

Contextual interference

KINESIOL 1E03 - Motor control and learning

Laura St. Germain
Fall 2022 Week 9
Lecture 18

Review from last lecture

How should we balance practice and rest intervals?

Q's: How many days a week should learners practice? How long should each practice session be?



MASSED PRACTICE: a **practice schedule** in which the amount of rest **between** practice sessions or trials is **relatively short**

DISTRIBUTED PRACTICE: a **practice schedule** in which the amount of rest **between** practice sessions or trials is **relatively long**

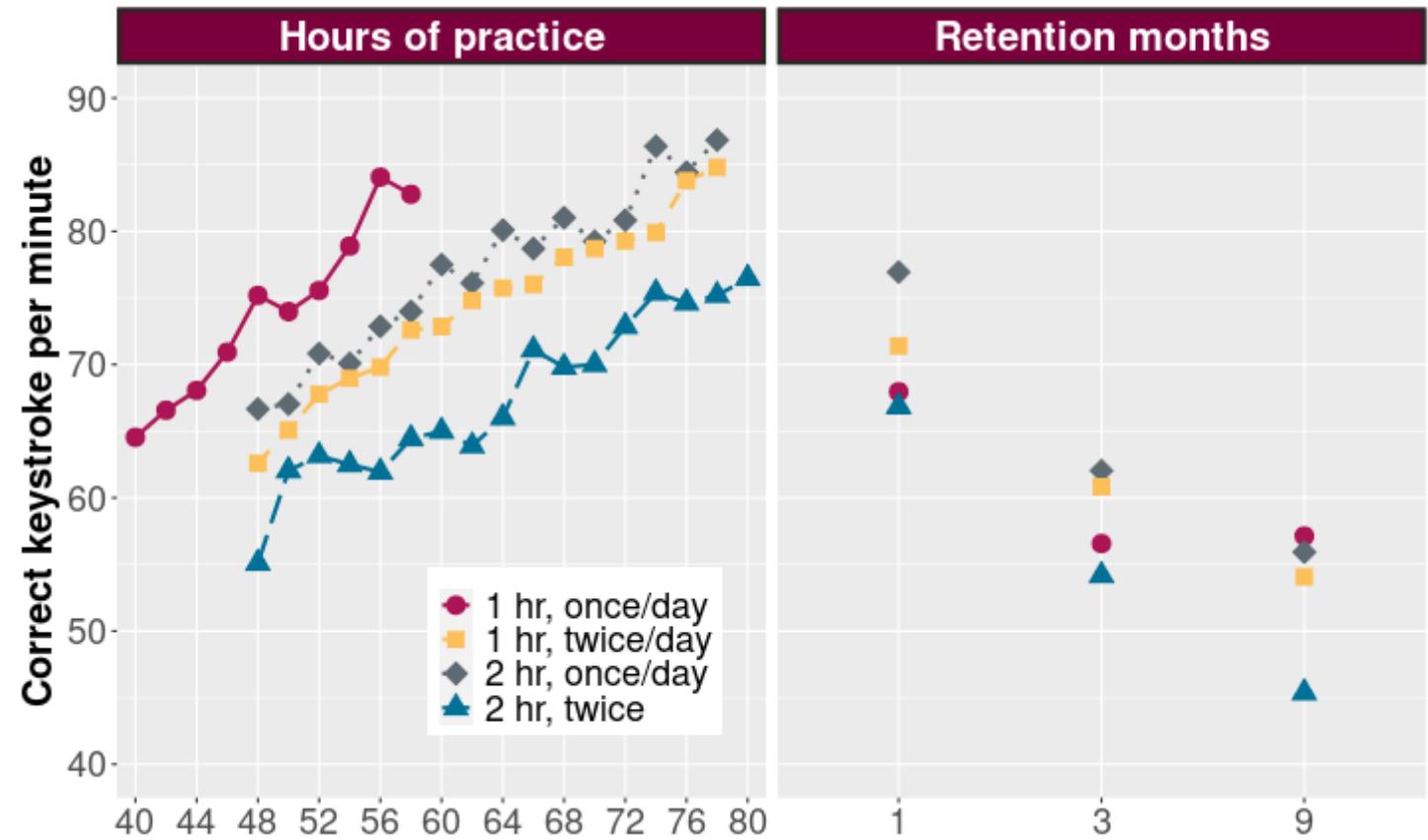
The benefits of more and shorter practice sessions

Task: Keyboard mail sorting machine

Training: Alloted 60 hrs and 5 days each week

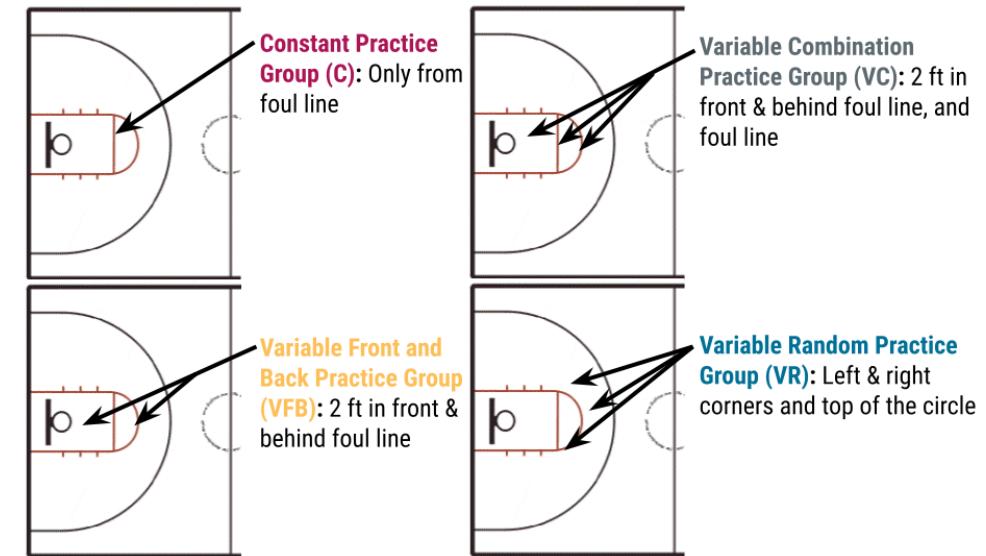
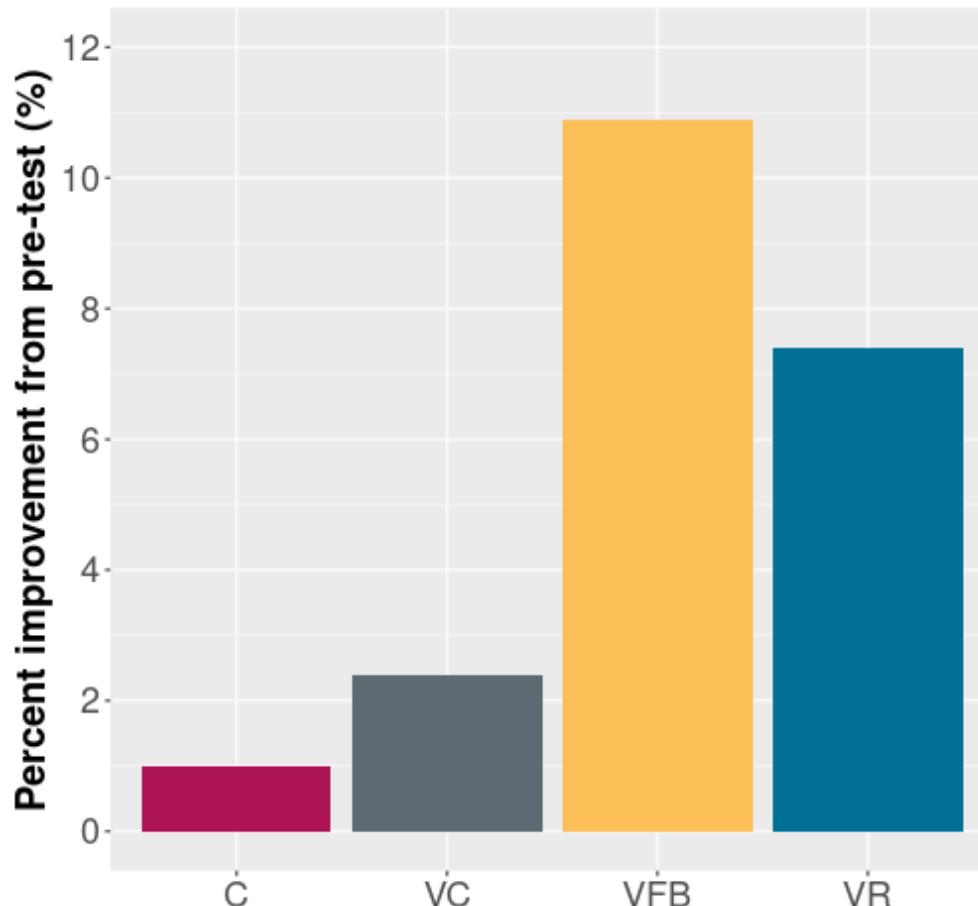
Groups:

