Using tools as cues for dual adaptation to opposing visuomotor rotations in virtual reality

Andrew King, Laura Mikula, Shanaathan Modchalingam, Jacob Boulrice, Bernard Marius 't Hart , & Denise Y. P. Henriques

Centre for Vision Research, York University, Toronto, Canada

Centre for Vision Research

VISTA VISION: SCIENCE TO APPLICATIONS
YORK UNIVERSITY

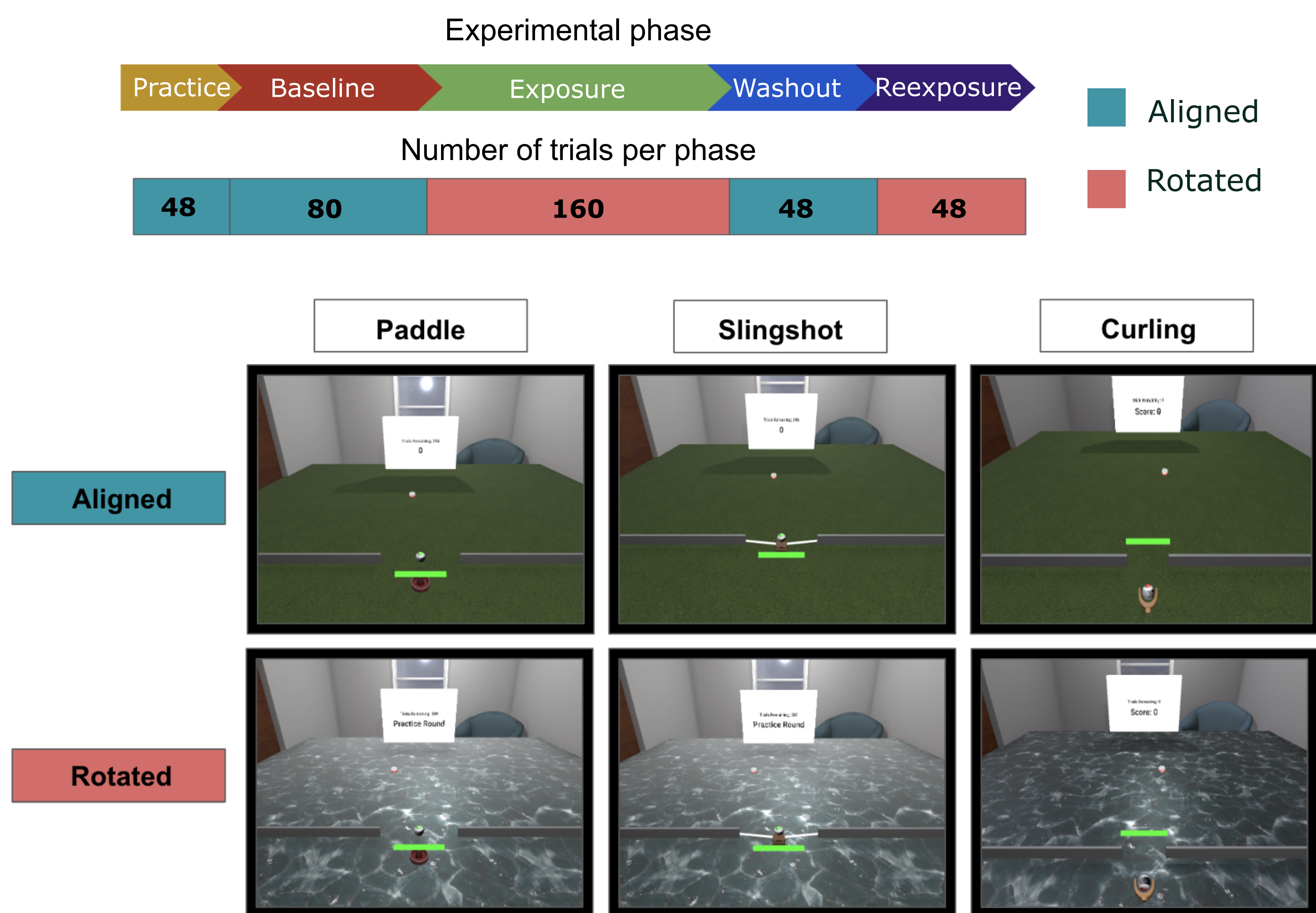## Contextual Cues are essential for learning how to use tools

