Colman KS, Koerts J, van Beilen M, Leenders KL, Post WJ, Bastiaanse R. The impact of executive functions on verb production in patients with Parkinson's disease. Cortex. 2009;45(8):930-942. doi:10.1016/j.cortex.2008.12.010
27. Grossman, M., Stern, M. B., Gollomp, S., Vernon, G., & Hurtig, H. I.. Verb learning in Parkinson's disease. Neuropsychology. 1994; 8(3), 413.
28. York C, Olm C, Boller A, et al. Action verb comprehension in amyotrophic lateral sclerosis and Parkinson's disease. J Neurol. 2014;261(6):1073-1079. doi:10.1007/s00415-014-7314-y