

# Anticipatory motor planning in children and adults

## Background

- Motor planning is the ability to take into account the demands of an upcoming task when planning a movement<sup>1</sup>, e.g. picking up an upturned cup on a draining board for a drink.
- Previous studies<sup>1</sup> have indicated deficits in motor planning in adolescents with Hemiplegic Cerebral Palsy (HCP).
- Our long-term aim is to compare motor planning in children with HCP with age-matched controls.
- We have previously devised a motor planning test suitable for adults and children and obtained normative data in healthy adults.

## Aim

- To compare motor planning in healthy 9-11 year old children with previously collected data from healthy adults .

## Hypothesis

- Motor planning will be immature in 9-11 year olds compared with adults.

## Methods

Participants: 36 children aged 9-11 years, 20 adults aged 20-41 years.

### Handle Rotation Task:

- 1) Participants were seated at a standardized distance from the device. An appropriate handle size was used, on the basis of their hand span.
- 2) Handle turning instructions were presented pictorially on a computer screen, with moving arrows indicating turn direction and one of six pictures for the target destination. At least 6 practice trials were undertaken before testing.
- 3) The task involved 48 trials consisting of 60° (n=6), 120° (n=6) and 180° (n=12) turns in each direction, presented in a random order. Participants performed the tasks using their dominant hand, followed by their non-dominant hand; they were encouraged to complete each turn **without readjusting the initial grip**.



▲ Example setup

## How it reflects action planning

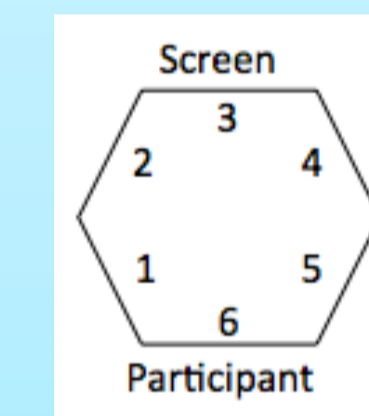


With a **neutral grip** (left), it is biomechanically almost impossible to perform 180° turn without readjusting grip or letting go – **failed turn** (right).

A **planned grip** (left) allows smooth completion of a 180° clockwise turn without grip readjustment - **successful turn** (right).

### Data collection

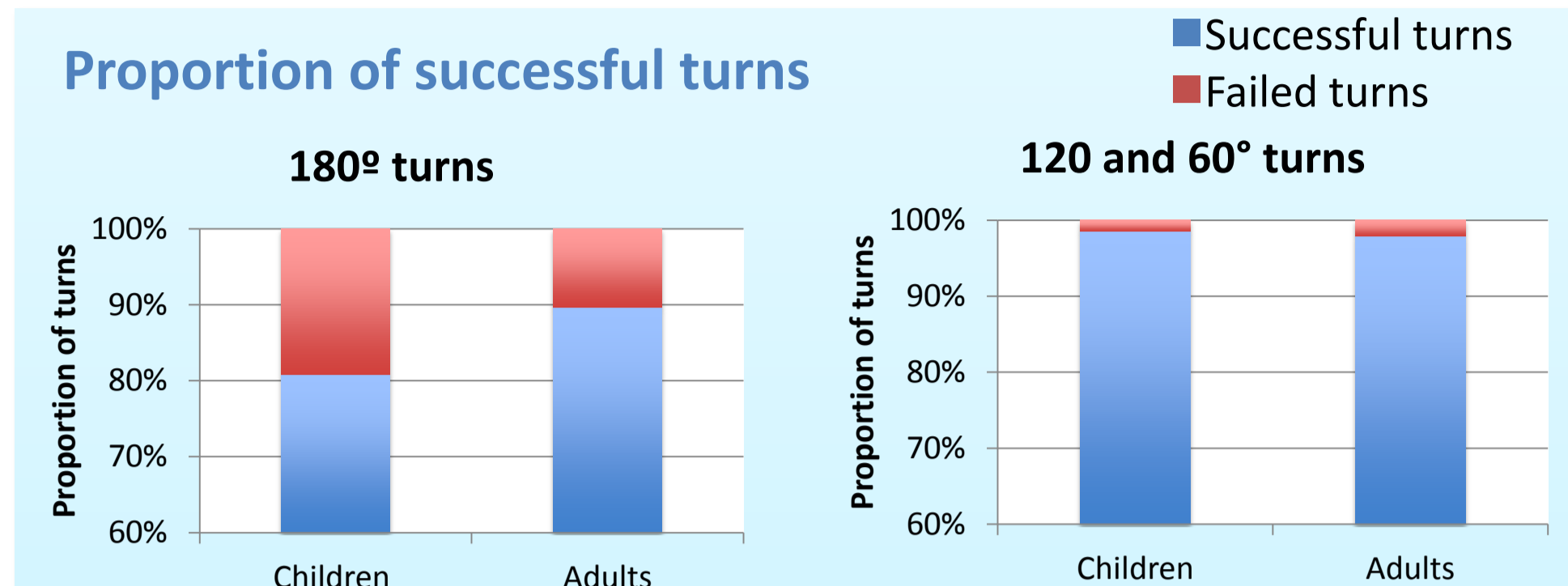
- The tasks were video-recorded to determine the starting grip positions for each turn
- Time at which the handle reached each position was electronically recorded to calculate the reaction time (time from video presentation to initiation of turn) and total turn time