-Everyday tasks requires competent operation of different tool with separate motor movements

-Successful dual adaptation (concurrently learning two opposing pertubations) is reliant on extrinsic (shape of tool) or intrinsic (motor movement) contextual cues
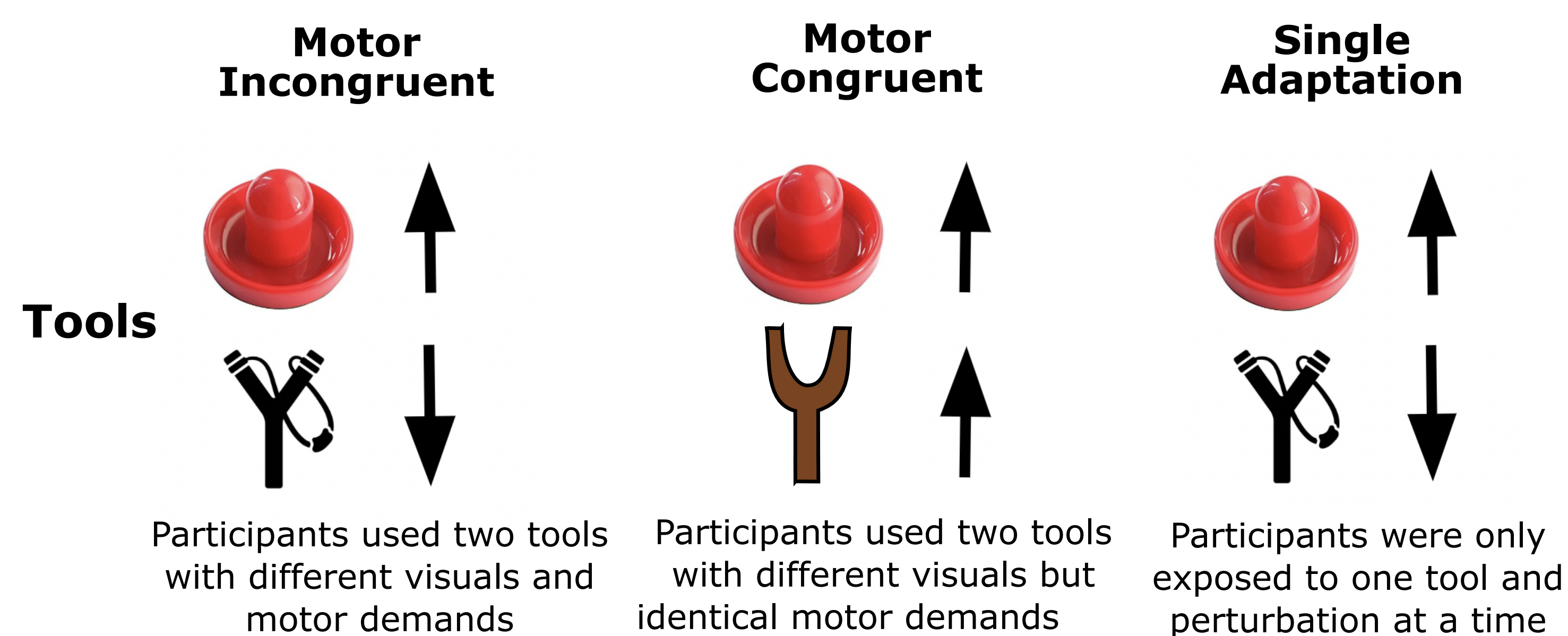
-Can we use different tools to cue opposing rotations during dual adaptation in virtual reality?
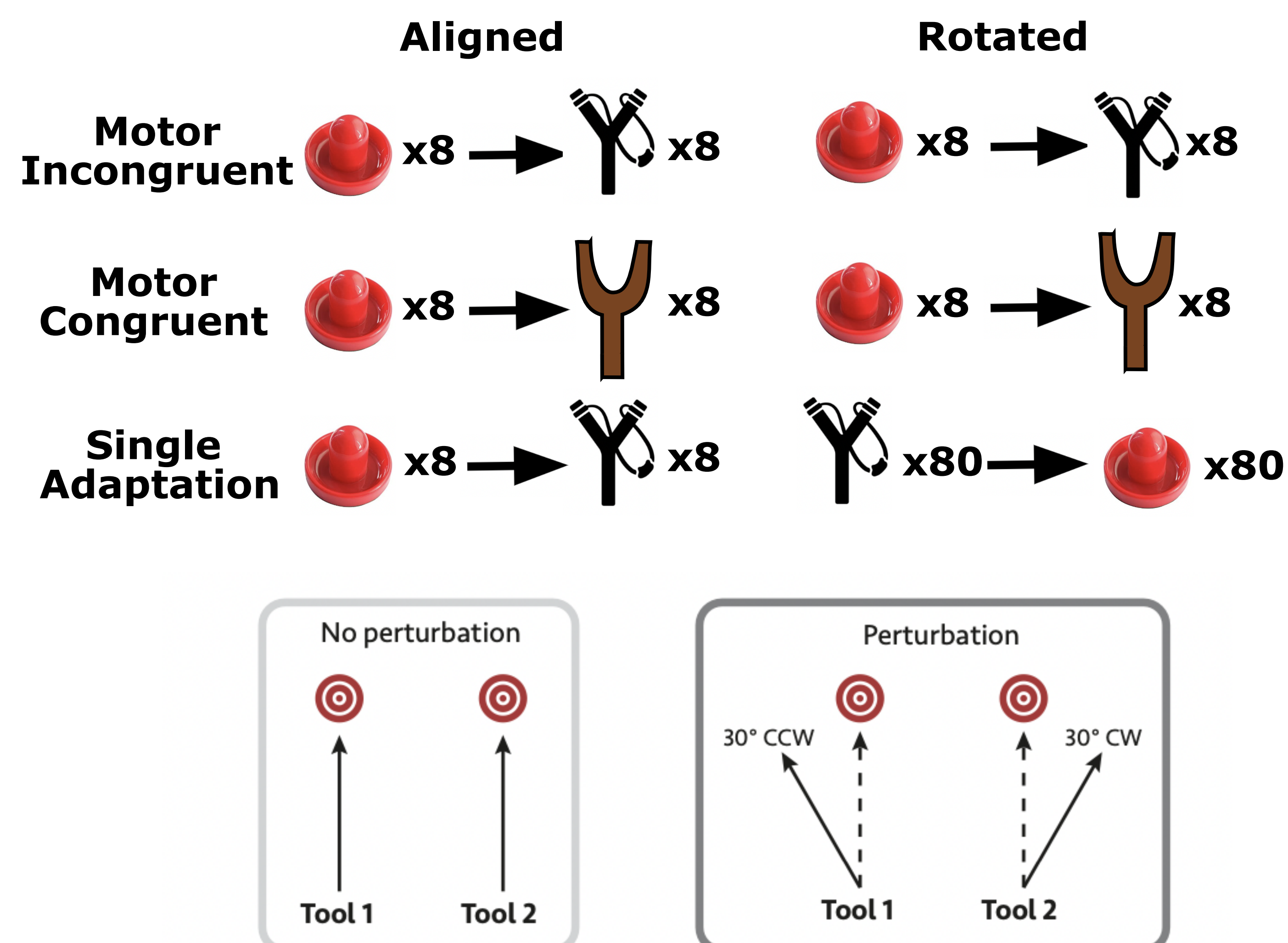
Virtual Paradigm

