BUFFALO LAB 

Learning to learn

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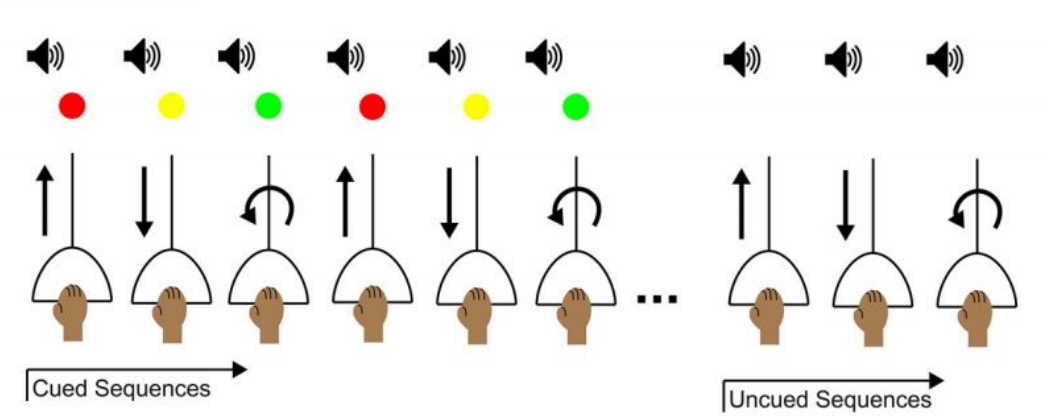
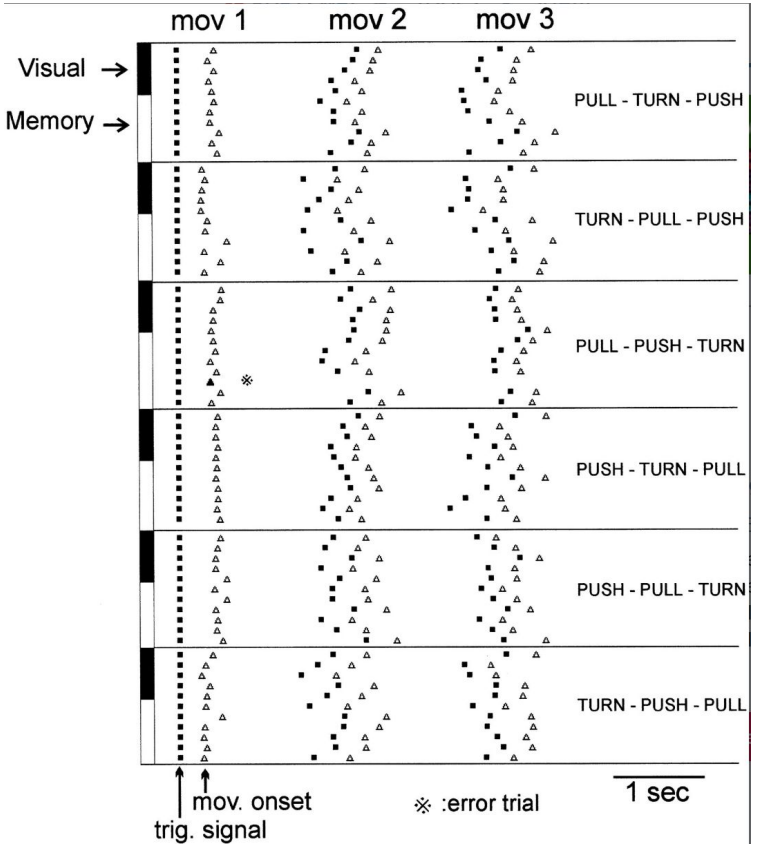
Background: Sequence learning and working memory





