

# Does the unified Parkinson's disease rating scale adequately estimate severity of dysarthria?

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## SUMMARY

**Background:** Speech decline is a common and detrimental complication of Parkinson's disease (PD). The Unified Parkinson's Disease Rating Scale (UPDRS) is typically used by the medical community to gauge the presence and severity of PD symptoms, including dysarthria. Accurately tracking the presence and severity of dysarthria has important implications for differential diagnosis, disease course, and therapeutic response.

**Objectives:** To determine the relationship between Movement Disorder Society (MDS) UPDRS ratings and gold standard speech intelligibility transcription scores.

**Methods:** Twenty-seven speakers with PD provided monologue speech samples. MDS-UPDRS ratings of speech were compared to average speech intelligibility scores attained by three naïve judges.

**Results:** MDS-UPDRS ratings and speech intelligibility calculations were significantly correlated.

**Conclusion:** The significant relationship between these two severity indicators provides preliminary evidence of criterion validity and suggests that the single MDS-UPDRS question is reflective of overall speech severity as determined by the gold standard of mean intelligibility transcription scores.

**Keywords:** Parkinson; Dysarthria; Speech; Intelligibility; UPDRS

## INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by a heterogeneous spectrum of motor and non-motor characteristics [1]. Accurate measurement of the symptoms of PD is important for tracking disease progression and therapeutic response and is most often conducted using the Unified Parkinson's Disease Rating Scale (UPDRS). This scale, first published in 1987, was revised in 2008 by the International Parkinson and Movement Disorder Society (MDS) [2,3]. At present, the MDS-UPDRS is the most widely used scale across clinical and research settings [4,5].

In both versions of the UPDRS scale, speech decline is captured with a single question. Speech disruption, or dysarthria, is highly prevalent in PD [6]. It leads to reduced speech intelligibility and has negative consequences for overall well-being and involvement in daily life, including social isolation [7-9]. The speech changes experienced by individuals with PD are variable in their nature and severity, and can differentially impact a wide array of subsystems, including respiration, phonation, articulation, and prosody. As such, detrimental and complex changes can be manifested in rate of speech, precision of articulation, voice quality, fluency, pitch variability, loudness level, and so forth [10].

There are few and conflicting reports about the ability of the UPDRS to accurately reflect the presence and severity of dysarthria [11-13]. In the dysarthria literature, speech intelligibility, or how understandable a speaker is to a listener, is often used as a proxy for speech severity [14]. To determine intelligibility levels, speaking passages are transcribed and the percent of understood words is determined by a naïve listener(s). Particularly in research settings, intelligibility is often calculated across speaking tasks as elicitation method is known to influence understandability in speakers with PD [15,16]. In contrast, the MDS-UPDRS question captures speech severity using a 5-point scale, representing no speech change or slight, mild, moderate, severe difficulty understanding speech [3].

It is unknown whether the UPDRS speech scale will parallel the more established, gold standard metric of intelligibility in its ability to represent speech decline in PD [17]. Thus, this study investigated the relationship between MDS-UPDRS speech ratings and speech intelligibility calculations. Given the negative impact of dysarthria to quality of life, it is important to understand whether a global speech rating is sufficiently sensitive to speech decline [7-9].

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Additionally, early presence of dysarthria is more suggestive of atypical parkinsonian disorders underscoring the importance of accurate identification of dysarthria to the differential diagnosis process [18,19]. Finally, the potential of dysarthria and other axial motor symptoms to inform disease course, such as more rapid progression to dementia, has been reported, elevating the need to accurately capture this secondary motor symptom of PD [20-22].

## METHODS

### Participants

Participants were 27 speakers with PD with an average age of 71.11 years and average disease duration of 9.06 years (Tab. 1). Inclusion criteria were an established diagnosis of PD by a neurologist with no other neurological complications (e.g., stroke, traumatic brain injury), presence of dysarthria without dyskinesias that would affect speech performance, minimum age of 50 years, and the ability to pass a vision, hearing, and depression screening. Participants were excluded for atypical Parkinsonism and young onset PD. All participants were in the ON medication state during examinations. Detailed participant characteristics are reported elsewhere [23].

### Procedure

Intelligibility calculations: A monologue was elicited by

asking participants to talk about their job, their family or a vacation for approximately 60 seconds. Use of a monologue is considered best practice for its ecological validity and is recommended for speakers with PD and mild-moderate speech decline [16]. Samples were segmented into speech runs, which are operationally defined as a stretch of speech bounded by a silent period or pause between words of at least 200 milliseconds [24]. Each monologue was transcribed to identify the first 100-word speech run that did not contain proper nouns, formulaic phrases or specialty vocabulary [25]. An independent judge reassessed 15% of the speech run coding; interjudge reliability was 97.8%. Speech was recorded using a high-quality, head-mounted microphone (AKG C520) with a constant mouth-to-microphone distance of two inches [23]. The microphone was connected to a portable digital speech recorder (Zoom H6, GU- ZOOMH6). All speech samples were recorded in a quiet environment with low ambient noise.

The transcribed, 100-word samples were then used for intelligibility scores. Transcriptions of the dysarthric speech were conducted by three naïve listeners to provide a mean intelligibility rating for each speaker with PD. Listeners were native English speakers without hearing loss.

Intelligibility scores were determined by counting the number of correctly identified words and dividing by the total of 100 words, using established transcription

**Tab. 1.** Demographic and speech severity ratings across participants.

Participant	Age	Sex	Years of Education	Disease Duration (Yrs)	Speech Intelligibility (100)	MDS-UPDRS Rating
01	77	M	20	12	87.67	3
02	80	M	18	8	89.00	1
03	68	F	17	16	88.00	1
04	69	M	19	8	87.00	2
05	70	M	16	8	81.33	3
06	76	M	16	18	95.67	1
07	74	M	16	15	93.00	2
08	66	F	17	9	88.33	2
09	73	M	16	8	94.00	1
10	67	M	16	6.5	96.00	1
11	63	M	16	4	100	1
12	66	M	18	17	99.00	1
13	70	M	16	13	97.33	0
14	73	M	15	2	94.67	1
15	69	F	17	1	98.67	1
16	80	M	16	11	97.33	1
17	76	F	18	4	95.00	0
18	71	F	21	7	96.67	1
19	65	F	22	8	97.67	1
20	81	F	18	20	96.67	1
21	62	M	18	7	99.00	1
22	64	M	14	4	85.33	1
23	60	M	16	4	89.00	0
24	73	F	16	6	95.67	1
25	72	M	18	10	93.67	1
26	75	M	13	11	94.33	2
27	80	F	18	10	97.00	2
Mean (SD)	71.11 (5.78)	M=18 F=9	17.07 (1.92)	9.06 (4.82)	93.82 (4.87)	1.25 (2.75)



## DISCLOSURES

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No specific funding was received for this work. The authors declare that there are no conflicts of interest relevant to this work.

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Spencer: Received salary from the University of Washington and royalties from Medical Speech Language Pathology Book Series through Plural Publishing.

Brown: Received stipend from the University of Washington and salary from Augustana College.

Elder: Graduate student; no additional disclosures to report.

## ETHICAL COMPLIANCE STATEMENT

The University of Washington Institutional Review Board approved this study. Written consent was secured for all participants.

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