Participants (N = 100) used two tools in virtual reality to launch a ball toward a target

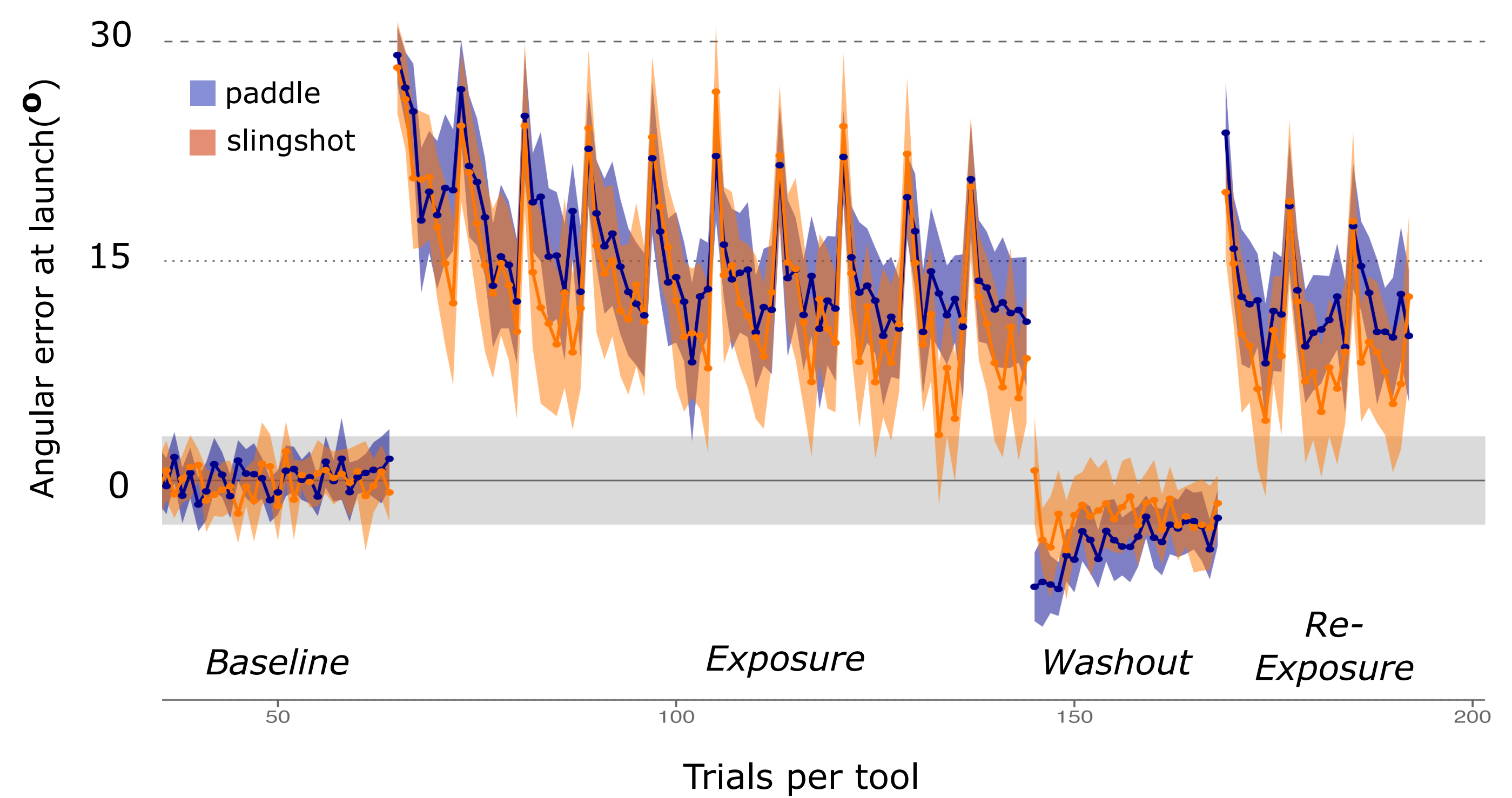Experimental phase

| Practice | Baseline | Exposure | Washout | Reexposure | | Aligned |
Number of trials per phase
| 48 | 80 | 160 | 48 | 48 | | Rotated |

Paddle **Slingshot** **Curling**

Aligned

Rotated

Conditions

Motor Incongruent | **Motor Congruent** | **Single Adaptation**

Tools

Participants used two tools with different visuals and motor demands | Participants used two tools with different visuals but identical motor demands | Participants were only exposed to one tool and perturbation at a time

