W24: Neural Modeling - HW 6 - Perturbation & After Effect

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Deadline: ***16.01.2024 - 1:59 pm***

Task-2

1. **What's the motor variability (MV) in the unperturbed segments?**

   Answer:

   $$\frac{\sum_i |a_i - \bar{a}|^2}{N-1} \tag{1}$$

   We used the `numpy.var` method from the Python library NumPy to calculate the motor variability, i.e., error variance.

   Results when mask mode is **True**:

   - **Motor Variability (MV) for unperturbed segment 1:** 3.87
   - **Motor Variability (MV) for unperturbed segment 2:** 8.35
   - **Motor Variability (MV) for unperturbed segment 3:** 3.46

   Results when mask mode is **False**:

   - **Motor Variability (MV) for unperturbed segment 1:** 4.54
   - **Motor Variability (MV) for unperturbed segment 2:** 4.00
   - **Motor Variability (MV) for unperturbed segment 3:** 5.02

2. **What do you observe in the subject's movements in the now unmasked part**

   Given the unmasked mode, the movement seems easier to track than the masked mode. It is mainly because we can see the cursor in all cases. Hence, we can say that in the mask mode, better visual feedback improves the motor adaptation process.

Task-3

1. What do you see when perturbation is introduced?

   Answer: We see a higher error angle variance when the perturbations are introduced. The error angles for sudden perturbations are larger than for gradual perturbations. Moreover, we see that the gradual error angles are more negative and correct initially, then approach zero afterwards, achieving motor adaption.

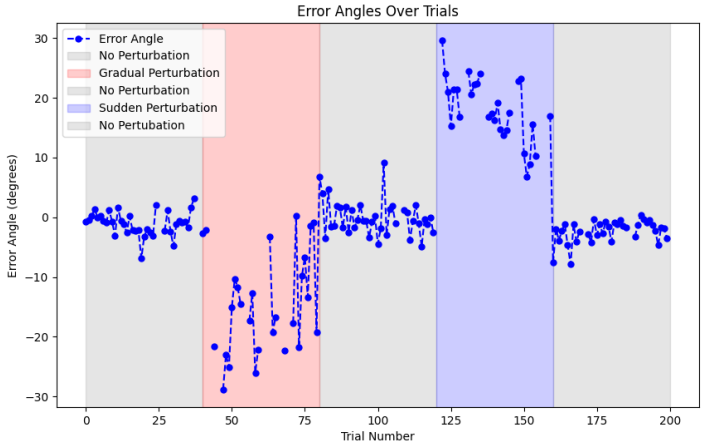

Figure 1: Error angles when the masked mode is set to **true**. This leads to the cursor being **hidden** when we exceed the mask radius, which is 66% of the target radius. This requires the participants to plan through to the end for the trajectory.

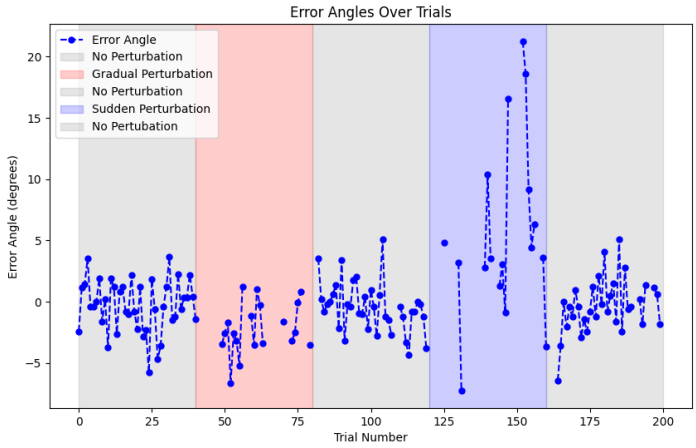

Figure 2: Error angles when the masked mode is set to **false**. This leads to the cursor being **shown** till the target. The task is simplified as the subject can plan and correct errors through the target acquisition.

2. Is there an after-effect?

   Answer: We see that for gradual error, a higher motor variability is introduced after the gradual trial has occurred. This indicates that gradual error leads to more persistent after-effects than the sudden trial.

3. What is the difference between sudden and gradual perturbation?

   Answer:

   The direction of errors for gradual and sudden perturbations are opposite due to the introduced signs of deviation. Gradual errors are counterclockwise, and sudden ones are clockwise. Gradual errors are also more complex to compensate for, leading to stronger

after-effects.

4. Why is it important to mask the last part of the trajectory?

   Answer:

   Masking the error trajectory forces the subject to plan through the hidden region, This leads to a more challenging task involving more significant planning and forces the subject to adapt to hit the target.

Task-4

1. **One sentence on what you did. One sentence about why it was interesting to you.**

   Answer: We changed the target circle to 50 (a larger feedback visualization) with an enabled mask mode (True). It was interesting because we wanted to see how better (larger) visuals affect learning and adaptation.

   Conclusion: A larger visual feedback, improves the learning rate with more successful hits compared to a smaller one.

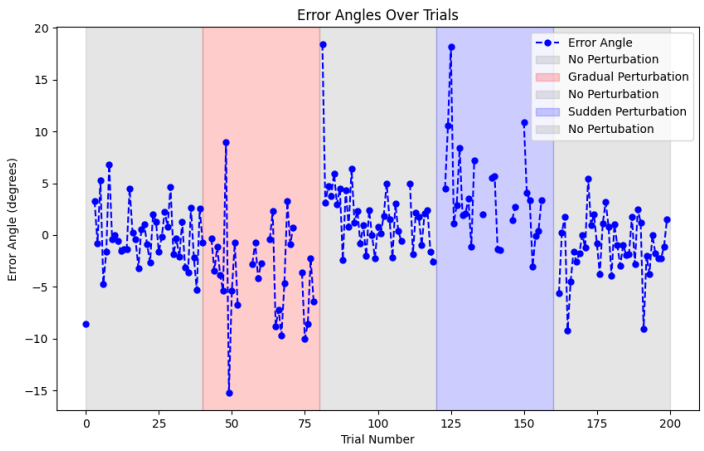

Figure 3: Error angles when the target size is set to 50 and mask mode is **true**. This leads to quicker motor learning in the sudden and gradual phases. The main reason is that the target size is bigger; hence, we have a higher success rate due to better feedback.