

Tricking your cerebellum with a reaching task

Exercise 2 – Savings, generalization & interference

Your solutions

General remarks HW

- 'After Effect' as a key word
- Comparison of gradual and sudden perturbation
- Calculation of motor variability ('MV') in blocks without perturbation (-> $\sim 3^\circ$)
→ compare this to our gradual perturbation

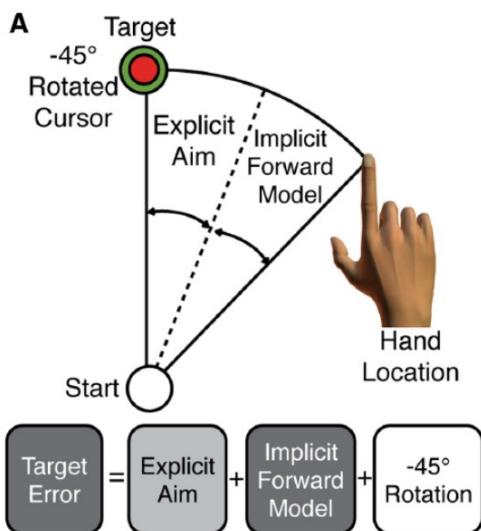
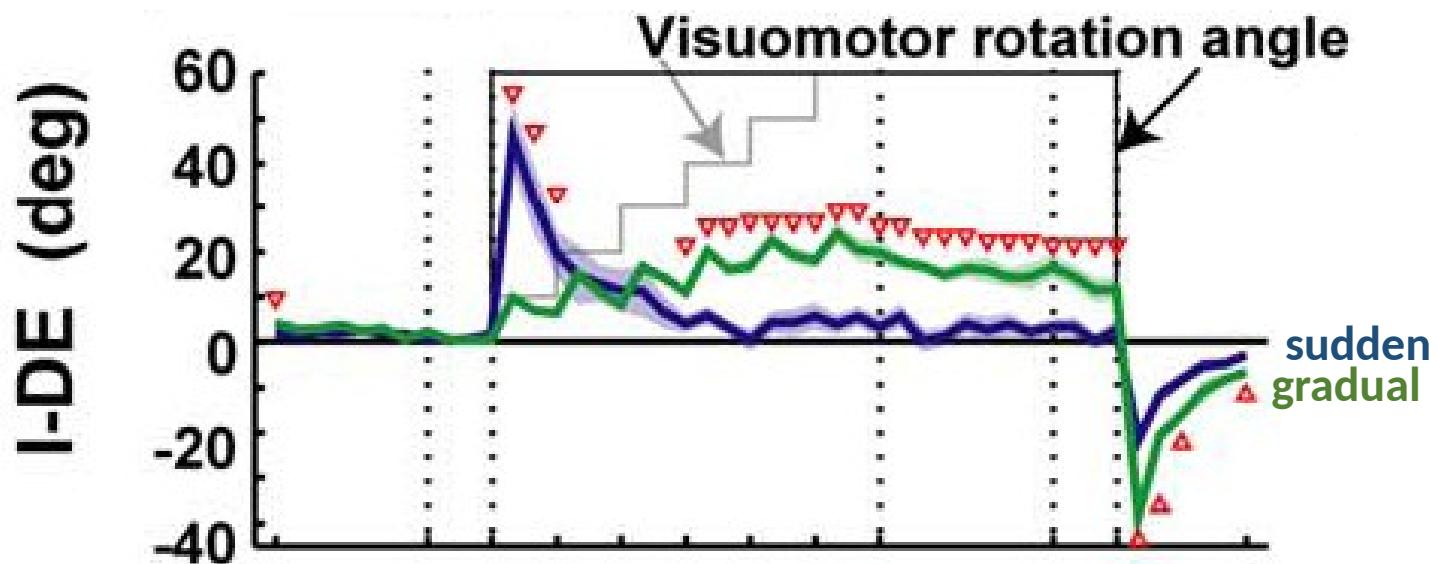
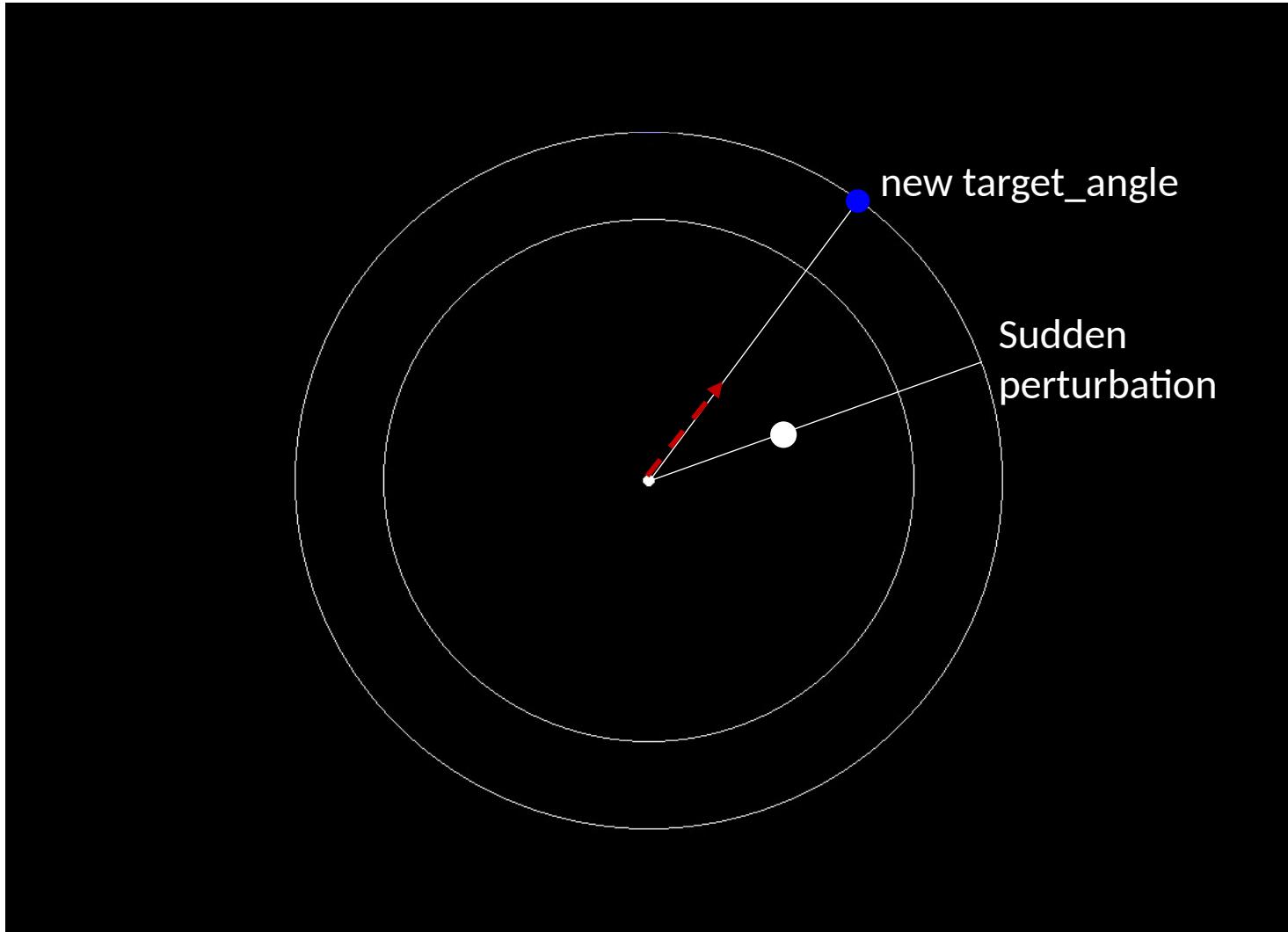