- **1 hr, once/day** = 12 weeks
- **2 hr, once/day** = 6 weeks
- **1 hr, twice/day** = 6 weeks
- **2 hr, twice/day** = 3 weeks



Approximate data adapted from Baddeley and Longman 1978 (<https://doi.org/10.1080/00140137808931764>) as presented in Schmidt and Lee 2011

Constant versus variable practice for free throws



Q1: What can you conclude based on this figure showing percent improvement from pre-test to 2-week retention test?

Q2: What is the most surprising finding from this data?

Consider the following scenario...

You are an **occupational therapist** working with a stroke patient. They want to **regain** some of their **independence** with 3 specific activities of daily living: 1) **brushing teeth**, 2) **pouring water into a glass**, and 3) **buttoning a shirt**. **How should you structure the practice (and why)?**

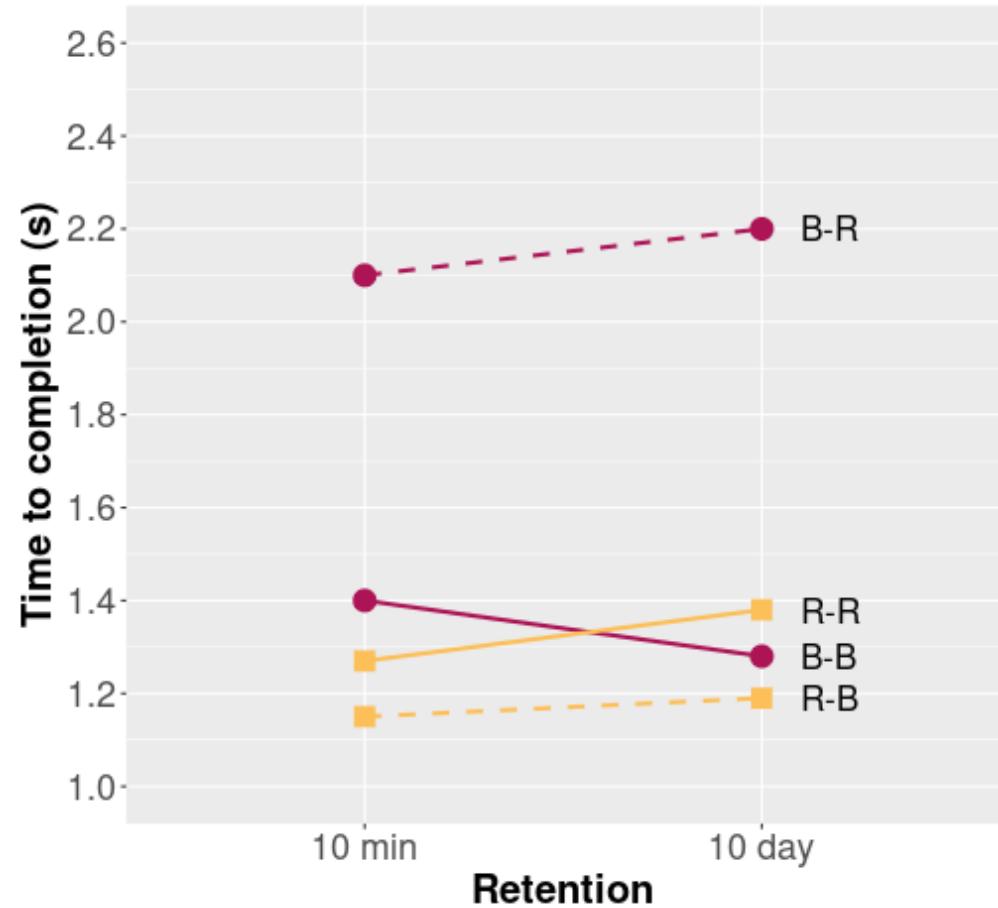
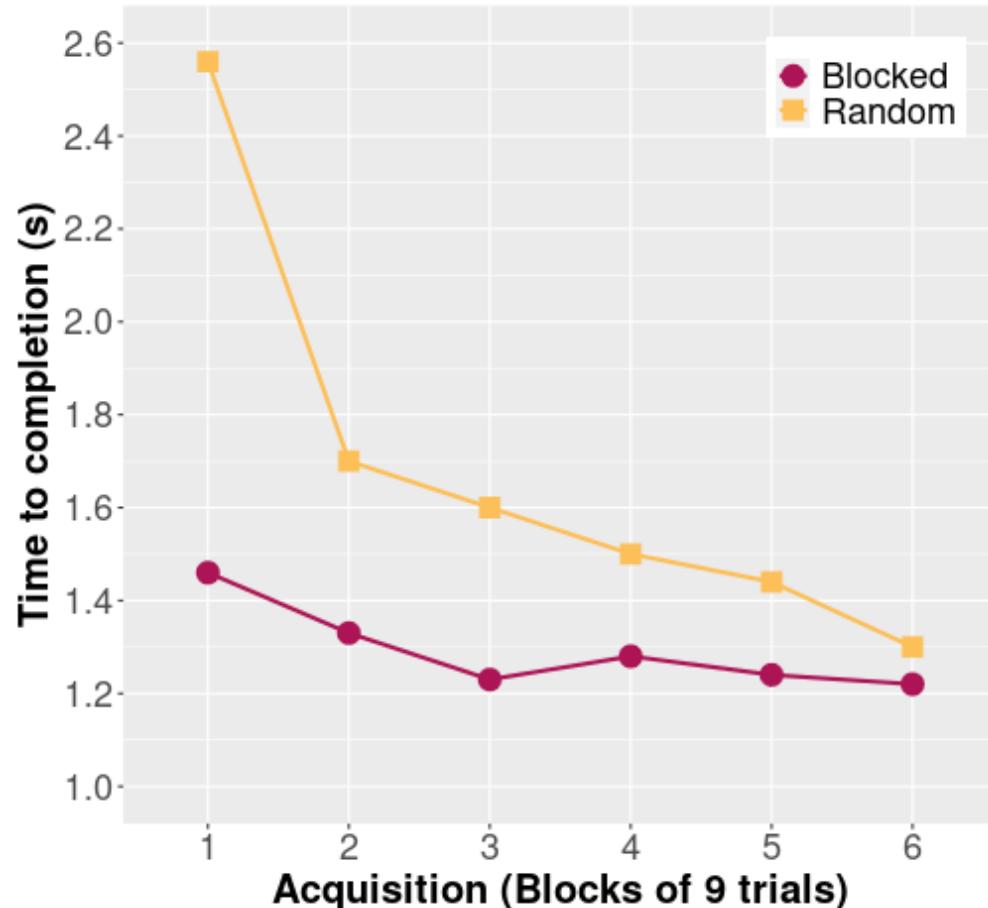
Blocked practice



