



Stuttering-like Dysfluencies in the Speech of Patients with Parkinson's Disease

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Abstract

Adult-onset, or neurogenic, stuttering is a comparatively rare form of stuttering that has been linked to disruptions in the basal ganglia control circuits. The classic works of Darley, Aronson, and Brown describe dysarthria in individuals suffering from diseases of the basal ganglia, but only a few studies have looked at adult-onset stuttering as a component of speech in these populations. Recordings of 18 individuals with mild Parkinson's disease (PD) describing a picture (self-formulated speech) and reading aloud were analyzed for type of dysfluency, frequency of dysfluency, and rate of speech. While results revealed a statistically significant difference in terms of the type and frequency of dysfluencies in the self-formulated task, there was no statistically significant difference in speaking rate between the two tasks. This study has shown that dysfluency is a component of the speech of individuals with PD and is an important feature to assess in the clinical evaluation of the speech of these individuals.

Basal Ganglia Diseases

- Parkinson's Disease (PD)
 - Believed to be caused by damage to neurons producing dopamine in the substantia nigra
 - Affects approx. 1% of population over 60
 - Hallmarks
 - Resting tremor
 - Rigidity
 - Bradykinesia

Speech Characteristics

- PD – Hypokinetic dysarthria
 - loss of volume, pitch, range, and intonation in the voice
 - rate of speech being either too fast or too slow
 - **uncontrolled repetitions of sounds, words, or phrases (stuttering)**
 - slurred speech
 - difficulty initiating speech
 - reduced facial expression and natural gesture
 - a harsh, breathy voice

Background

- Disrupted speech is one of the earliest signs of disease, with mild dysfluency being potentially one type of disruption. Mild dysfluency may not affect intelligibility, so it may be dismissed as sign or symptoms of more serious disease onset. While stuttered speech may be a relatively minor symptom of PD, the presence of stuttering in these individuals can be an important characteristic to observe for diagnostic purposes.
- Current protocols rate the intelligibility of speech of individuals with PD but do not specifically look at dysfluency. Due to the presence of stuttering-like dysfluencies in the mild disease state, it may be important to include a dysfluency analysis in the screening of individuals who potentially have PD and to offer both self-formulated speech and reading tasks to elicit a comprehensive evaluation of their fluency.

Purpose

- The purpose of this study is to describe the type and frequency of dysfluencies, as well as the speaking rate, in the speech of persons with PD.

Method

- *Speakers.*
 - Data for the current investigation are considered to be archival and were taken from speech samples of participants who were recruited previously from the outpatient Movement Disorder Neurology Clinic at the University of Arkansas for Medical Sciences, Little Rock, Arkansas.
 - Patients with PD presented with at least 2 of the 4 cardinal signs of the disease (resting tremor, rigidity, bradykinesia, and postural instability) in the absence of other signs or symptoms suggestive of other parkinsonian syndromes.
 - In addition to presentation of clinical symptoms of PD, patients were required to be able to follow verbal instructions in order to participate. Patient medical histories were obtained including age, time post-onset of disease, and medication status. The Unified Parkinson's Disease Rating Scale was used to measure motor ability.

Method

- *Materials and Recording Procedure.*
 - The assessment speech protocol consisted of a conversational speech sample taken from the description of the Cookie Theft (CT) picture and a reading of the Grandfather Passage (GP).
 - All speakers performed each task once and followed the same, randomly determined task order.

Method

- *Dysfluency Data Analyses.* The recorded samples were orthographically transcribed using the *Systematic Analysis of Language Transcripts (SALT)* program.
- **Analysis 1 – Type of Dysfluency.** The speech samples first were analyzed by identifying dysfluencies, classifying those dysfluencies according to six widely recognized types. These include three types designated as stuttering-like dysfluencies (SLD = part-word repetitions [PW], single-syllable word repetitions [WW], and dysrhythmic phonations [DP]) and three types designated as other dysfluencies (OD). This dysfluency classification included: interjections, revisions/incomplete phrases, and multi-syllabic word or phrase repetitions.
- Once the types of dysfluencies observed in each speech sample were classified as either SLDs and ODs, the total, mean, and standard deviations for each dysfluency type were recorded for the self-formulated speech task and the reading task. Total SLDs and total ODs then were recorded under each speech task. After initial recording of each type of dysfluency, specific correlations were made. For each speaking task, total SLDs were compared to total ODs, total DPs were compared to PW and WW repetitions combined, and total DPs were compared to total ODs. Individual dysfluency types in the self-formulated speech task were then compared to individual dysfluency types in the reading task. Total SLDs, total ODs, and total overall dysfluencies also were compared between each task.
- Comparisons were made by using first the *F*-test to determine the two-tailed probability that the variances of the two data sets being compared are not significantly different. Then, *p*-values were calculated using the student *t*-test to determine if differences in the occurrence of the types of dysfluencies were significantly different among and between tasks. *P*-values <0.05 indicated a significant difference.