▲ Codes for start thumb position

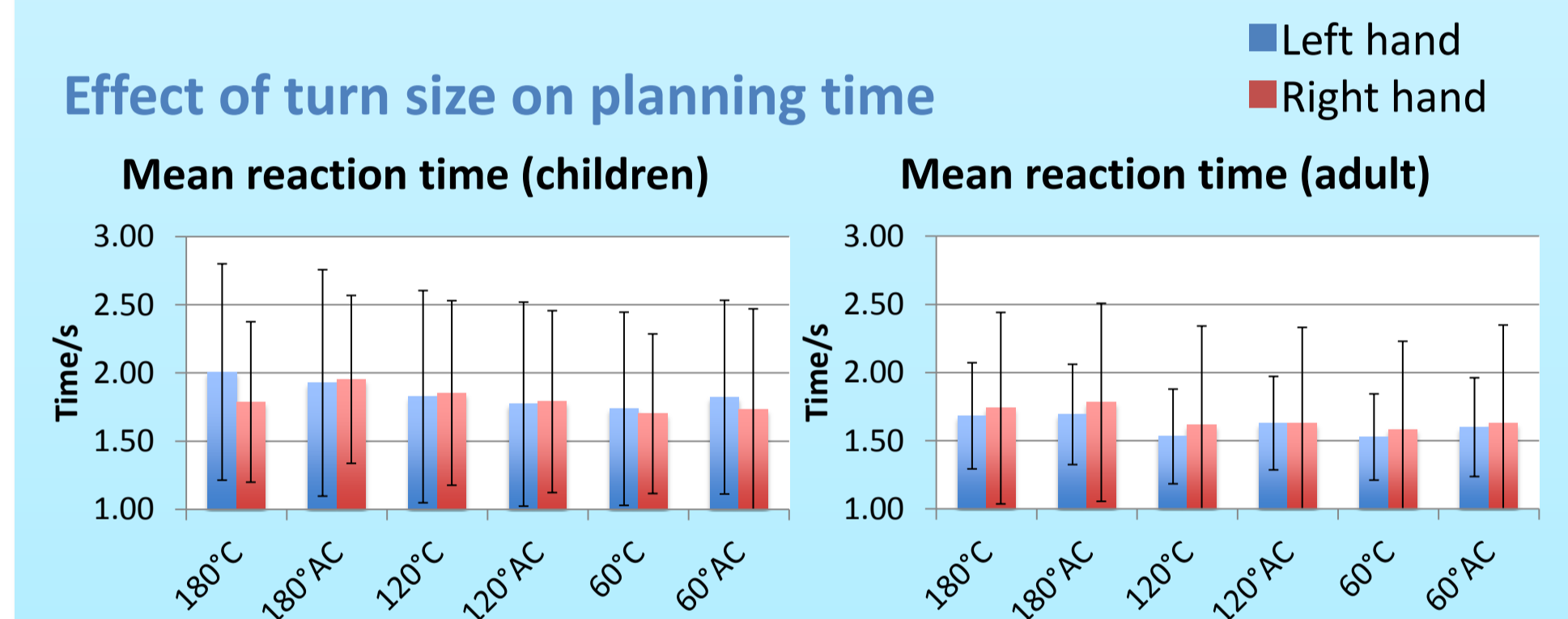
**Turns were discounted** if they were in the wrong direction (except for 180° turns), to the wrong destination or if the handle was not grasped at start with the thumb opposite the fingers.

## Proportion of successful turns



▲ The graphs above compare the proportion of successful and failed turns between children and adults. Chi-squared tests showed a higher failure rate among the children with the 180° turns (19.3% vs. 10.3%,  $p < 0.001$ ), but not with the 60° and 120° turns (1.43% vs. 2.07%,  $p = 0.13$ ).