Desrochers et al.(2016). *Monitoring and Control of Task Sequences.*

Learning the reward-association faster in a new image set

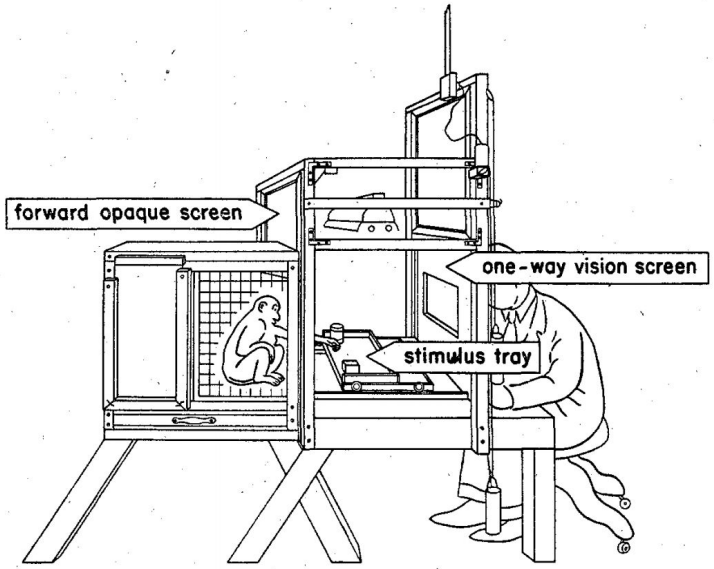
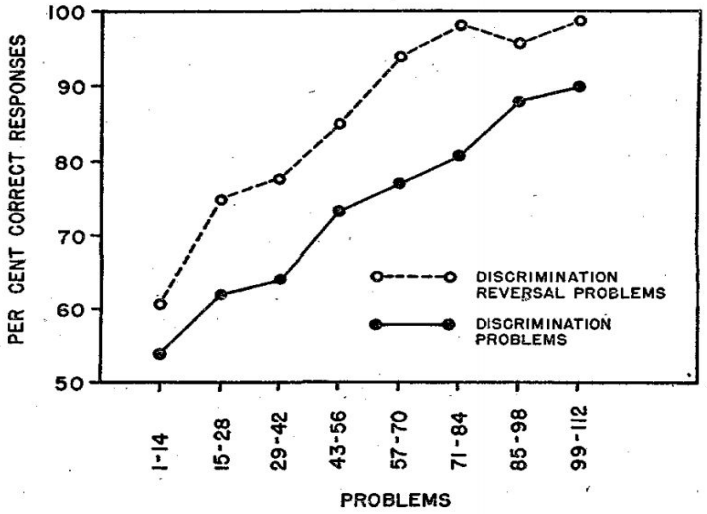


FIG. 1. Wisconsin general test apparatus.



Harlow., (1948). *Learning how to learn efficiently*

Aims of the study

1. To determine what constitutes a sequence task's structure
    - Predictive sequences will be treated as segments
    - Goal related and goal independent sequences will be treated separately
2. To determine how learning a sequence task's structure facilitates learning a new set of task
    - We predict that people will get faster and will be more accurate with practice
    - We predict that habitual sequences will be less memorable

The Experiment: Learning phase

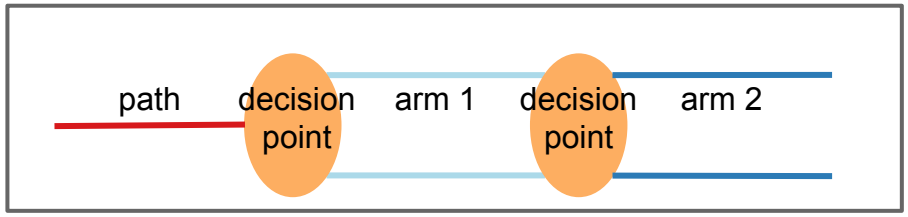
- N = 30 (14 Male, 16 Female)
- Age range: 18-23
- 29 right-handed, 1 left-handed
- 2 subjects were excluded in the data analysis due to lack of memory accuracy