Random practice



Is blocked or random practice more effective?



Approximate data of Shea and Morgan 1979 (<https://doi.org/10.1037/0278-7393.5.2.179>) through plot digitization

Any questions?



Learning objectives

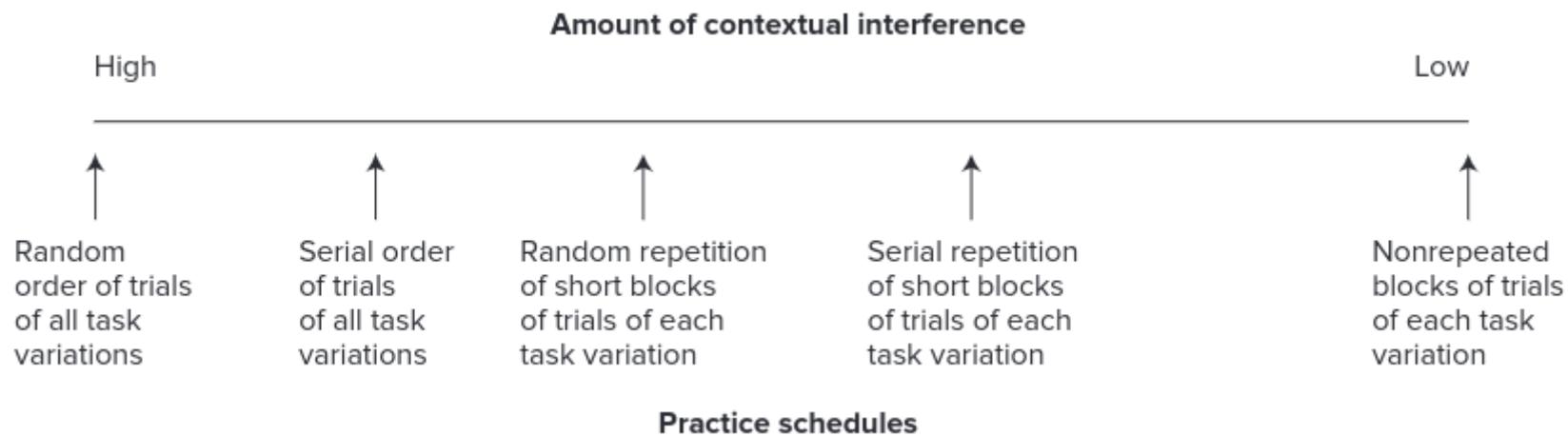
1. Define **contextual interference** and explain the **contextual interference effect**.
2. Compare and contrast the **two main explanations** for why a **random** schedule is **more effective** than a blocked schedule.
3. Describe **two techniques** that have been used to support these explanations.
4. Discuss how contextual interference impacts **metacognition**.

Take-home message:

The organization of one's practice session can have profound and often paradoxical effects of motor learning.

Practice can be organized to promote different amounts of contextual interference

CONTEXTUAL INTERFERENCE¹: refers to the **interference** that results from performing various tasks or skills with the **context** of practice



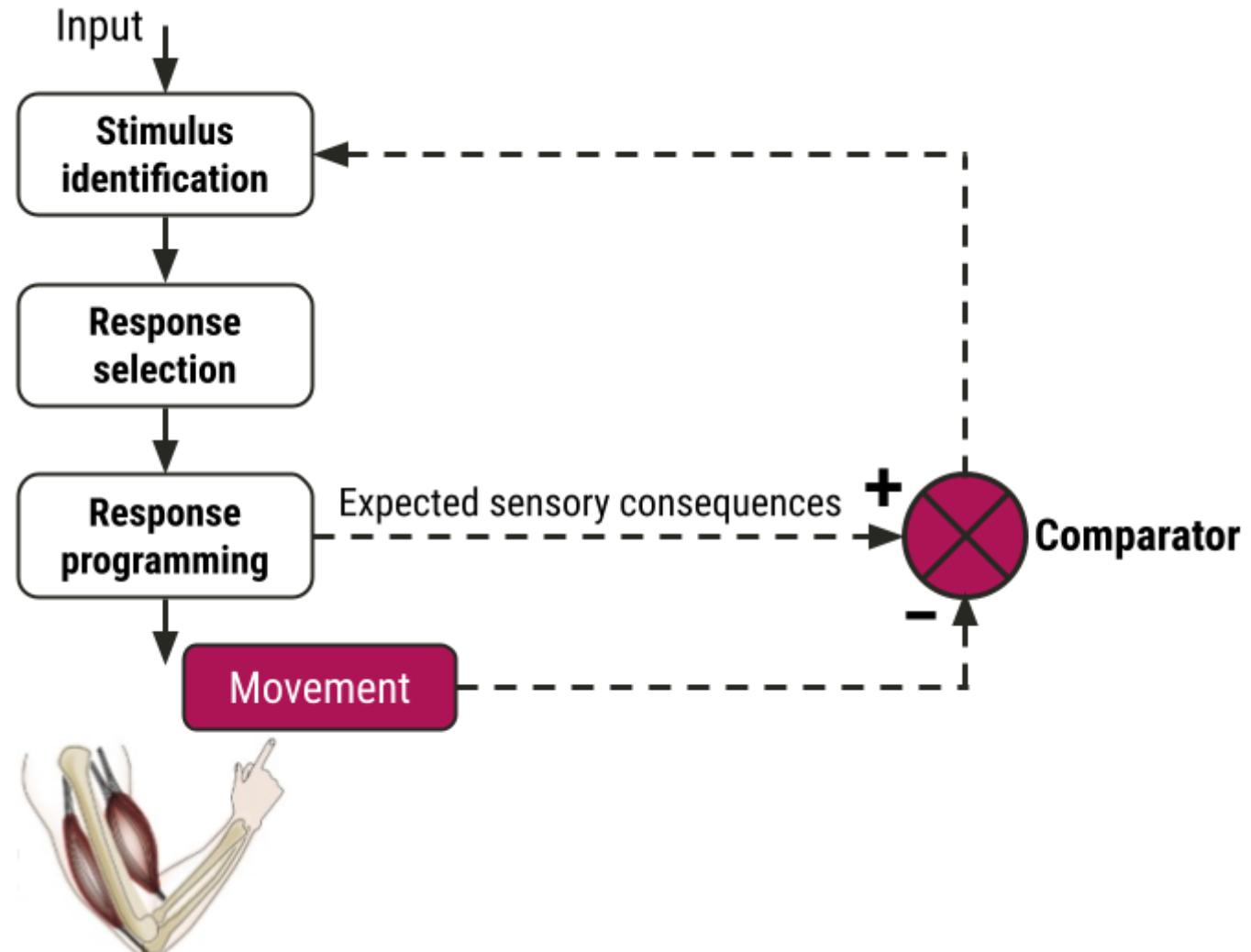
CONTEXTUAL INTERFERENCE EFFECT: when a **high amount** of contextual interference results in **better** retention and/transfer performance than a low amount of interference