Figure 4. A, Target error (performance) is the sum of the explicit aiming direction and implicit subtraction of the aiming direction (see Fig. 2C) from the target error. Instruction-Endpoint, blue



Design your experiment!



By simply changing the target angles and sequence of the experiment blocks, you can learn something new about motor adaptation!

→ Each team chooses their own target_angles for each block, then we try combining our insights next week

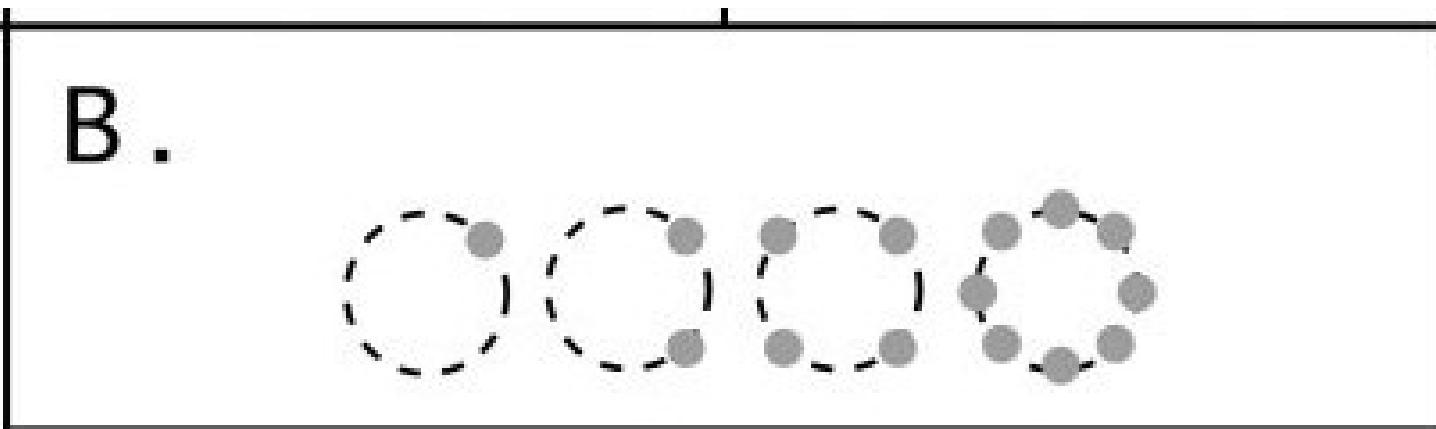
Motivation Generalization

Learning of Visuomotor Transformations for Vectorial Planning of Reaching Trajectories

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- Visuomotor rotation 30° CCW