Shot Procedure

Aligned | **Rotated**

Motor Incongruent x8 → x8 | x8 → x8

Motor Congruent x8 → x8 | x8 → x8

Single Adaptation x8 → x8 | x80 → x80

No perturbation
Tool 1   Tool 2

Perturbation
30° CCW   30° CW
Tool 1   Tool 2

Each tool was associated with either a **30° (clockwise)** or **-30° (counterclockwise)** rotation
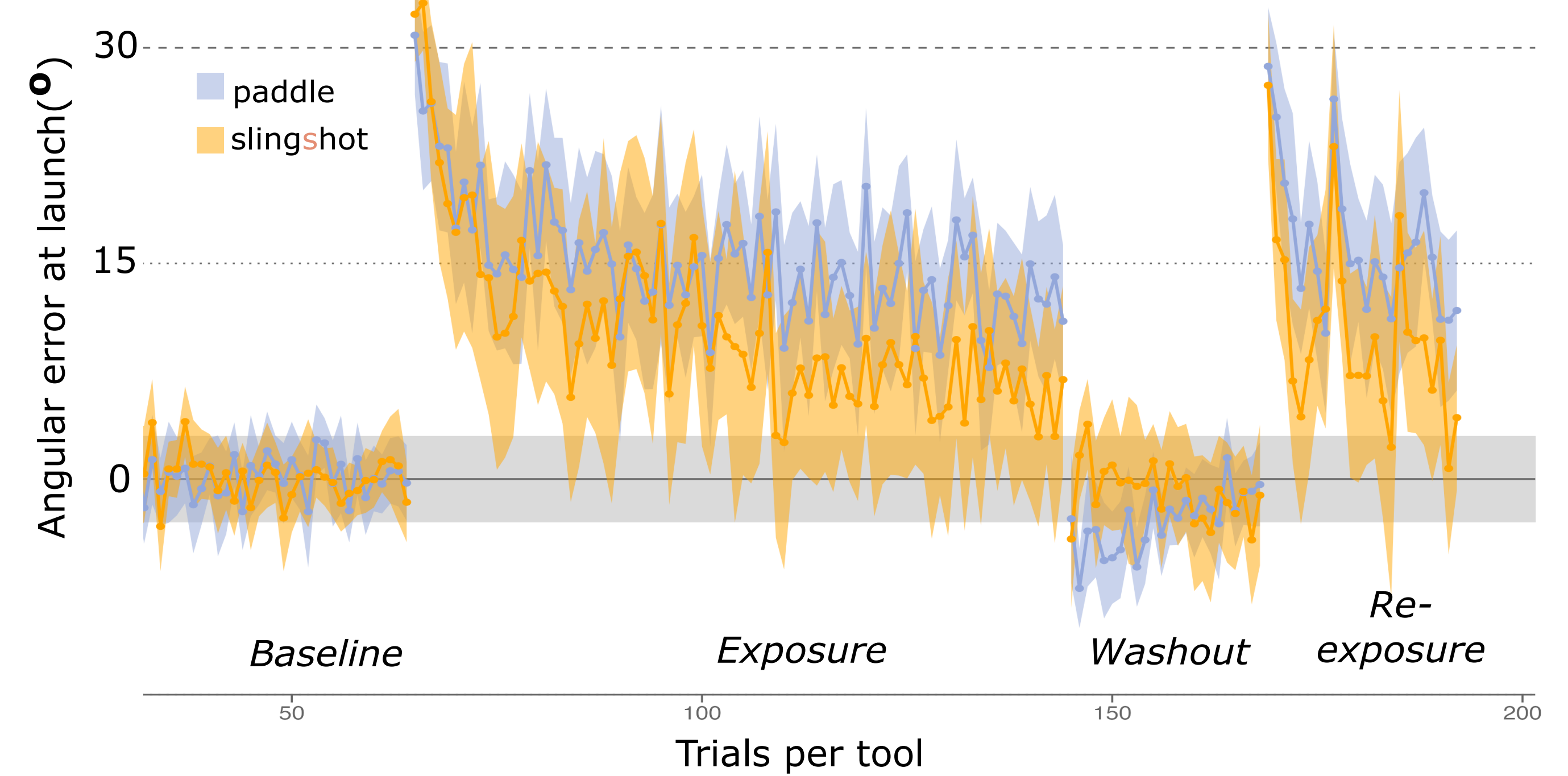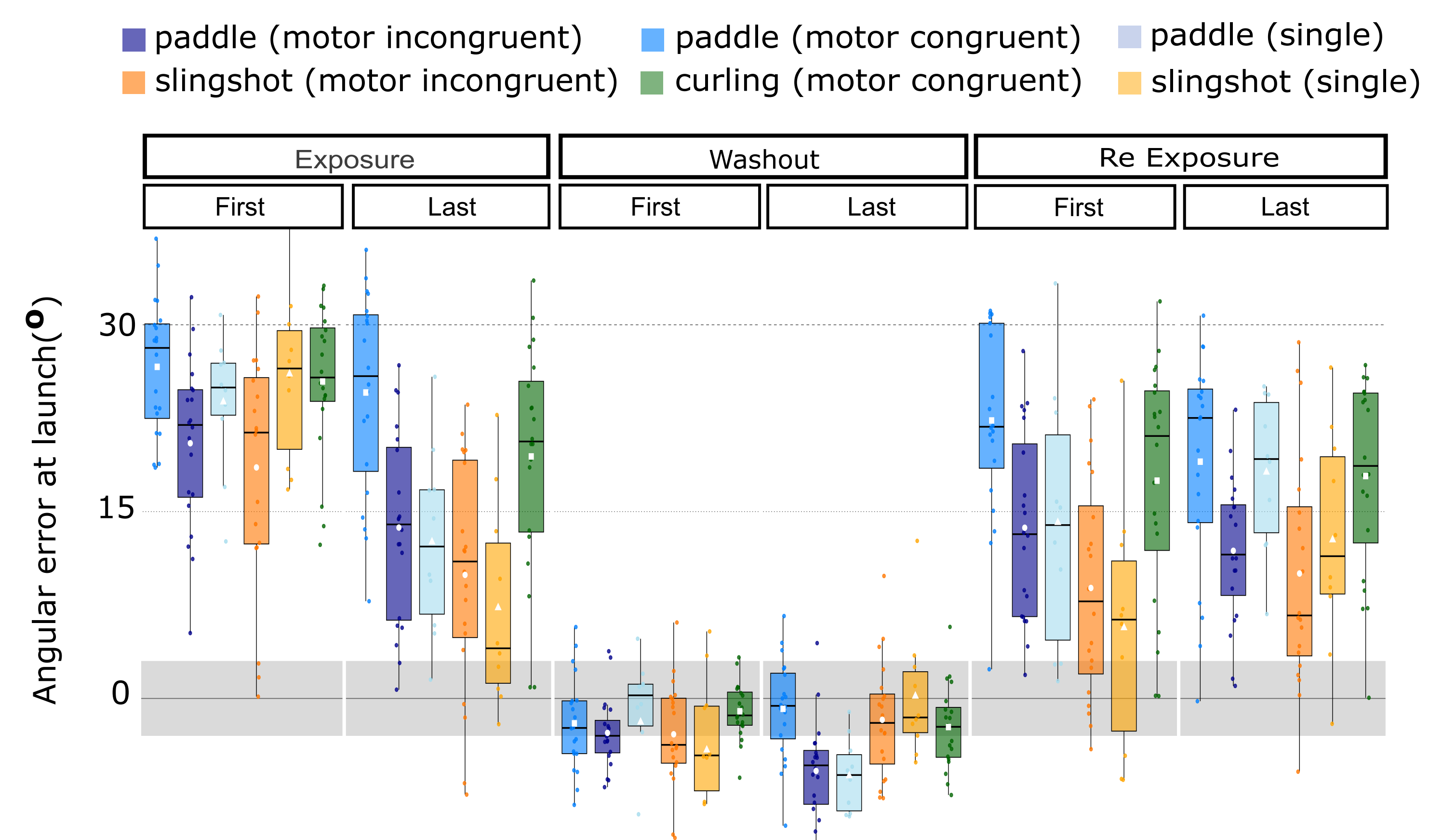
Motor Incongruent

