Is freezing of gait in Parkinson’s disease associated with changes in gaze behaviour?

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PURPOSE
To investigate gaze behaviour of PD FOG while walking through narrow corridors and prior to freezing episodes

HYPOTHESIS
PD FOG will extract more visual information from the narrowest point of a narrowing corridor than PD non-FOG and healthy individuals, especially in trials when FOG occurs

Background
- Although previous research has suggested that freezing of gait (FOG) in narrow spaces may result from impaired visuomotor processing [1,2], a direct relationship between gaze behaviour and the occurrence of FOG has never been evaluated.
- The impaired ability of individuals who experience FOG to integrate sensory feedback while walking through narrow spaces has been previously demonstrated [3,4]. Thus, one could predict that continuously narrowing spaces, which may require frequent integration of sensory information, would influence gaze behaviour of individuals with Parkinson’s disease who experience FOG (PD FOG) and lead to increased gaze episodes compared to a consistently narrow space.
- The aim of the present study was to investigate how PD FOG extract visual information while walking through a continuously narrowing space compared to a consistently narrow space. Furthermore, this study aimed to describe what PD FOG look at prior to FOG episodes.

Methods
Table 1. Participant’s demographic and clinical information

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (yrs)</th>
<th>UPDRS-III</th>
<th>DD</th>
<th>3MS</th>
<th>LB</th>
<th>TMT B-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD-FOG (n=1)</td>
<td>72.11 (9.22)</td>
<td>35.61 (9.67)</td>
<td>9 (5.76)</td>
<td>85.88 (12.99)</td>
<td>6.42 (7.44)</td>
<td>136** (74.72)</td>
</tr>
<tr>
<td>PD non-FOG (n=11)</td>
<td>66.45 (8.38)</td>
<td>27.36 (7.60)</td>
<td>4.81 (4.83)</td>
<td>98 (1.61)</td>
<td>3.5 (4.30)</td>
<td>84.18 (66.54)</td>
</tr>
<tr>
<td>HC (n=11)</td>
<td>73.36 (7.64)</td>
<td>-</td>
<td>-</td>
<td>97.81 (9.26)</td>
<td>3.19 (1.05)</td>
<td>45.09 (20.45)</td>
</tr>
</tbody>
</table>

- Participants walked through a 10-meter corridor in two conditions: parallel walls (PW) and narrowing walls (NW) (Figures 1A and 1B, respectively)
- Two blocks of five trials were performed in each corridor condition
- A wireless eye-tracking system (Mobile Eye - ASL) recorded participants’ gaze behaviour to five areas of interest (AOIs): pathway, walls, and through the distal opening
- Results’ software (ASL) was used to calculate the percentage of fixations (PF) and the percentage of total fixation duration (PTFD)

Results

Figure 2. Participants fixated more often at the pathway than through the distal opening or the walls [F(2, 38.4) = 0.001]

Figure 3. Participants fixated longer at the pathway than through the distal opening or the walls [F(2, 36.7) = 0.001]

Figure 4. Prior to freezing episodes, fixations were mainly focused on the pathway (4 FOG episodes on NW and 4 FOG episodes on PW - no statistical analysis)

Discussion

- These results demonstrated that all individuals had similar gaze behaviour while walking through both conditions. Therefore, even though the distance between the walls in the NW corridor changed as walking progressed, participants’ gaze behaviour was not influenced by this change.
- The increased number and duration of fixations on the pathway suggests that all individuals primarily extracted visual information regarding self-motion [5] rather than planning for the end goal (through the distal opening) or potential points of collision (walls).
- Since all participants used similar gaze strategies while walking through narrow spaces, PD FOG may plan for narrow spaces ineffectively, failing to employ adaptive visual strategies to avoid FOG episodes.
- Finally, the findings that PD FOG individuals fixated mainly at the pathway in all trials in which FOG occurred suggest that impaired perception of self-motion may underlie the FOG phenomenon.

Key References

Acknowledgements

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