Motivation Generalization across targets

Krakauer et al. • Learning Transformations for Vectorial Planning

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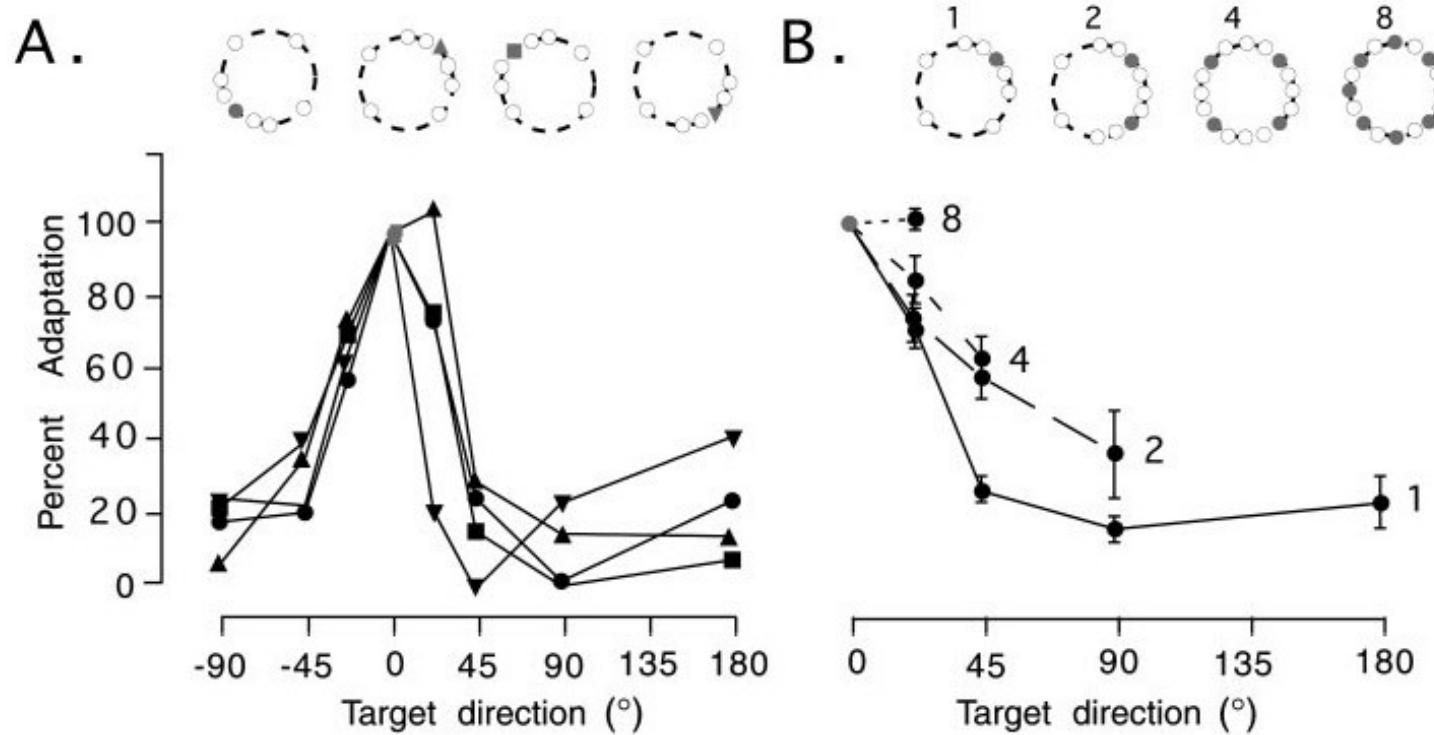
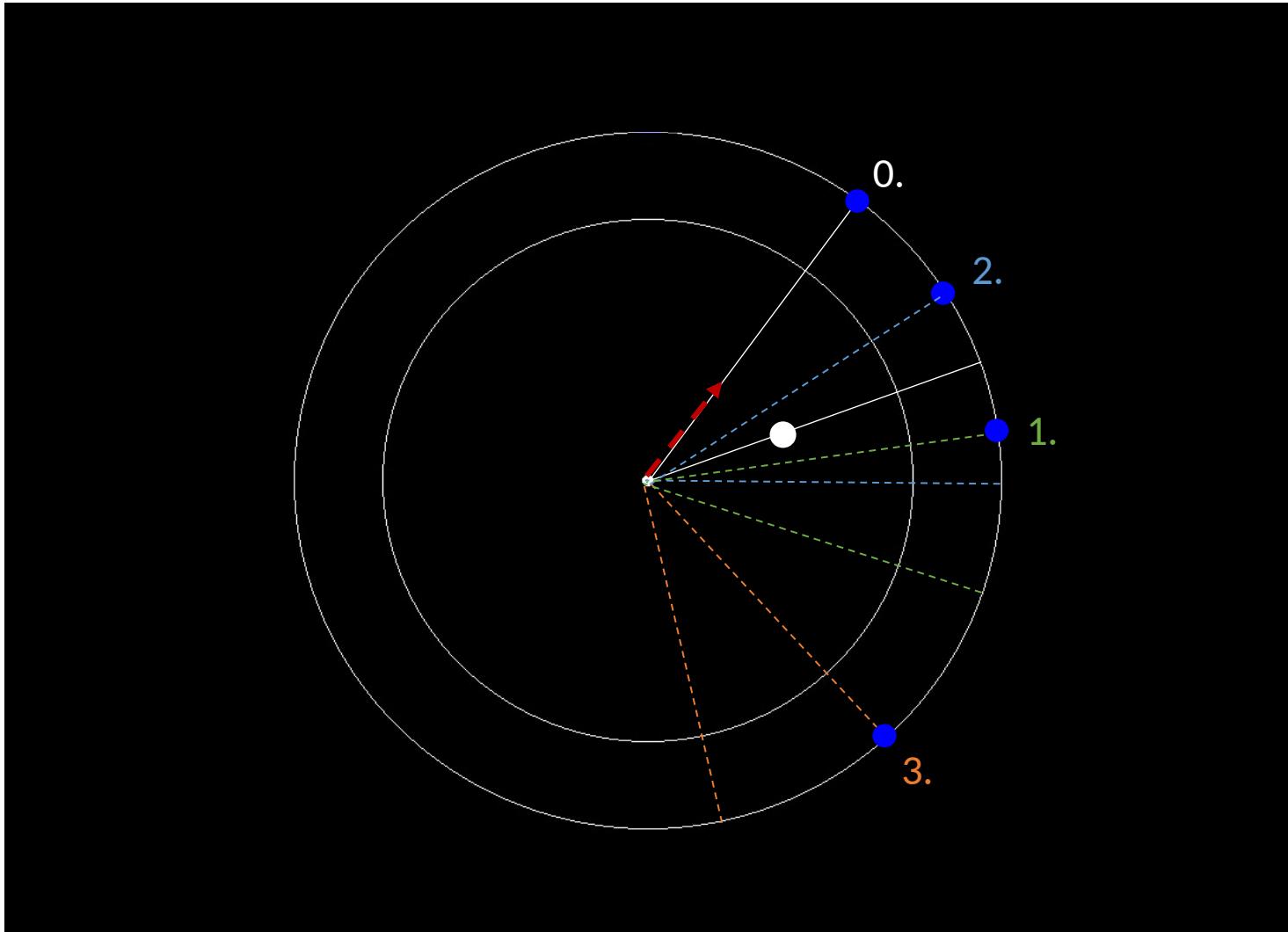


