Egocentric and Allocentric Navigation Strategies in Williams Syndrome

Hannah J. Broadent, Emily K. Farran, and Andrew Tolmie
Institute of Education, University of London, UK

Introduction
- Individuals with Williams syndrome (WS) often present with difficulties on both small and large-scale tasks requiring an understanding of spatial relationships (Nardini et al., 2008; Farran et al., 2010).
- In typical development (TD), young children and adults predominantly use an egocentric navigation strategy (body-centred), but between 5-10 years of age become more able to use an allocentric strategy (external or object-centred) (Bullens et al., 2010).
- In TD, egocentric strategies are associated with dorsal stream representations (Atkinson et al., 1997; Meyer-Lindenberg et al., 2005).

Do difficulties in understanding spatial relationships in WS lead to the use of atypical navigation strategies in a large-scale environment?

Method: Participants
TD children aged 5-10 years (total N=64), and participants with WS (N=17).

Table 1: Mean age and cognitive abilities in each group

<table>
<thead>
<tr>
<th>CA yrs.mths</th>
<th>BPVS</th>
<th>RCPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 yrs (N=16)</td>
<td>5.7 (0.4)</td>
<td>78.9 (13.5)</td>
</tr>
<tr>
<td>6 yrs (N=15)</td>
<td>6.8 (0.3)</td>
<td>91.3 (14.3)</td>
</tr>
<tr>
<td>8 yrs (N=17)</td>
<td>8.3 (0.4)</td>
<td>112.4 (15.8)</td>
</tr>
<tr>
<td>10 yrs (N=16)</td>
<td>10.1 (0.4)</td>
<td>130.8 (15.2)</td>
</tr>
<tr>
<td>WS (N=17)</td>
<td>21.10 (8.5)</td>
<td>123.7 (22.4)</td>
</tr>
</tbody>
</table>

1 Verbal and non-verbal cognitive abilities were assessed using the British Picture Vocabulary Scales (BPVS-III) and Ravens Coloured Progressive Matrices (RCPM), respectively.

BPVS = 5 and 6 year-olds < 8, 10 and WS groups (p< .01)
RCPM = 5 year-olds and WS < 6, 8 and 10 year-olds (p< .01)

Results
- **Number of trials taken to reach criterion:** 10 year-olds < 5 and 6 year-olds and WS groups (p< .05 for all).
- **Four different strategies observed (b, c, d, and e):**
  a) Route taken on learning trials
  b) Sequential Egocentric (uses same body-based series of turns)
  c) Allocentric (uses layout and landmark knowledge to make short-cut)
  d) Mirrored egocentric (uses layout but not landmarks)
  e) Mixed strategy (starts using egocentric, then uses distal landmarks)

Conclusions
- **TD children predominantly use a sequential egocentric strategy to navigate, becoming increasingly more able to use an allocentric strategy when necessary between 8 and 10 years**
- **Individuals with WS predominantly rely on landmarks to navigate, but are unable to develop an understanding of the relationships between landmarks and are therefore unable to use an allocentric strategy when it is required to make short-cuts**
- **The WS group demonstrated an atypical pattern of performance both on spontaneous strategy trials and enforced allocentric trials, suggesting difficulties in the use of both egocentric and allocentric spatial representations**
- **Atypical presentation of egocentric and allocentric spatial encoding in WS may be related to known cortical abnormalities in Dorsal stream (Atkinson et al., 1997) and Hippocampal regions (Meyer-Lindenberg et al., 2005) in this disorder.**