Sequential planning is not always associated with a reaction time cost

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Background

In daily life, individuals perform various movements, many of which contain a sequence of actions that need to be done swiflty and accurately.

One important behavioral finding in the context of sequential actions is that reaction time **(RT) increases when more sequence elements are cued** and this **RT increase** is often taken as evidence that individuals **plan multiple elements** of the sequence before initiating the sequence.

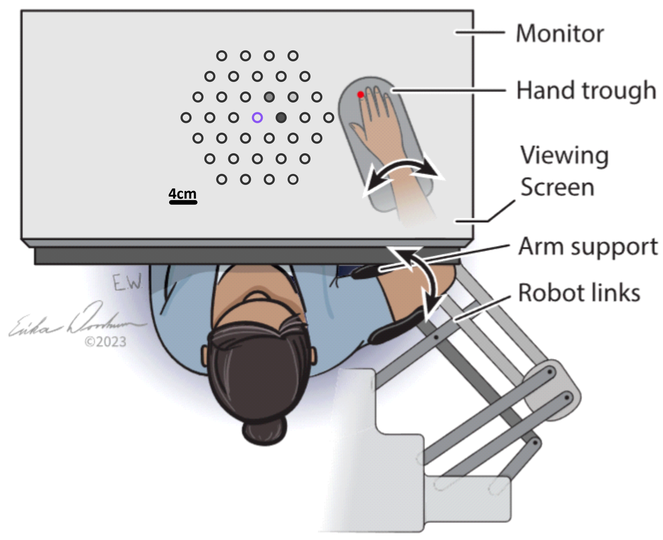
Here, we introduce a fresh prespective on RT and how it should be interpreted when it comes to the preparation of sequential movements.

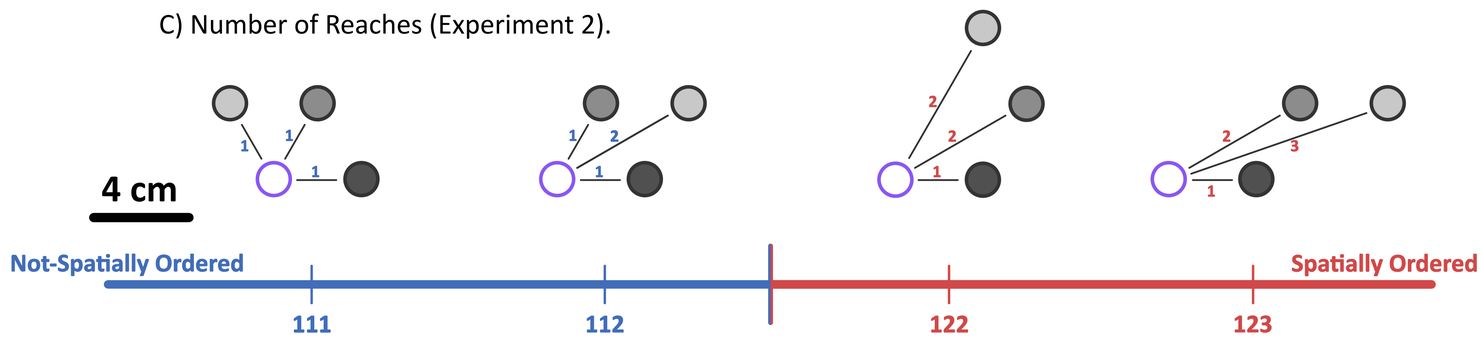
We specifically answer:

1. Does sequential planning happen before sequence initiation?
2. Can sequential planning happen without RT cost?
3. Is RT cost due to sequential planning or is it due to complexity of resolving the order of the sequence?