Figure 6. Rotation generalization. *A*, Generalization across multiple directions after training in a single direction. The directional data are relative to the training target. *Bottom*, The plot is of mean (\pm SEM) group data showing the percent adaptation to untrained directions relative to the training target. *Top*, The four different training directions (45, 135, 225, and 315°) for 4 different days are shown by the gray symbols. The positioning of the testing targets (in white) is shown. *B*, Generalization across multiple directions after training in one, two, four, and eight directions. *Bottom*, The plot is of mean (\pm SEM) group data showing the relative percent adaptation in the untrained directions relative to the trained directions. When there was more than one training target, the mean performance to all the training targets was used to calculate the relative adaptation in untrained directions. Data were collapsed for clockwise and counterclockwise directions. *Top*, Training targets are shown in gray, and testing targets are in white.

Group A: Generalization

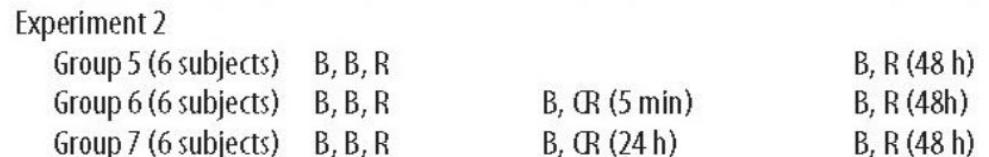
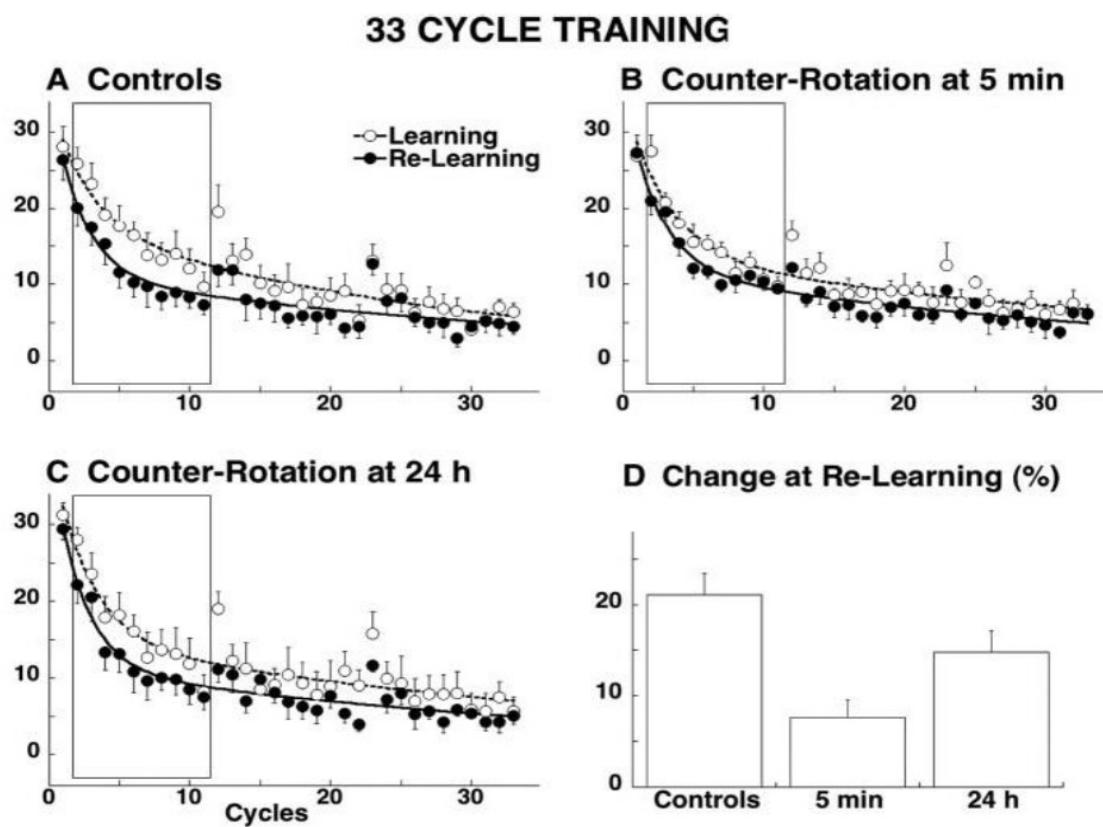