¹This term was introduced by Battig 1979 when he first demonstrated the contextual interference effect; Fig: Magill & Anderson 2017

Why is random more effective than blocked?

ELABORATION HYPOTHESIS

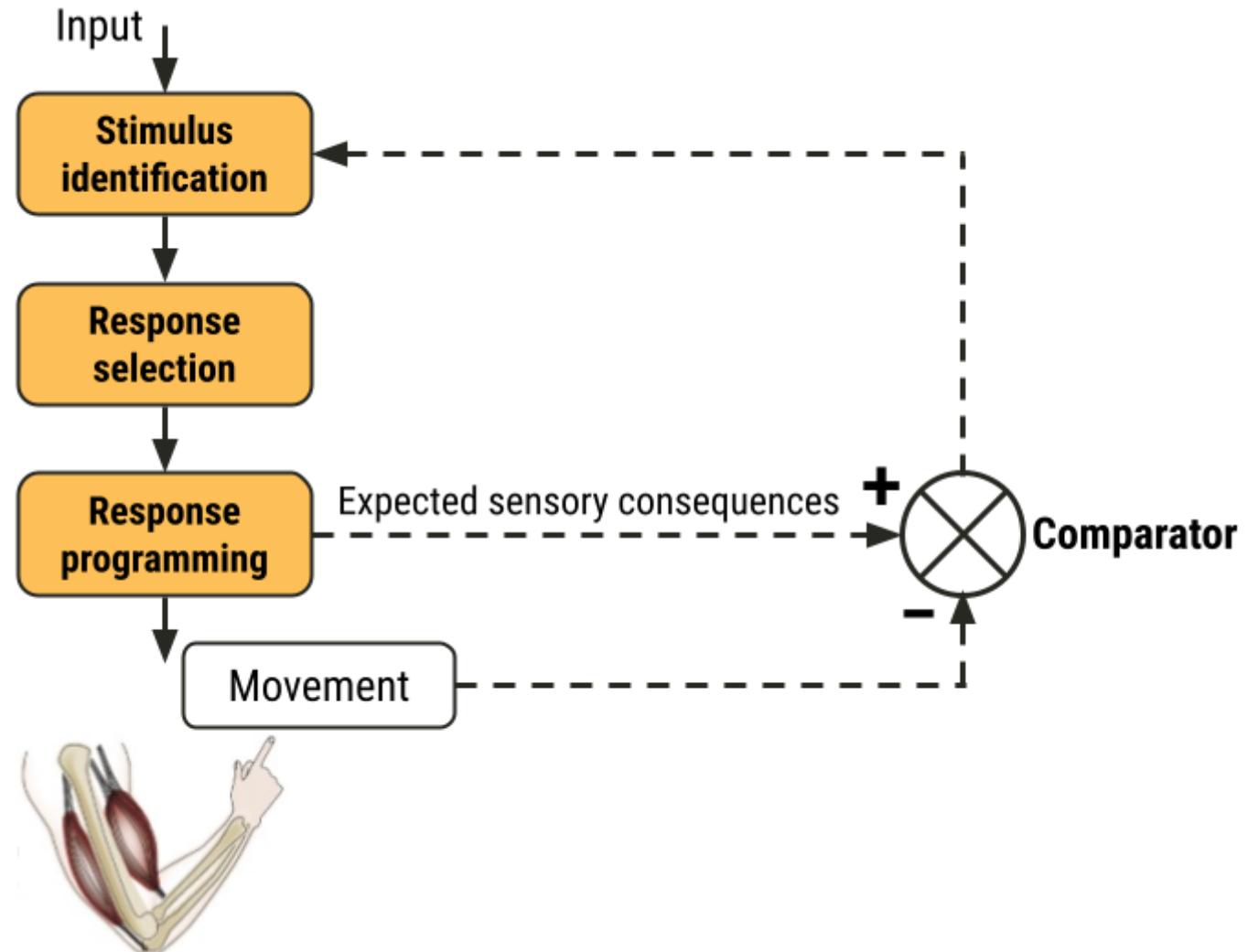
Interleaving tasks gives the learner opportunities to engage in **inter- & intra-task processing** (i.e., compare and contrast) in **working memory**, which **facilitates** the development of more **distinct or elaborative** motor memories



Why is random more effective than blocked?

FORGETTING-RECONSTRUCTION HYPOTHESIS

Interleaving tasks forces the learner to "forget" or dump a given **action plan** from **working memory** to plan and execute successive trials. The learner must then **(re)construct an action plan** on each trial.