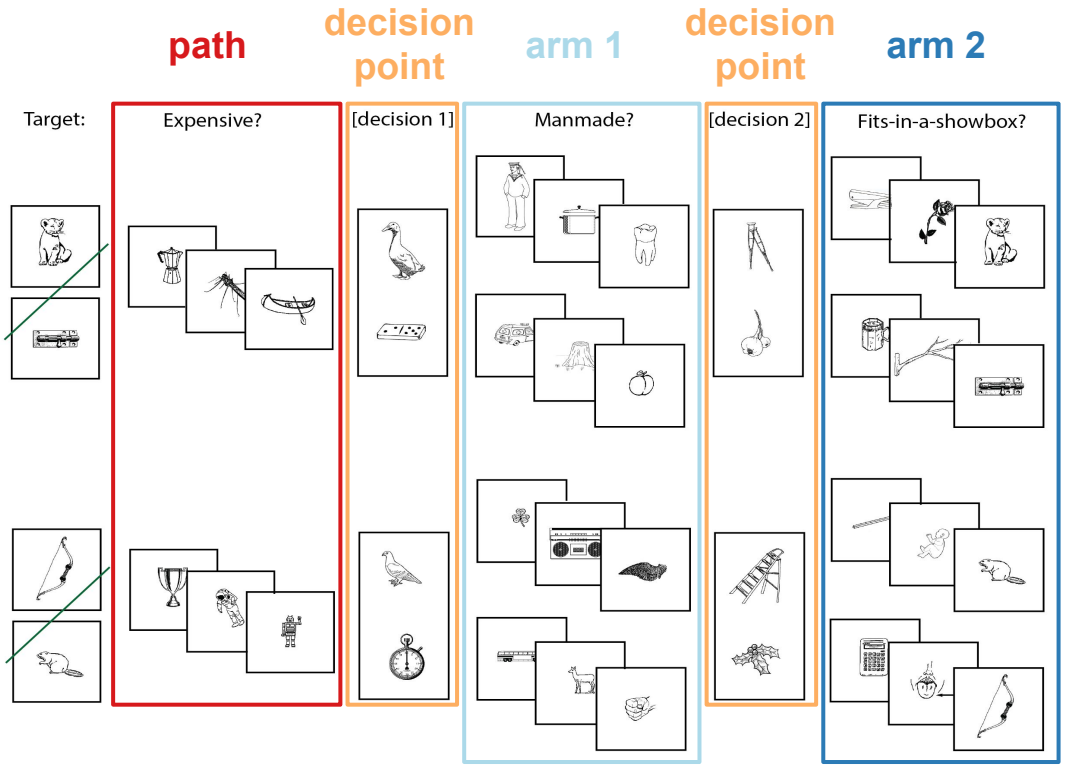
	Block 1	Block 2	Block 3	Block 4
image set	A / B	B / A	A / B	B / A
total trials	50	50	20	20

Target: Expensive? path

Set B

Double Y maze design



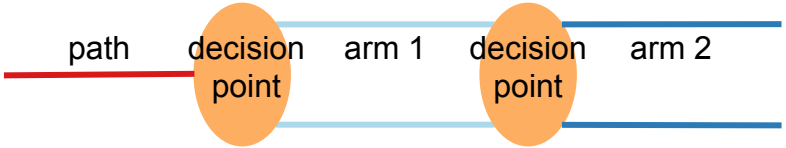


The Experiment: Retrieval phase

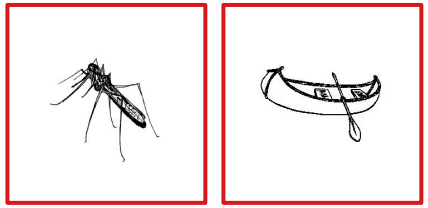
Free recall test

- Each target was used as a probe for the sequence of images.
- Acceptable answers for free recall was not restrained to the image name

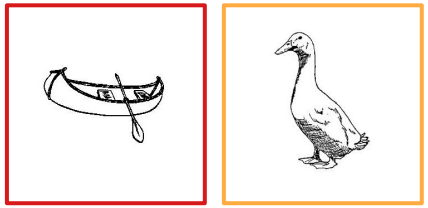
Order test: Which image showed up first in the sequence?