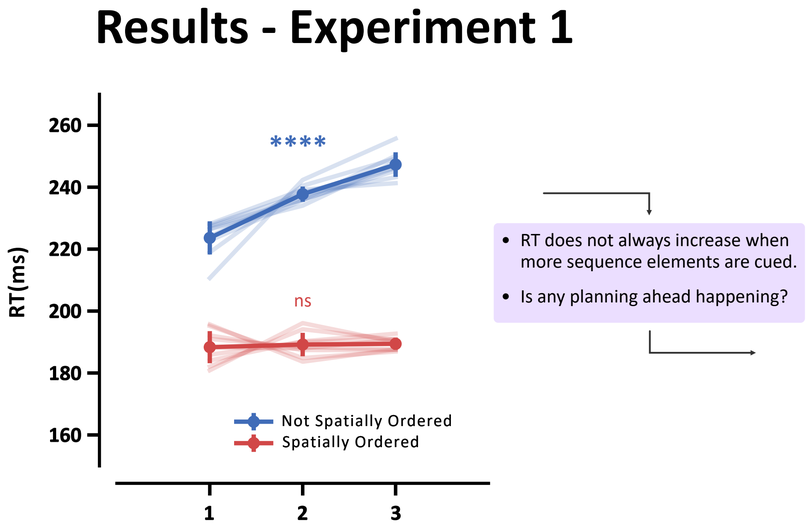
Methods

- Participants performed sequences of fixed-length reaches in which the order was indicated by target brightness.
- Sequences were randomly generated from grid of equidistanced circular targets.
- Participants could only see the targets and their hand feedback.
- We manipulated:
  - A) Number of future targets visible (Horizon).
  - B) Complexity of identifitying the first target in sequence (Spatially Ordered or Not).
  - C) Number of Reaches (Experiment 2).