Method

- **Analysis 2 – Frequency of Dysfluencies.** After identification and classification of all dysfluency types, the total frequency of each type of dysfluency per 100 syllables was calculated for each speaker in order to equate differences in length of the speech samples obtained from various participants. To determine these values, the number of each type of dysfluency occurring in each sample was divided by the number of total syllables of that sample and then multiplied by 100. The SLD and OD count was derived by combining the frequencies per 100 syllables of all dysfluency categories under each classification. A syllable-based metric was used because it more accurately reflects the quantity of speech affected by dysfluency [20]. Once these calculations were completed, the total, mean, and standard deviations for each dysfluency type as well as total syllables, were recorded for the self-formulated speech task and the reading task. Statistical analysis for frequency of dysfluencies was the same as that for type of dysfluencies discussed previously. *F*-tests and *t*-tests were performed using an alpha of 0.05.
- **Analysis 3 – Speech Rate.** Speaking rate was calculated for each participant using standard procedures suggested by Guitar [21]. The total number of words was determined with the assistance of the *SALT* software, and the total speaking time in seconds for each speech sample was recorded. Next, the total number of words in each speech sample was divided by the total speaking time of the sample, in seconds. This number was then multiplied by 60 to yield the total words per minute (WPM). Speaking rates for normal speakers range from approximately 115 to 165 WPM. Statistical analysis was performed to determine differences in speaking rate on the self-formulated speech task and the reading task independently. Performance for each task was analyzed using the *F*-test and the student *t*-test to determine significant differences using an alpha of 0.05.

Results

- Analysis I
 - Interjections occurred statistically significantly more often ($t_{17} = 14.2, p = 0.014$) in the self-formulated speaking task than in the reading task.
 - There were statistically significantly ($p < .05$) more total dysfluencies in the self-formulated task than in the reading task.

Results

- Analysis 2
 - Dysrhythmic phonations and interjections occurred statistically significantly more often ($p < .05$) in the self-formulated speaking task than in the reading task.
 - Other dysfluencies and total dysfluencies occurred statistically significantly more often ($p < .05$) in the self-formulated speaking task than in the reading task.

Results

- Analysis 3
 - There was no statistically significant difference in speaking rate, measured in either words per second (wps) or words per minute (wpm).

Discussion

- Participants were more dysfluent during self-formulated speaking than during reading aloud. This was an expected result and one that is consistent with the findings of previous investigations, where oral reading was found to invoke less stuttering than self-formulated speech.
- In terms of dysfluency types, dysrhythmic phonations were present, and they were more notable than part-word or whole-word repetitions during the self-formulated speaking task.
- Dysrhythmic phonations also occurred more often than part-word and whole-word repetitions and “other dysfluencies” while reading. This finding indicates that PD speakers are producing true stuttering-like dysfluencies, even with the printed words in front of them. In terms of “other dysfluencies” persons with PD produced interjections and they were more notable in self-formulated utterances than reading aloud. These findings are somewhat expected as even normal speakers often interject filler words such as “um” or “uh” while speaking spontaneously. However, the impact may be greater on the person with PD because of the presence of other types of dysfluencies.
- Interjections may represent a ‘placeholder’ when the speaker is searching for a word. In the person with severe PD, interjections may indicate such word-finding difficulty, while in the more mild PD speaker (such as in those in the current study), interjections may reflect a deficit in motor planning as opposed to cognitive planning.

Discussion

- Limitations:
 - This study examined a relatively limited number of persons with PD. As a result, there were a limited number of speech samples available for analysis.
 - In regard to the samples themselves, their length was short, mostly less than one minute in duration and less than 100 syllables.
 - Also, spontaneous conversational speech was not examined.

Discussion

- Future Research
 - Include cognitive-linguistic testing in the evaluation of these individuals to further investigate the validity of the motor and cognitive hypotheses
 - Investigate individuals with more severe disease progression and look at “on” and “off” L-dopa states
 - Investigate emotional impact of dysfluencies in these individuals