Introduction

Persons with Parkinson’s Disease (PD) have difficulty performing repetitive movement tasks. Previous research from this lab has revealed that persons with PD demonstrate the greatest impairment in repetitive finger movements at high rates. However, there is limited quantitative data on how movement rate effects toe tapping.

Objective

The purpose of this study is to compare kinematic data between repetitive toe tapping at 70 beats per minute (bpm) and 140 bpm. We hypothesize that movement performance will be more impaired at the higher rate.

Methodology

Participants

- 10 participants
- Mean age: 67 years
- 60% Female
- Mean Disease Duration: 6.6 years
- Handedness: 86% R
- Most Affected Side: 50% R

Data Collection

- Participants tapped their foot repetitively while their heel remained on a wooden plank.
- The most affected side was used to tap with the beat at two rates (70 bpm and 140 bpm).
- Four trials were collected for each condition.
- Electromagnetic sensors were placed on top of the foot and on top of the big toe (Figure 1).

Graph 1

**Inter Movement Interval CV**

<table>
<thead>
<tr>
<th></th>
<th>70 BPM</th>
<th>140 BPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV</td>
<td>0.15</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Graph 2

**Peak-to-Peak Amplitude**

<table>
<thead>
<tr>
<th></th>
<th>70 BPM</th>
<th>140 BPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplitude</td>
<td>0.035</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Graph 3

**Peak-to-Peak Amplitude CV**

<table>
<thead>
<tr>
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Results for inter movement interval revealed a trend of increased variability at 140 bpm. This trend may show significance as more data from the other participants is analyzed.

Results for peak-to-peak amplitude revealed a significant decrease in amplitude at 140 bpm.

Results for peak-to-peak amplitude CV revealed a significant increase in variability at 140 bpm.

Conclusion

- The results supported our hypothesis that movement performance, amplitude and variability, would be more impaired at the higher rate.
- However, the decreased amplitude in the higher rates could be due to the disease or frequency/amplitude trade-off. As the rate of the repetitive motion increases, movement amplitude decreases. Further analysis is being completed to control for this factor.
- These results are in keeping with results from repetitive finger tapping in persons with PD suggesting that a common neural pathway may underlie impaired repetitive movement performance at high rates. Knowledge on these pathways aid in the diagnosis and treatment of PD.
- Future studies on toe-tapping with healthy older adults are needed to compare results to PD participants to aid in understanding if the results are due to age or disease.
- Future studies in this lab will examine the relationship between repetitive toe tapping and gait in persons with PD.