

# A Multiple Baseline Analysis of Speech Performance Variation in People with and without Progressive Motor Disorders

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## Introduction

### Background and Rationale

- Progressive ataxias can result in speech problems including articulatory inaccuracy, prosodic excess and phonatory-prosodic insufficiency (Spencer & Dawson, 2019).
- Previous clinical trial data suggest considerable variations in pre-treatment performance, questioning to what degree post-treatment improvements are a function of intervention versus natural variability.

## Study Aim

- Assess the degree of natural variation in task performance in people with progressive ataxia and healthy control speakers

## Research Questions

- What is the natural variability in speech performance in speakers with progressive ataxia across a day?
- Do the self-ratings of speech quality and fatigue reflect actual performance?

## Method

### Participants

- 17 people with ataxia (mean age 54.9 years; SD 16.85 years)
- 5 controls (mean age 30.4 years; SD 12.12 years)

### Procedures

- The speech tasks included sustained vowel production and “PATA” repetition over 10 seconds.
- Each task was repeated twice in quick succession
- Participants were asked to record themselves twice a day for 5 consecutive days.
- The first recording was usually made between 8 and 11 am, and the second recording was made between 3 and 6 pm on each day.
- Participants also scored their level of fatigue and their speech quality on a 10 point scale at the time of each recording.

### Analysis

- Speech data were analysed acoustically with Praat: maximum length for sustained vowel, rate and stability for PATA repetitions

# Results

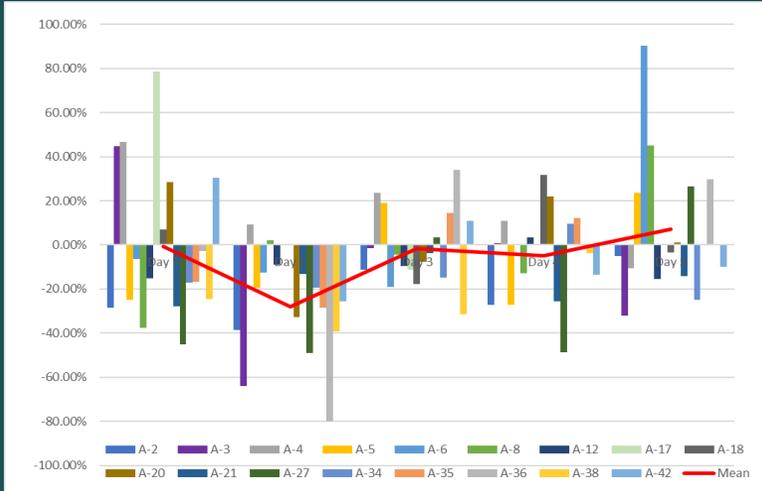


FIGURE 1. Percentage Change in Production of a Sustained Vowel Between the Morning and Afternoon Recordings in Ataxic Group

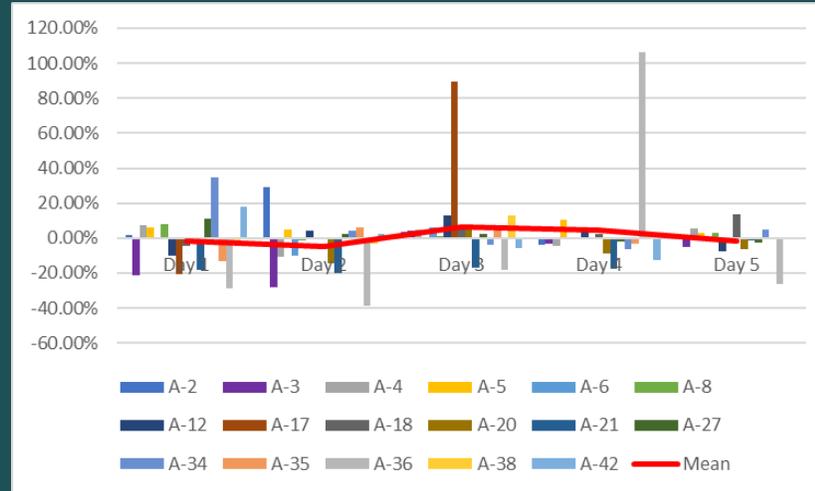


FIGURE 2. Percentage Change in PATA Rate Between the Morning and Afternoon Recordings in Ataxic Group