Testing between explanations: TMS

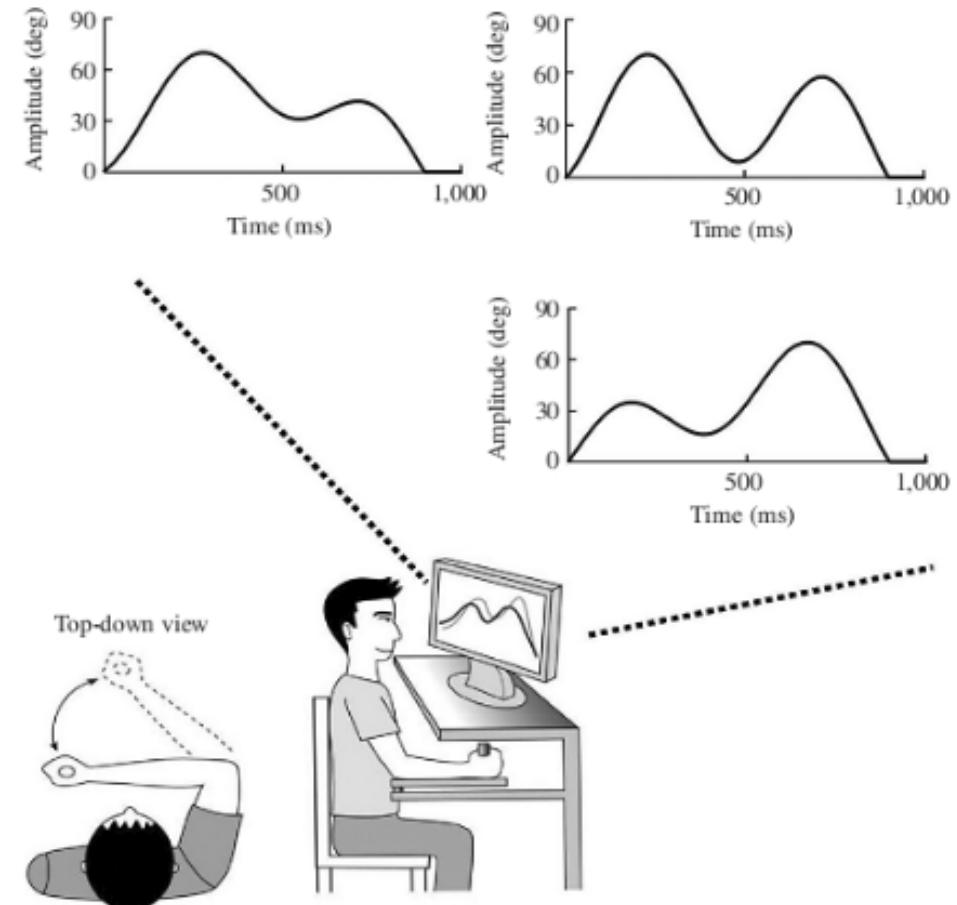
Task: Waveform matching

Groups:

- **Random** groups
 - 1. No-TMS
 - 2. Sham-TMS
 - 3. TMS
- **Blocked** groups
 - 1. No-TMS
 - 2. Sham-TMS
 - 3. TMS

TMS protocol: **Suprathreshold** TMS during the **intertrial interval** to modulate **elaborative** and/or **forgetting-reconstruction** processes

Lin et al. 2008 (<https://doi.org/10.3200/JMBR.40.6.578-586>)

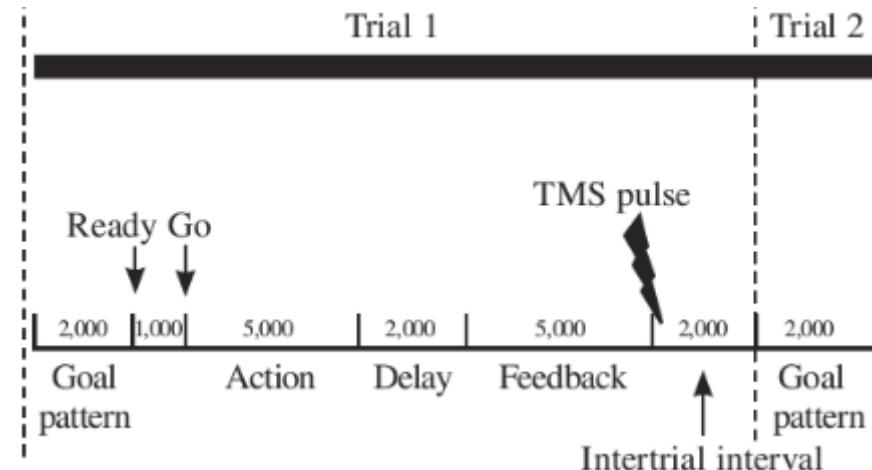


Testing between explanations: TMS

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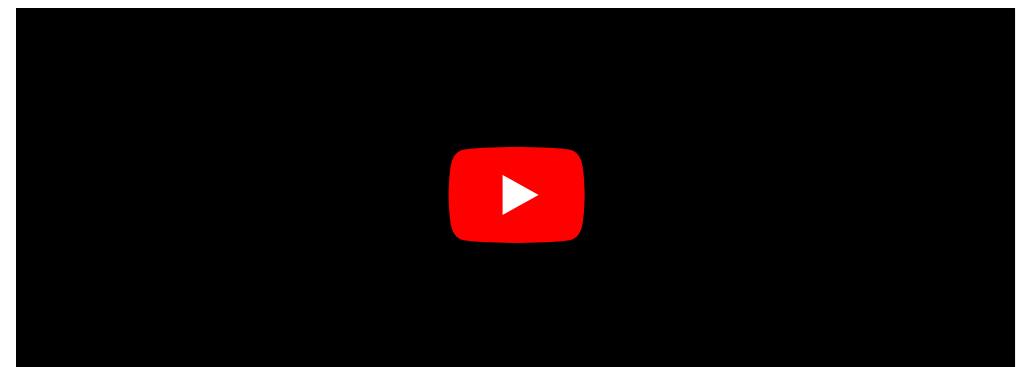
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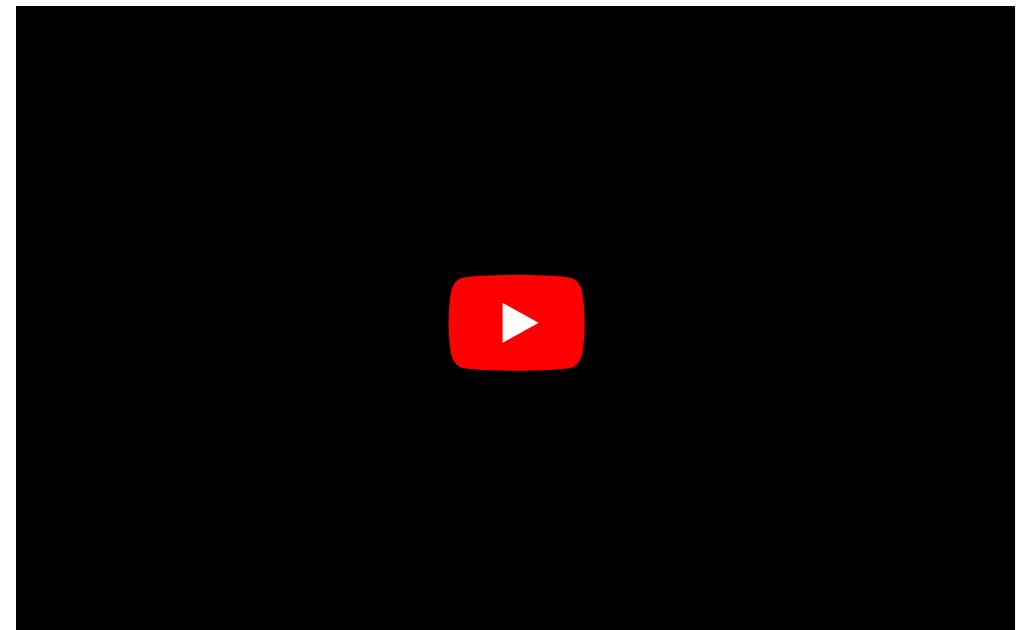
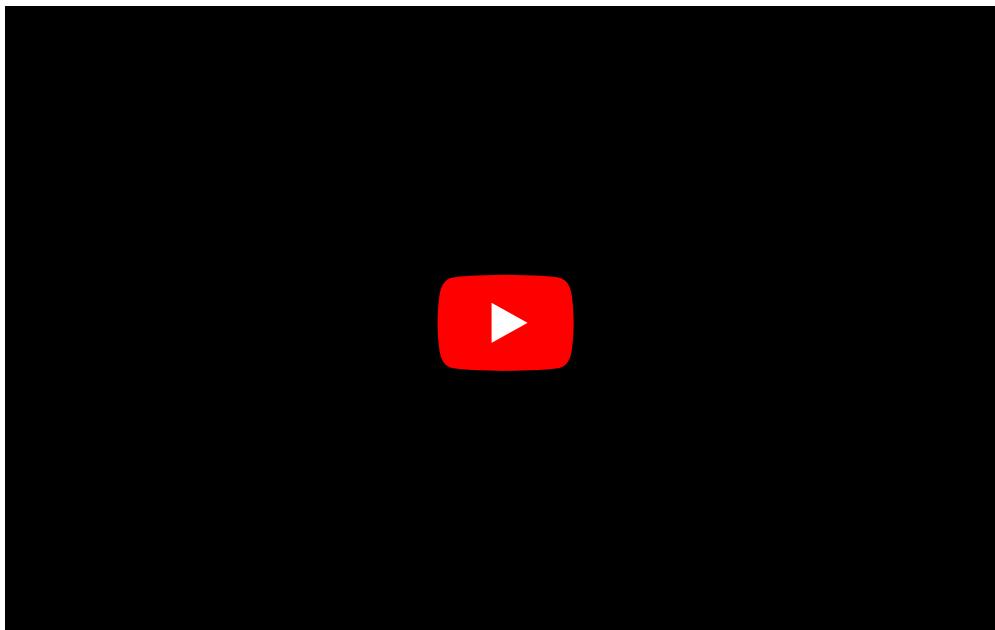
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Transcranial magnetic stimulation or TMS