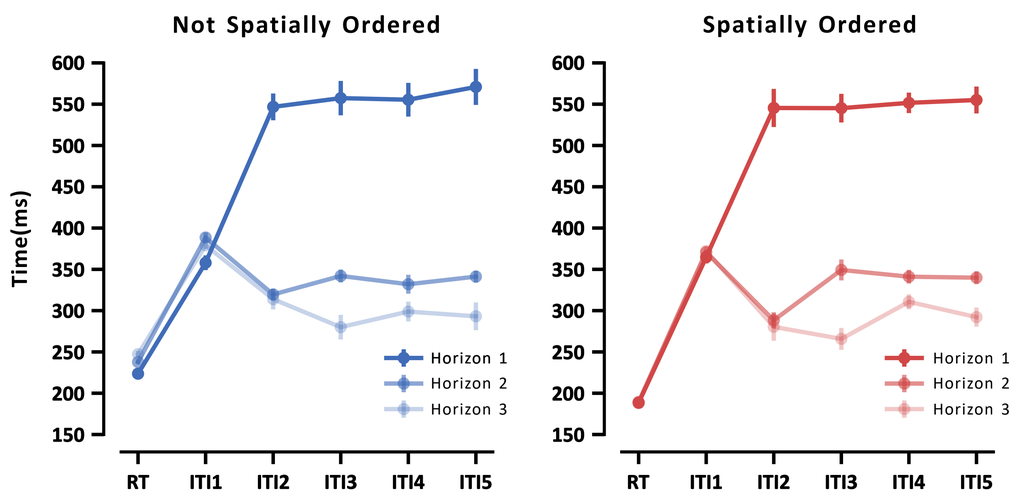


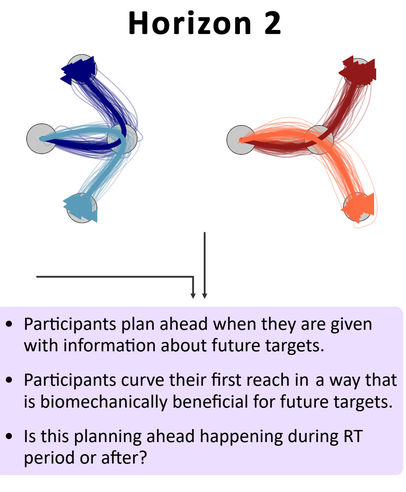


Results - Experiment 1



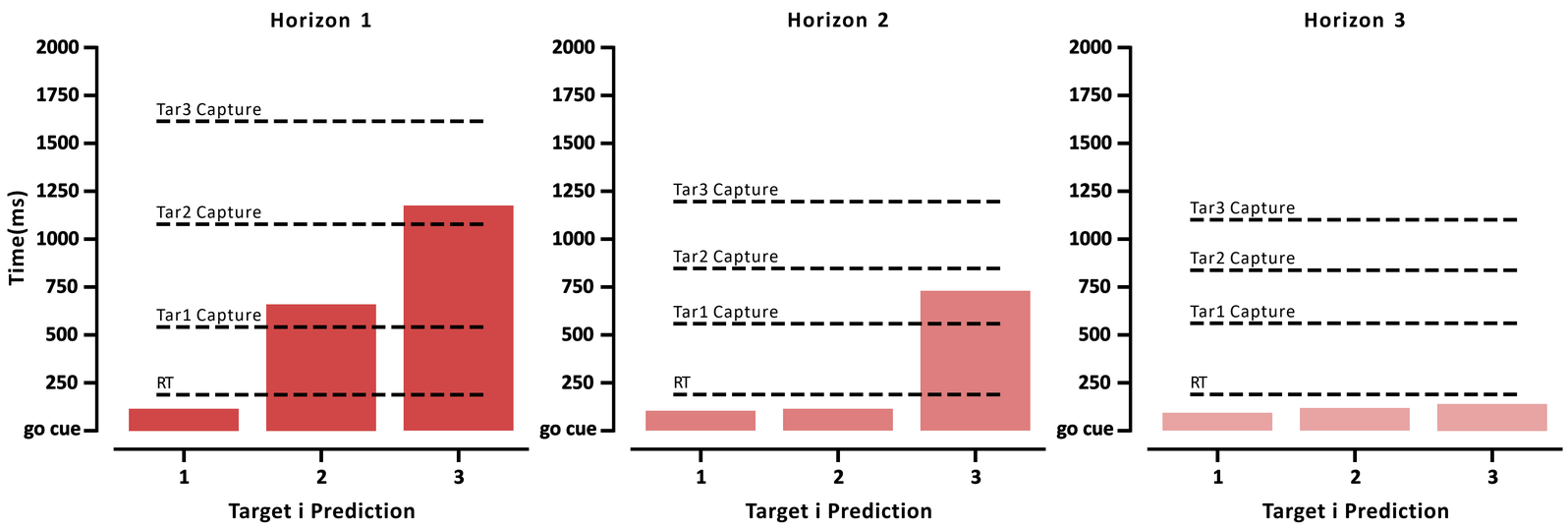
- RT does not always increase when more sequence elements are cued.
- Is any planning ahead happening?

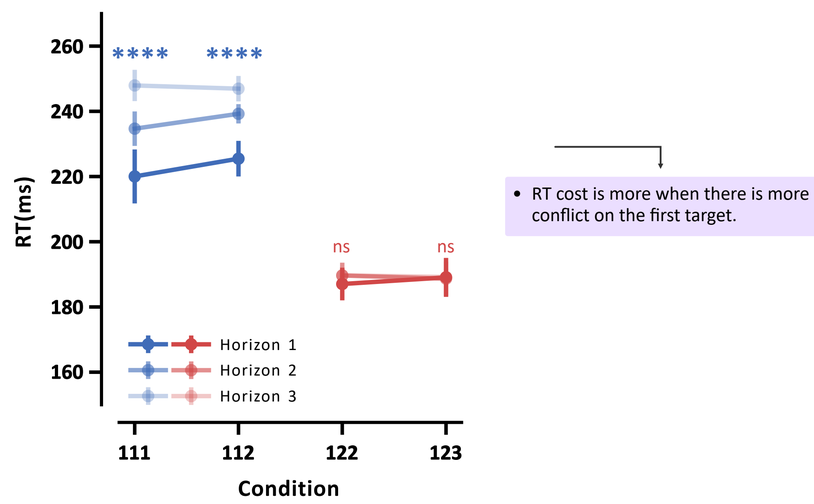




- Participants plan ahead when they are given with information about future targets.
- Participants curve their first reach in a way that is biomechanically beneficial for future targets.
- Is this planning ahead happening during RT period or after?