n = 40

- paddle
- slingshot

Angular error at launch(°)

30 / 15 / 0

Baseline   Exposure   Washout   Re-Exposure

50   100   150   200

Trials per tool

Motor Congruent

n =40

- paddle
- curling

Angular error at launch(°)

30 / 15 / 0

Baseline   Exposure   Washout   Re-Exposure

50   100   150   200

Trials per tool

Single Adaptation

n =20

- paddle
- slingshot

Angular error at launch(°)

30 / 15 / 0

Baseline   Exposure   Washout   Re-exposure

50   100   150   200

Trials per tool
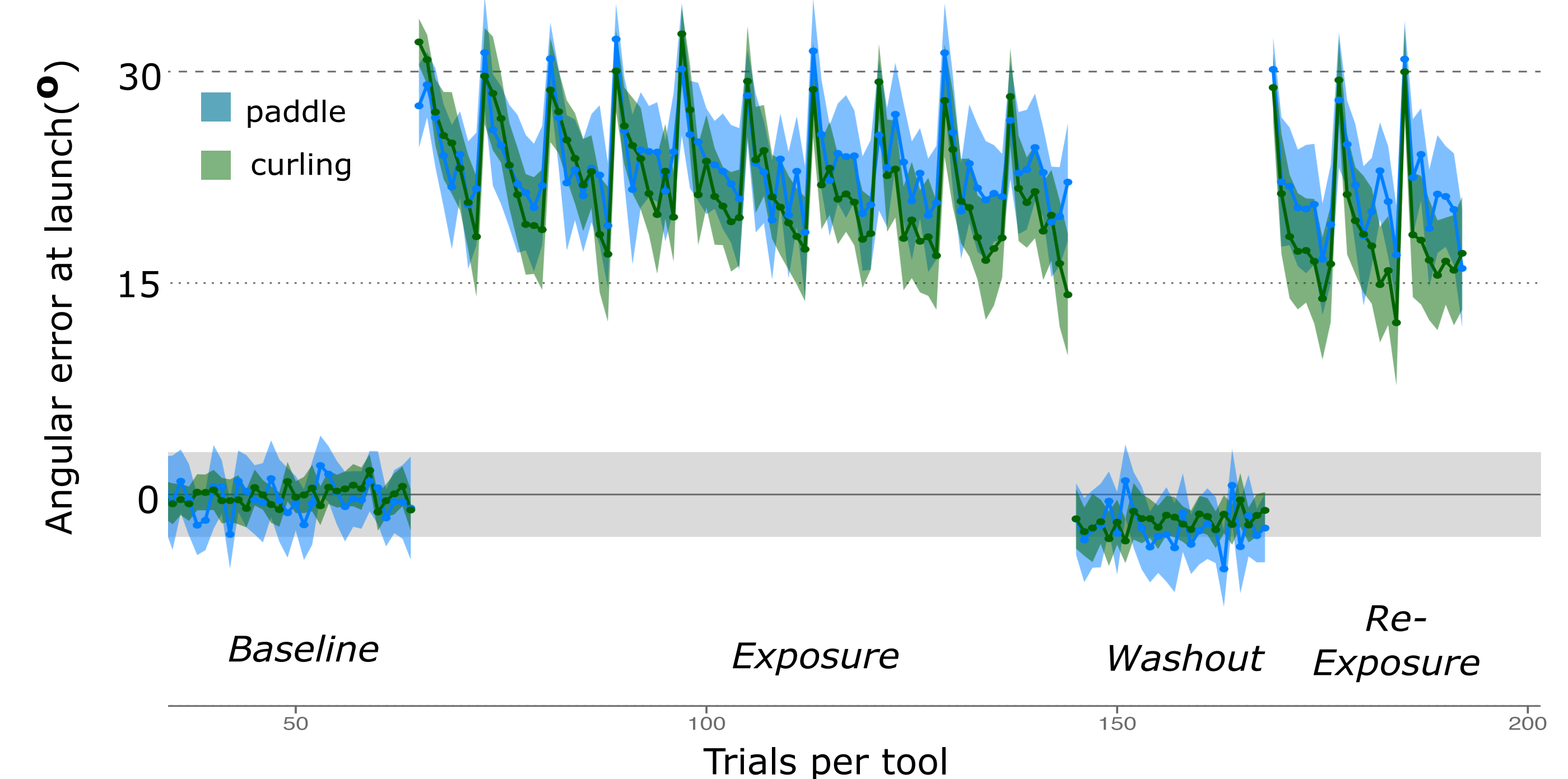
Individual differences across experimental phase

- paddle (motor incongruent)
- paddle (motor congruent)
- paddle (single)
- slingshot (motor incongruent)
- curling (motor congruent)
- slingshot (single)

| Exposure | | Washout | | Re Exposure | |
| First | Last | First | Last | First | Last |

Angular error at launch(°)

30 / 15 / 0

Distinct movement profiles significantly contribute to the formation and retrieval of separate motor memories

Main Takeaways

1) Visual cues not as important as motor cues in dual motor adaptation

2) Moderate task switching cost for all conditions

3) Decrease in angular error across exposure phase for both tools

4) Small aftereffect in washout for dual adaptation

5) Reduction in angular error during the beginning of Re-Exposure phase

Contact:
kinga21@yorku.ca
@PsychFanBoy