0. Change starting_angle
1. Increase target_angle
2. Choose a target_angle between the last two.
3. Increase target_angle even more (greater than in 1.)

Keep perturbation_angle always the same
20 attempts without perturbation at the beginning AND end of each block

Motivation Interference

Krakauer et al. • Consolidation of Visuomotor Learning



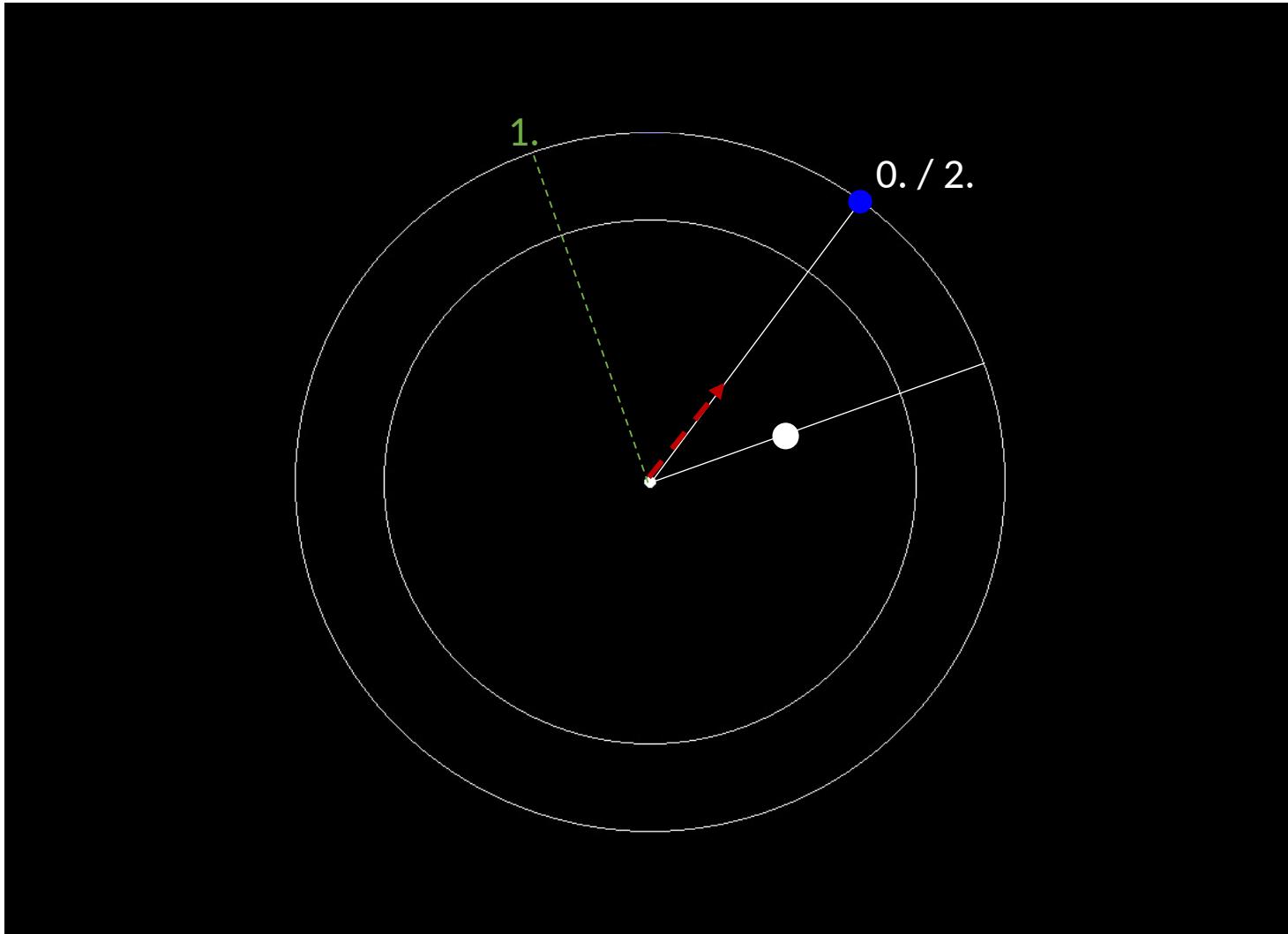
B= Baseline



**Washout the
Rotation**

Figure 2. Experiment 2. A–C, Rotation learning and relearning curves with washout. Repeated-measures ANOVA revealed a significant effect of session (learning vs relearning) on directional error ($F_{(1,30)} = 10.828; p = 0.0026$). There was no significant effect of group ($F_{(1,30)} = 0.097; p = 0.9075$) nor a significant session \times group interaction ($F_{(3,30)} = 0.439; p = 0.649$). D, Percentage change in learning from the learning to the relearning session. ANOVA revealed a main effect of group ($F_{(2,15)} = 4.17; p = 0.03$). Post hoc tests showed a significant difference ($p < 0.016$) between the control and the 5 min interference group but not between the control group and the 24 hr interference group ($p > 0.05$).