- A **single pulse**² TMS protocol can be used to investigate the functional roles of brain regions such as the **motor cortex**.
- A **high** enough stimulation **intensity** (e.g., 120% of resting motor threshold) can inhibit brain activity for a short period



²Can also do repetitive pulses (see video on right side); Left video: <https://youtu.be/5RN79vEKTss>; Right video: <https://youtu.be/gp8KnAHkwdo>

Testing between explanations: TMS

Elaboration predictions



Random practice

ACBACABCBCACBCAB...

- TMS **disrupts** elaborate processes
- Retention **reduced**



Blocked practice

AAAAAA... BBBBB... CCCCC...

- Little to no elaborate processes to **disrupts**
- Retention **not affected**

Forgetting-reconstruction predictions



Random practice

ACBACABCBCACBCAB...

- Forgetting has **already** been induced
- Retention **not enhanced**

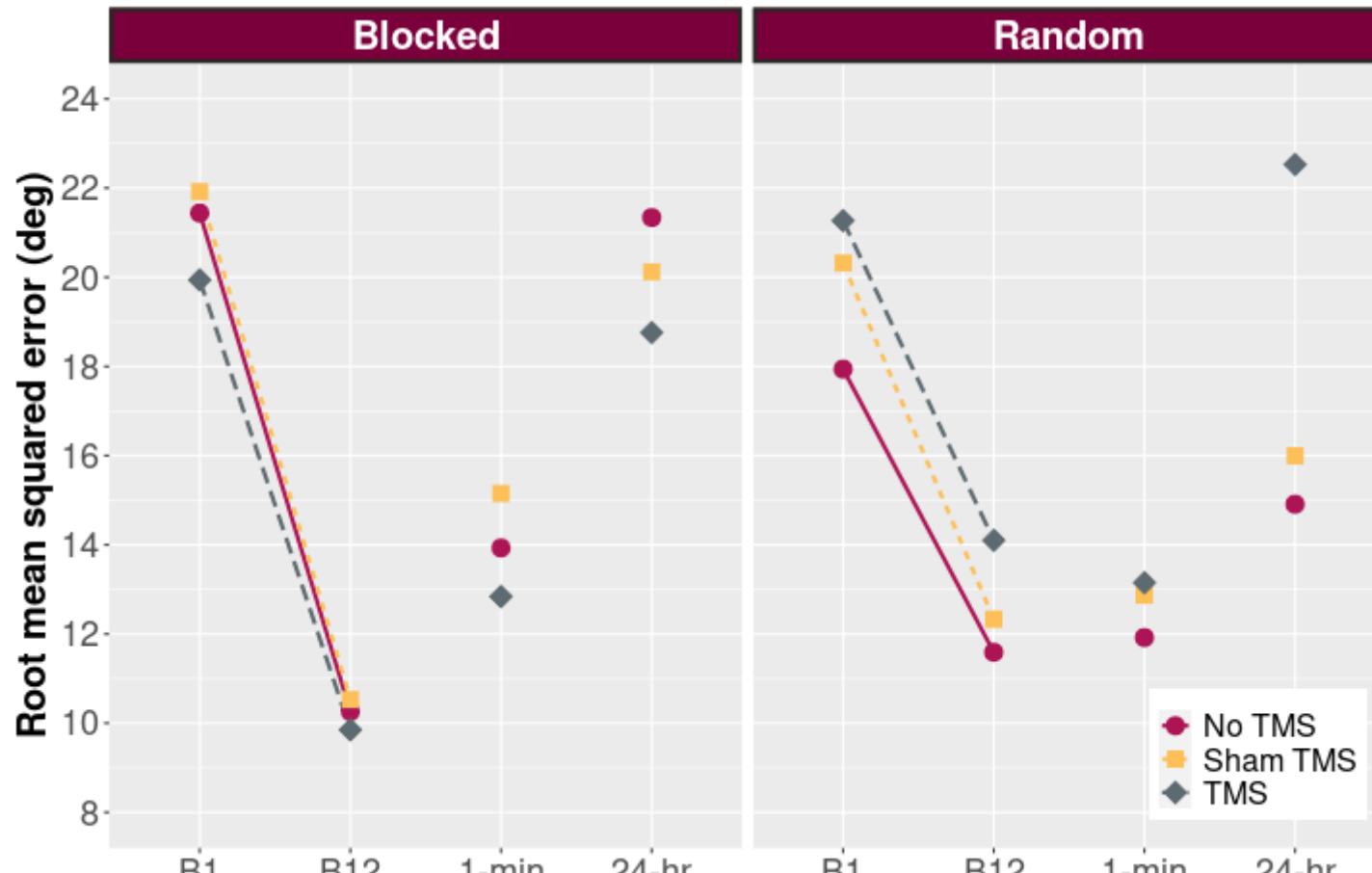


Blocked practice

AAAAAA... BBBBB... CCCCC...

