A tool for assessing motor planning across the age spectrum: towards understanding motor difficulties after early brain damage

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Introduction

- Hemiplegic cerebral palsy (HCP) affects around 12,000 UK children. Use of the affected hand can be severely limited, restricting independence.
- Preliminary research[1] indicated additional deficits in action *planning,* impacting movements performed even with the less affected hand.

Aims

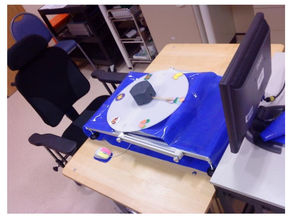
- To adapt a pre-existing test of motor planning[2] for use in children
- To collect normative data from healthy adults on this task and explore how it could be affected by age
- To begin to compare the performance of children with HCP and age-matched controls in action planning

Methods

Participants: 19 healthy adults; 2 healthy children and 2 with HCP (using the less affected hand only)

Handle Rotation Task:

1. The participant was seated on an adjustable chair at a standardised distance from the apparatus. An appropriate handle size was used, determined by handspan.



▲ An example of instructions

2. Handle turning instructions were presented pictorially via a computer, with moving arrows to indicate direction of turns and one of the 6 pictures for the target destination. At least 4 practice trials were undertaken.

3. The task involved 48 trials consisting of 60° (6), 120° (6) and 180° (12) turns in each direction, presented in a random order. Participants used their dominant hand first and then repeated the task with the non-dominant hand. Each turn was completed **without readjusting grip.**

▲ An example of turning action for the above example.

4. A video recording was made for later analysis.

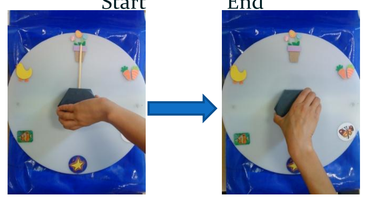
How it reflects action planning

▶ A comfortable start grip, **i.e. default grip**

Start End

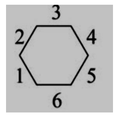
◀ However, with this it is biomechanically almost impossible to perform a 180° turn without readjusting grip or letting go, **i.e. failed turns**

▶ A planned start grip different from the default one



◀ A 180° turn can then be completed, **i.e. successful turns**

Turns were **discounted** if in the wrong direction, to the wrong destination or if the handle was not grasped at start with the thumb opposite the fingers. Only 180° turns were analysed.

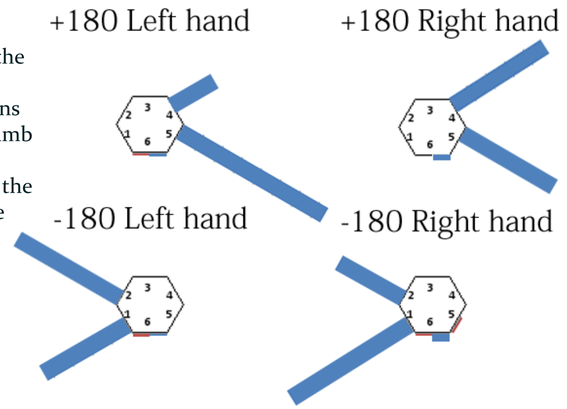


Codes for start thumb position. ▲

Results

Normative data from healthy adults

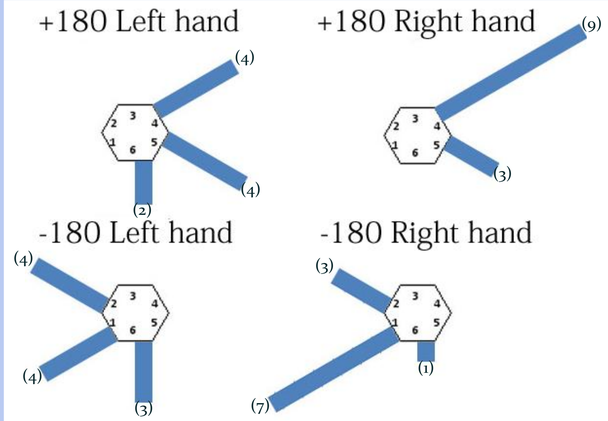
▶ The length of the bar depicts the proportion of turns with the start thumb position at that particular side of the hexagonal handle



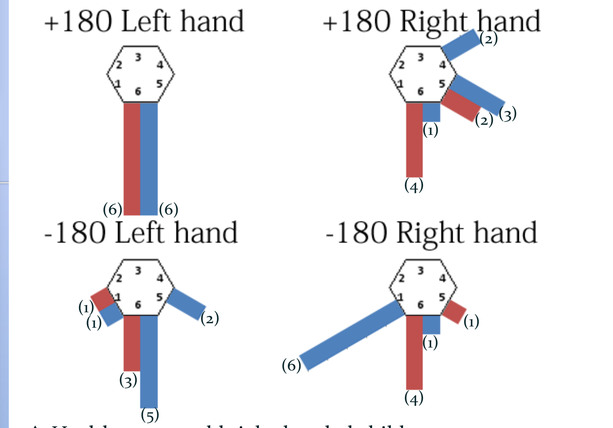
They show evidence of anticipatory motor planning as the start thumb positions for successful turns were different for clockwise and anticlockwise rotations as well as from the default grip.

Preliminary data from children

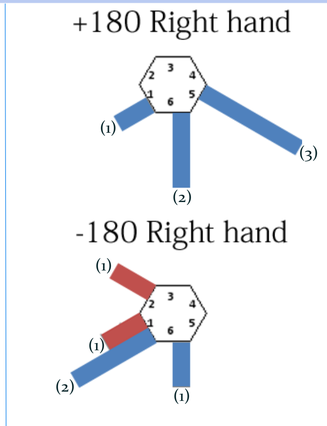
The diagrams on the right demonstrate handle turning patterns of an 8-year-old were similar to adults' but with higher preference for default start grip, while a 5-year-old showed less evidence of motor planning. Children with left HCP seemed to have problems with getting the turn directions right (leading to many discounted trials), particularly for anticlockwise turns.



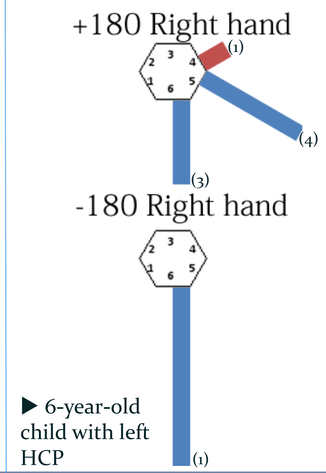
▲ Healthy 8-year-old left-handed child. The bracketed numbers indicate the number of turns.



▲ Healthy 5-year-old right-handed child



▲ 9-year-old child with left HCP



▶ 6-year-old child with left HCP

Conclusion

- We have adapted a test to study how well movements are planned. The task is feasible, quick, safe and tolerated by adults and children.
- Action planning is well developed in adults and initial data suggest action planning is immature in young children.
- Children with HCP may have different types of difficulties with motor planning (e.g. more errors with turn direction) than controls but further investigations are required.
- Further developments planned include collecting timing information

References

1. Steenbergen B, Gordon A. Dev Med Child Neurol. 2006;48(9):780-3.
2. Mutsaarts M, Steenbergen B, Bekkering H. Exp Brain Res. 2006;172(2):151-62.

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