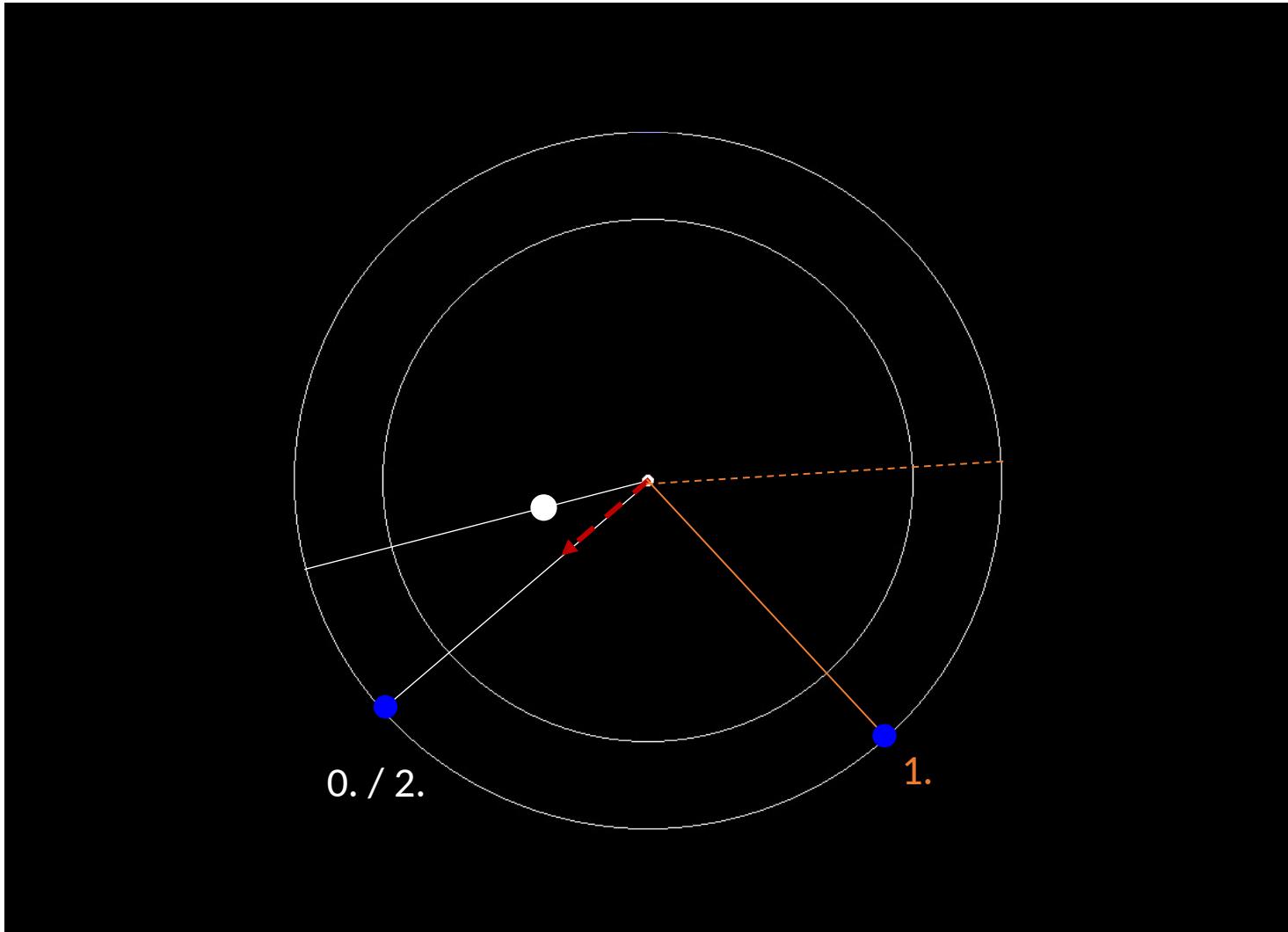
Group B: Interference



0. Change starting_angle + sudden perturbation
1. Interfere adaptation with an interference_angle in the other direction **at the same target_angle**
2. Stop interference

Keep perturbation_angle always the same
20 trials without perturbation at the beginning AND end of each block & 60 trials with perturbation resp. interference

Group B: Interference



Repeat the experiment but interfere at another target_angle

0. Change the starting_angle to another position
1. Interfere adaptation with an interference_angle in the other direction **at another target_angle**
2. Stop interference

Keep perturbation_angle always the same

20 trials without perturbation at the beginning AND end of each block & 60 trials with perturbation resp. interference

Exercise 2

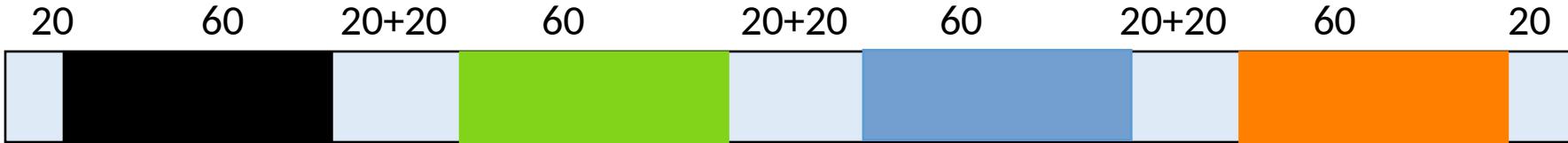
- TASK 1: Implementation of recording mode and new experiment
 - **Design** your own experiment according to your group [A or B]
- TASK 2: Analysis of experiment on unbiased subjects
 - **Rerun** first experiment with two sudden perturbations, **repeat** it after 30 minutes (all)
 - **Record** the same subject performing your own experiment (A or B)
 - Plot the error_angles to observe the motor adaptation
- TASK 3: Discussion of your results
 - Is there any motor adaptation left after 30 minutes? (all)
 - Under which conditions was your subject able to generalize to new target positions? (A)
 - What was the effect of interference to your subject's motor adaptation? (B)
- Bonus TASK 4: Try out your ideas, just state what you did and why it was interesting to you

Design your experiment!

- No perturbation
- own perturbation
- special condition



Rerun as baseline and repeat after 30min



A: Generalization



B: Interference, **repeat**