- TMS perturbation **induces** forgetting
- Retention **enhanced**

Testing between explanations: TMS

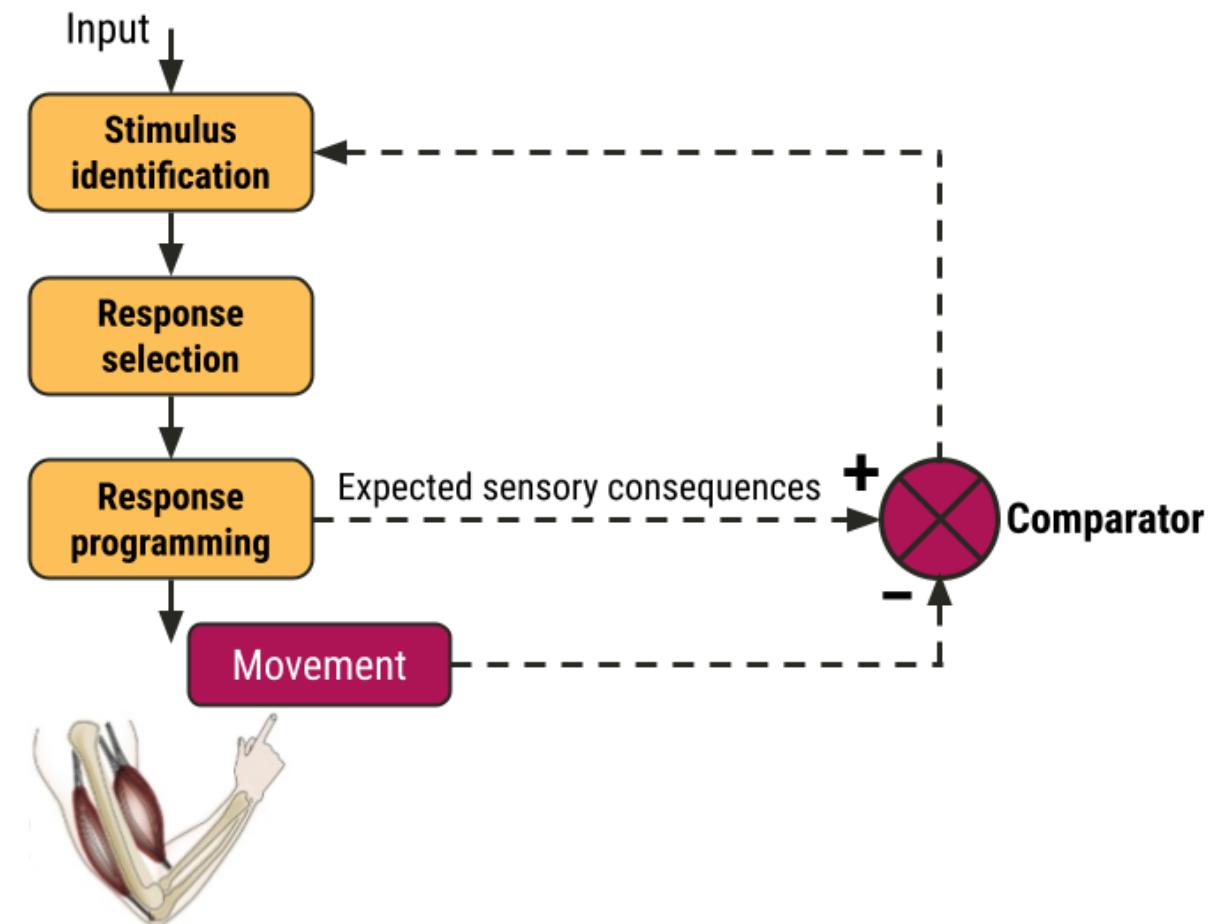
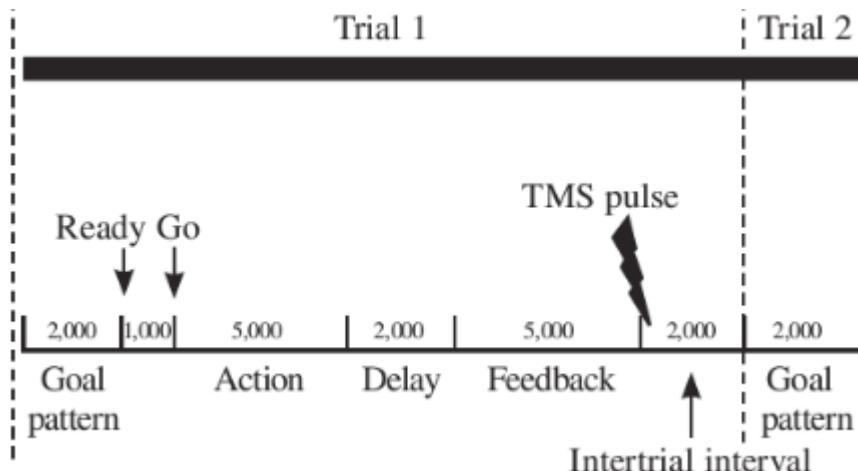


- **Random+TMS** group significantly **worse** than Random+No-TMS and Random+Sham groups
- **No significant differences** found between the different **Blocked** groups

Q: Which hypothesis is supported by this data?

Approximate data of Lin et al 2008 (<https://doi.org/10.3200/JMBR.40.6.578-586>) through plot digitization

But was there a methodological issue in the experiment?



