Utility of prosaccadic eye movements as a response modality in people with severe speech and physical impairments (SSPI)

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SUMMARY
- A between-groups experimental design was used with a group of adult participants with SSPI and a control group of adults without movement difficulties.
- A cued attention prosaccade task as per Posner (1980) was designed taking into consideration Carter and Luke (2020) as well as accessibility to and reliability of eye-tracking procedures.
- The experiment was developed together with individuals with SSPI.
- Comparable patterns of eye-tracking were observed across groups.
- Slowed reaction times indicating fatigue effects were seen in the SSPI group, highlighting potential accommodations that may be necessary for increased effort in the presence of SSPI.

RATIONALE
- Individuals with SSPI have historically been underserved in education, training and employment situations, with assumptions frequently made that they are not competent because they are not able to use mainstream assessment methods.
- Reports that eye gaze is a robust alternative response modality to pointing or verbalisation have been made, but these are often anecdotal in nature.
- This proof-of-concept experiment aimed to compare reaction times of SSPI participants and a control group to changes in visual stimuli by using a commercially available remote eye-tracking set-up.
- Similarity in reaction times and response patterns would be an indicator that eye gaze tracking may be a robust and appropriate alternative response modality for cognitive-linguistic assessment by people with SSPI.

METHODS

Table 1: Inclusion and exclusion criteria for participants

<table>
<thead>
<tr>
<th>Group</th>
<th>Eligibility Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>Normal or corrected-to-normal hearing; Male (62)</td>
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<tr>
<td></td>
<td>Female (38)</td>
</tr>
<tr>
<td></td>
<td>Presence of a primary learning difficulty</td>
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<tr>
<td></td>
<td>Presence of a primary learning difficulty</td>
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<tr>
<td></td>
<td>Diagnosis rendering a severe physical or visual impairment (e.g. cerebral palsy)</td>
</tr>
<tr>
<td></td>
<td>Presence of a primary learning difficulty</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>Male (23)</td>
</tr>
<tr>
<td></td>
<td>Female (11)</td>
</tr>
<tr>
<td></td>
<td>Non-binary (1)</td>
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</tbody>
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DATA COLLECTION

A standard sequence of procedures was followed:
- 1. Verbal briefing of the participant
- 2. Calibration of eye gaze
- 3. Presentation of a practice block of stimuli
- 4. Presentation of first half of experimental block of stimuli
- 5. Recalibration of eye gaze
- 6. Presentation of first half of experimental block of stimuli
- 7. Participant debrief

VISUAL DISPLAY ITEMS
- A series of 40 individual display sequences was created.
- Each sequence comprised a centrally-placed 1cm x 1cm hairline cross on a white background, followed by a 1.5cm diameter white circle in each of the four quadrants of the display and then replacement of one of these white circles with a 1.5cm diameter blue circle (Figure 1).
- Use of a Latin Square to randomise quadrant selection for blue circle placement.

DISCUSSION AND CONCLUSION
- Similar patterns of eye gaze movement and timing across the two groups at the outset of the task were found.
- The rate of eye gaze shifts to visual targets in the task slowed in the second half of the task for participants with SSPI but not for the control group. This plausibly reflects a cumulative effect of fatigue associated with extended intense fixation of eye gaze by participants with SSPI.
- Tracking of prosaccadic eye movements has potential to provide an appropriate alternative response modality for cognitive-linguistic assessment by people with SSPI but effects of fatigue should be considered when interpreting results.

REFERENCES

KEY RESULTS

Table 3: Timing of gaze shift during the cued attention task

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean total response time (second)</th>
<th>Significance</th>
</tr>
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<tbody>
<tr>
<td>Control Group</td>
<td>0.28±0.04</td>
<td>p=0.03</td>
</tr>
<tr>
<td></td>
<td>0.25±0.04</td>
<td></td>
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</tbody>
</table>

Table 4: Description of participants

<table>
<thead>
<tr>
<th>Number of participants</th>
<th>SSPI experimental group</th>
<th>Control group</th>
</tr>
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<tbody>
<tr>
<td>13</td>
<td>13</td>
<td>74</td>
</tr>
</tbody>
</table>

Figure 1 Visual display items

Figure 2 Arrangement of equipment for the study

Figure 3 Illustrative scanpath and fixation point clusters

Figure 4 Mean total time to first fixation across groups

Figure 5 Timing of gaze shift during the cued attention task

Figure 6 Mean total time to first fixation within groups

Figure 7 Visual display item