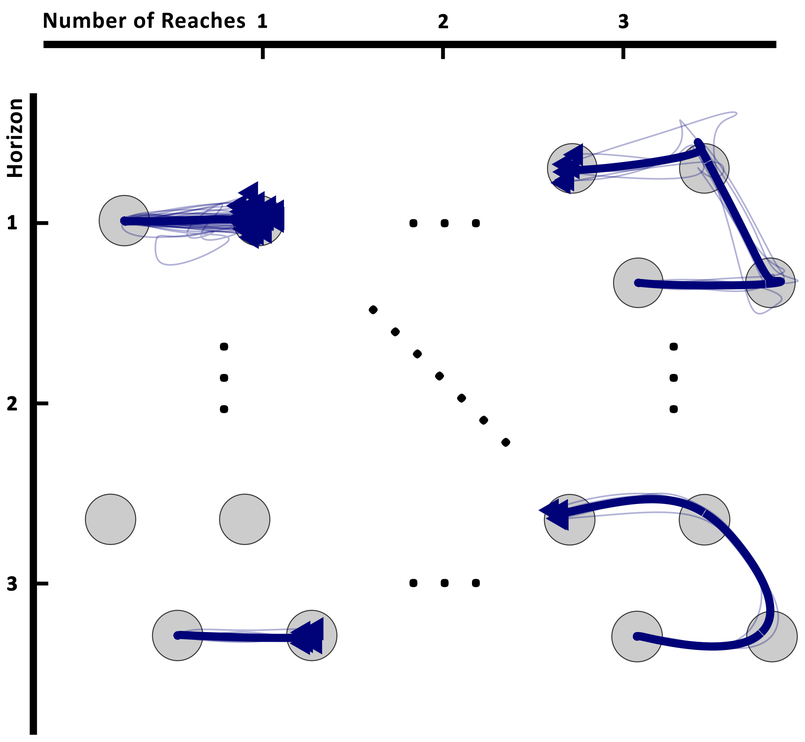
- Sequential planning happens during RT:

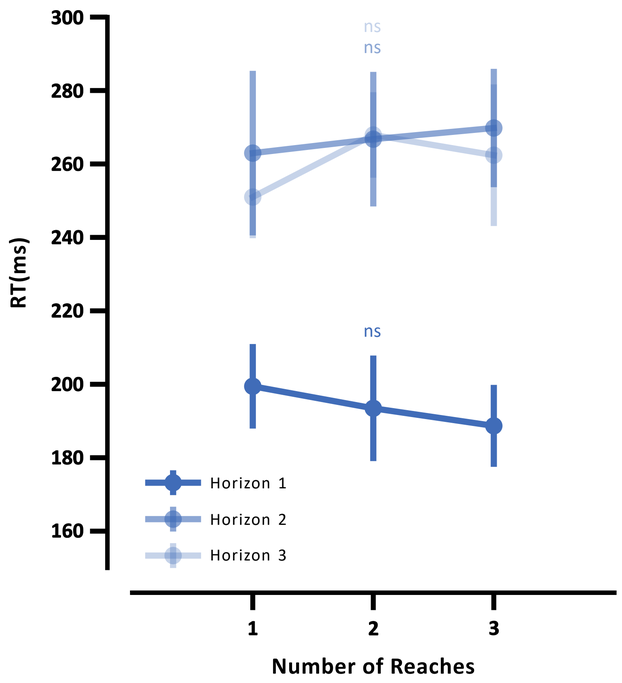




- RT cost is more when there is more conflict on the first target.

Results - Experiment 2





Summary

- **Sequential planning happens before sequence initiation**

  At least the first three targets are considered.
- **Sequential planning happens either with or without RT cost**

  Depending how hard is it to resolve the order of the sequence. In our case, response conflict on the first target.
- **RT cost is not always associated with sequential planning**

  There is no RT cost when performing more number of reaches, all the cost is due to response conflict on first target.
- **Spatial ordering fascilitates resolving of sequence order**

  Determining sequence order when its elements are spatially cued has no cost on RT.
- **Response conflict intensity is correlated with RT cost**

  The harder the response conflict gets, the more the cost on RT.

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