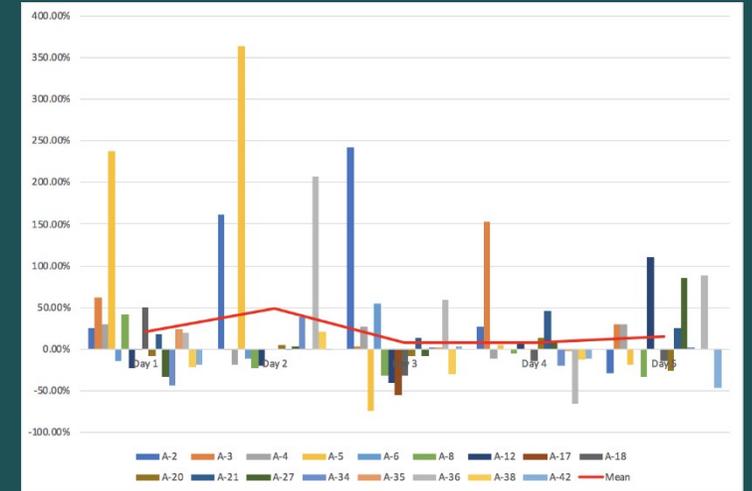


FIGURE 3. Percentage Change in PATA SD Between the Morning and Afternoon Recordings in Ataxic Group

Measure	Control Group		Ataxic Group	
	Mean	SD	Mean	SD
Duration (AM) (seconds)	11.06	1.73	10.74	5.73
Duration (PM) (seconds)	12.08	3.09	8.48	5.18
Average Duration (seconds)	11.57	2.36	10.33	5.36

TABLE 1. Mean and Standard Deviation for Sustained Vowel Production for Control and Ataxic Groups

Measure	Control Group		Ataxic Group	
	Mean	SD	Mean	SD
PATA Rate (AM) (syll/second)	7.0476	0.8685	3.6942	0.8268
PATA Rate (PM) (syll/second)	7.0361	0.8107	3.6449	0.7536
Average PATA Rate (syll/second)	7.0419	0.8382	3.6666	0.7806
PATA SD (AM)	0.0215	0.0045	0.0789	0.0446
PATA SD (PM)	0.0229	0.0050	0.0849	0.0567
Average PATA SD	0.0222	0.0046	0.0829	0.0495

TABLE 2. Mean and Standard Deviation for PATA exercise for Control and Ataxic Groups

	Control Group		Ataxic Group	
	Fatigue	Speech Quality	Fatigue	Speech Quality
Sustained Vowel Duration	.200ns	.051ns	-.102ns	.034ns
PATA Rate	.600ns	.0410ns	-.175ns	.188ns
PATA SD	-.200ns	-.462ns	.178ns	-.095ns

TABLE 3. Correlations Between Acoustic Measures and Self-ratings of Speech Quality and Fatigue

	Wilcoxon Signed Rank Test		Mann Whitney U Test	Mean Percentage Change		
	Control Group	Ataxic Group		Control Group %	Ataxic Group %	Difference %
	p	p	p			
Sustained Vowel Production	.225	.435	.611	9.68	5.58	4.1
PATA Rate	.686	.831	<.001	1.52	0.51	1.01
PATA SD	.043	.554	.003	11.66	19.97	8.31

TABLE 4. Results in Wilcoxon Signed Rank Test and Mann Whitney U Test and Mean Percentage Change for Sustained Vowel Production and PATA exercise Between Control Group and Ataxic Group

## Discussion

### **Group differences:**

- Control group performed better than speakers with ataxia on PATA (faster and more stable) because syllable repetition is associated with motor control (Pane et al., 2018)
- No difference in sustained vowel production. One possible cause is that our audio-recording process is participant-led and self-generated, no monitoring was involved. This causes results to differ from other studies; our control group performed worse than other literature, such as Maslan et al. (2011), that reported a 21.14-22.97s phonation time for the control group.

### **Performance Variation across the day:**

- Statistical tests indicate no significant change from morning to evening except for PATA rate in the control group
- Descriptive data suggests that this is due to varying direction in change with some speakers performing better in the evening and others in the morning, rather than a uniform performance
- Percentage change figures show that performance can vary up to 90% between the two test times
- There was no performance trend across the week, i.e. participants did not improve performance with learning
- Task performance did not correlate with self-perception of speech performance or fatigue levels, i.e. speakers could not predict their performance levels

### **Limitations:**

- Reasons for a statistically insignificant variation between AM/PM recordings include a limited sample size, and omitted variable bias like environmental factors that affect performance could not be further investigated due to a restricted timeframe of the study

## Conclusion

- Both healthy speakers and those with neurological disorders experience potential large variations in speech performance across multiple attempts
- Highlights the need to collect multiple assessments at different times of the day to establish reliable baseline measure for therapy evaluation
- Same applies to outcome measures of which several should be collected to fully capture post-treatment performance
- Speaker self-perception not helpful in judging potential performance variation, but morning/afternoon assessment times appear to capture variation sufficiently.

### References

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