Testing between explanations: Probe reaction time

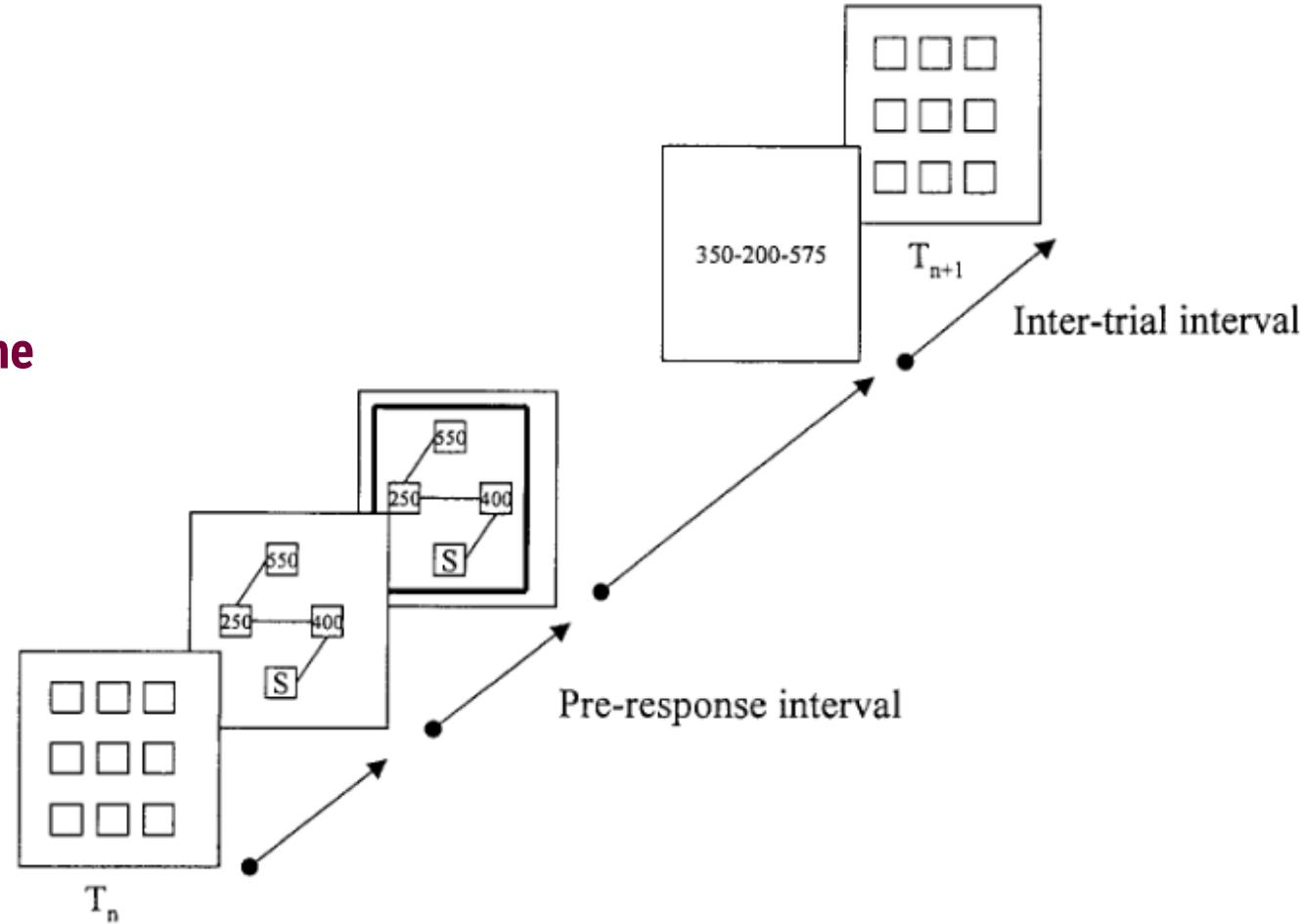
Task: Sequence learning (3 patterns)

Probe task: 2-Choice reaction time task (**low** versus **high** tone)

Probe protocol: **Randomly** presented on **some** trials (12 trials for each tone)

Groups:

- **Random** groups
 1. Pre-response interval
 2. Inter-trial interval
- **Blocked** groups
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Testing between explanations: Probe reaction time

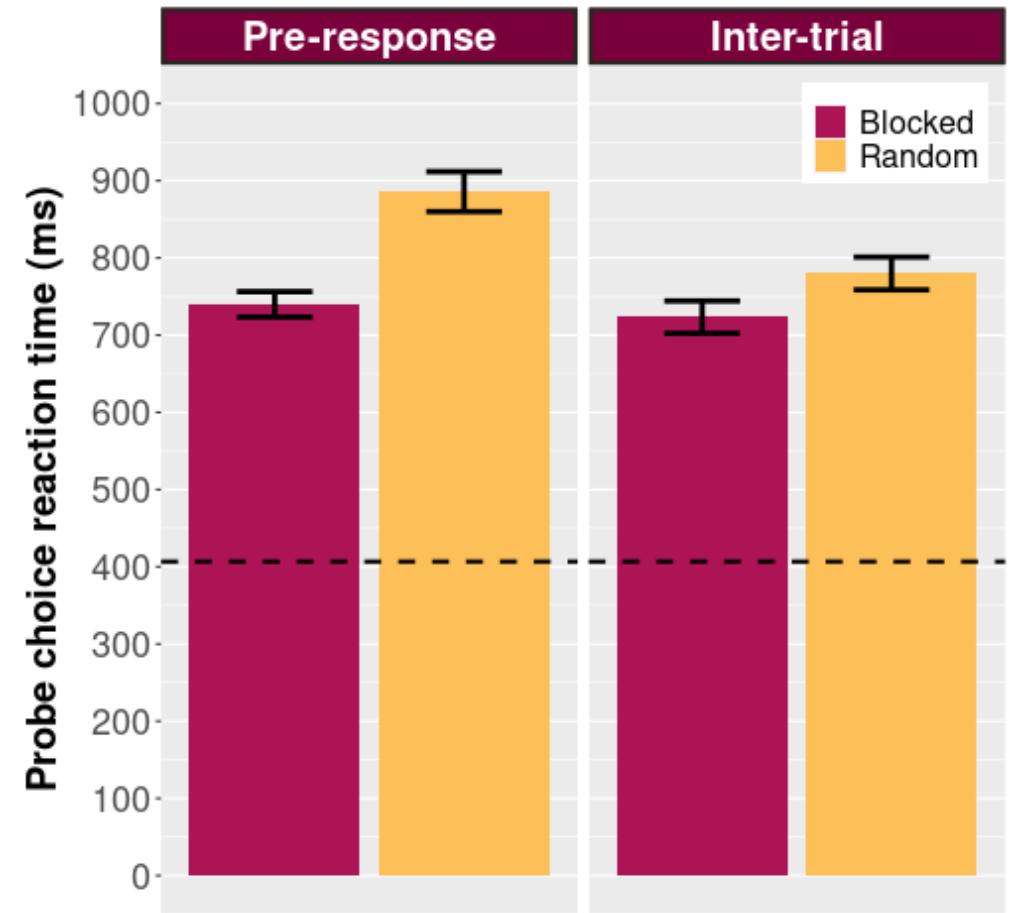
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Knowledge translation of best practice conditions poses a considerable challenge



*Too often our **perceptions** about the **best** ways to facilitate learning are **heavily biased***

Judgments of learning based on repetition schedule



Knowledge translation of best practice conditions poses a considerable challenge



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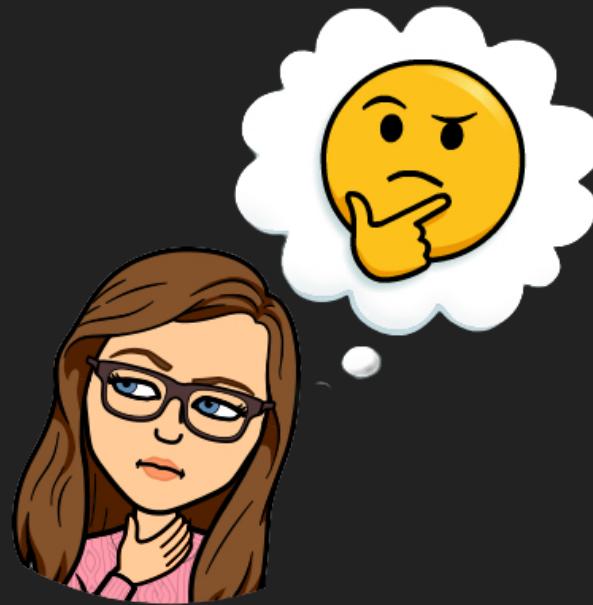
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What questions do you have?



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