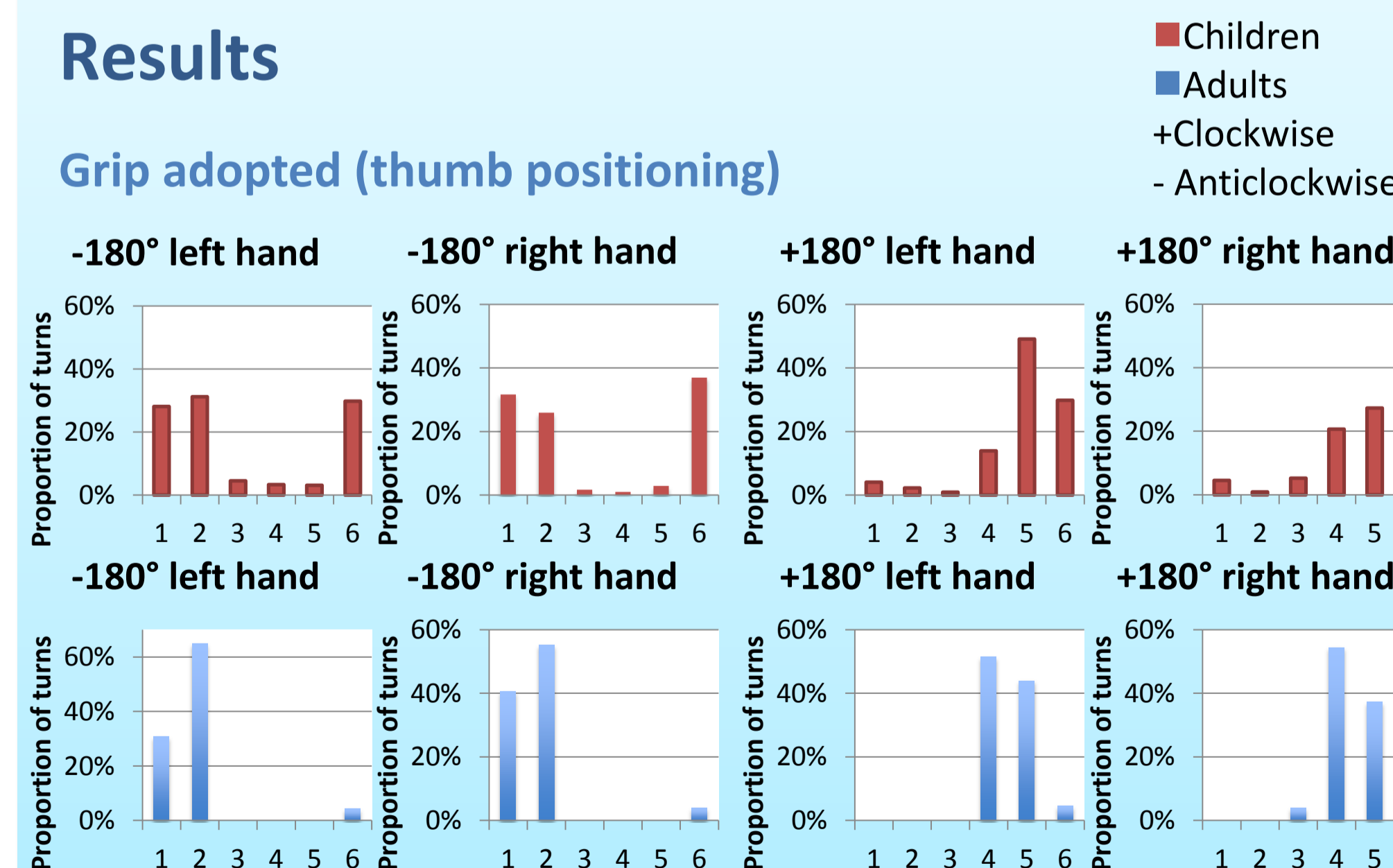
## Effect of turn size on planning time



▲ Graphs demonstrate the average time to initiate turns. Planning time was not significantly different between adults and children. However, there was a significant effect of turn size on planning time for both children ( $F(2, 70) = 13.0, p < 0.001$ ), and adults ( $F(2, 42) = 30.2, p < 0.001$ ), with 180 degree turns taking significantly longer than 60 or 120 degree turns.

## Results

### Grip adopted (thumb positioning)



▲ The graphs demonstrate handle turning patterns of children (top) were similar to adults (bottom) but with higher preference for neutral start grip, showing less evidence of planning of 180° turns than adults.

## Conclusion

- Action planning is well developed in adults, but less mature in 9-11 year old children.
- Further data collection from both younger and older children is needed to clarify the development and maturity of action planning across different age groups.

## Reference

1. Mutsaerts M, et al. Motor Control. 2005;9(4):439-58.