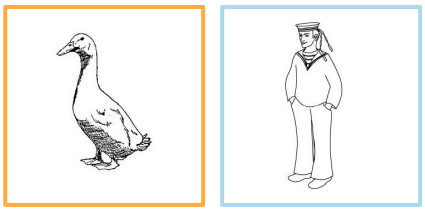
path only



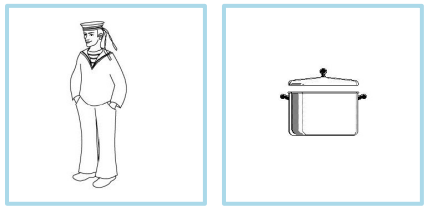
pre decision point 1



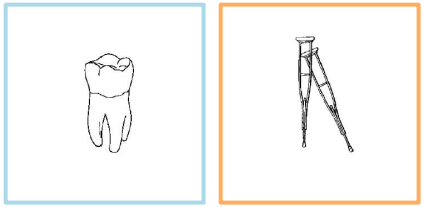
post decision point 1



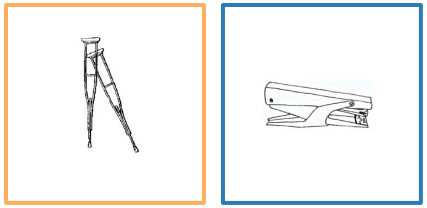
arm 1 only



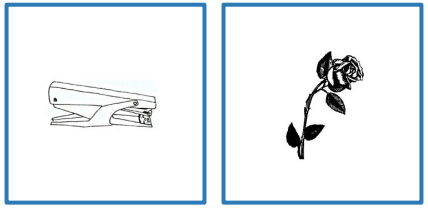
pre decision point 2



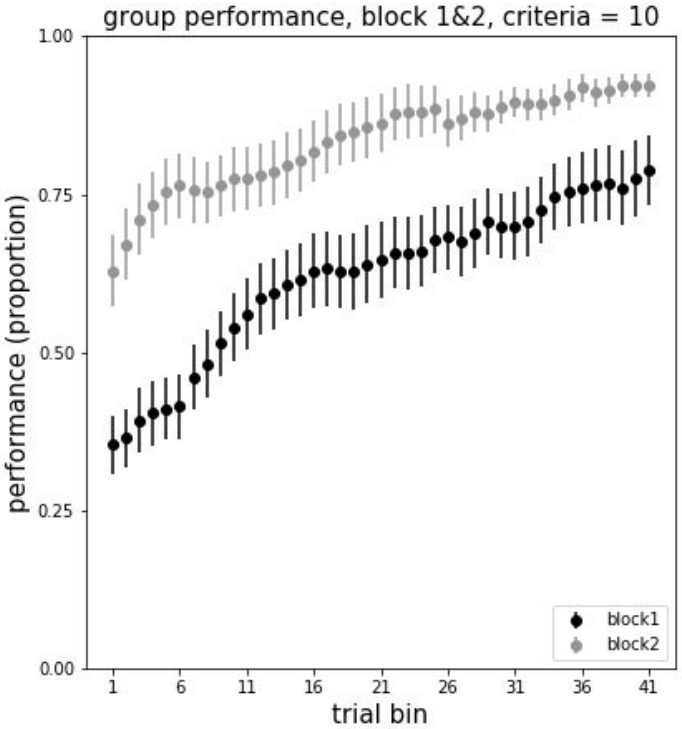
post decision point 2

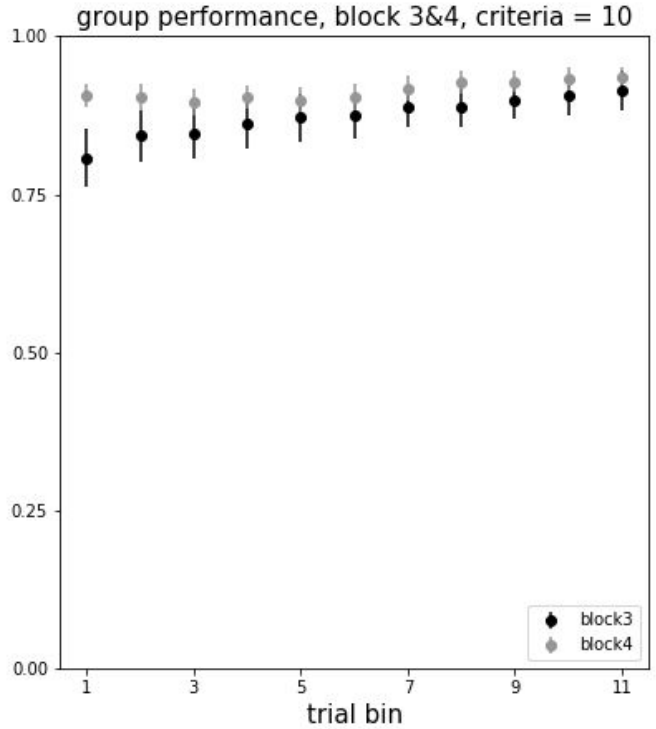


arm 2 only

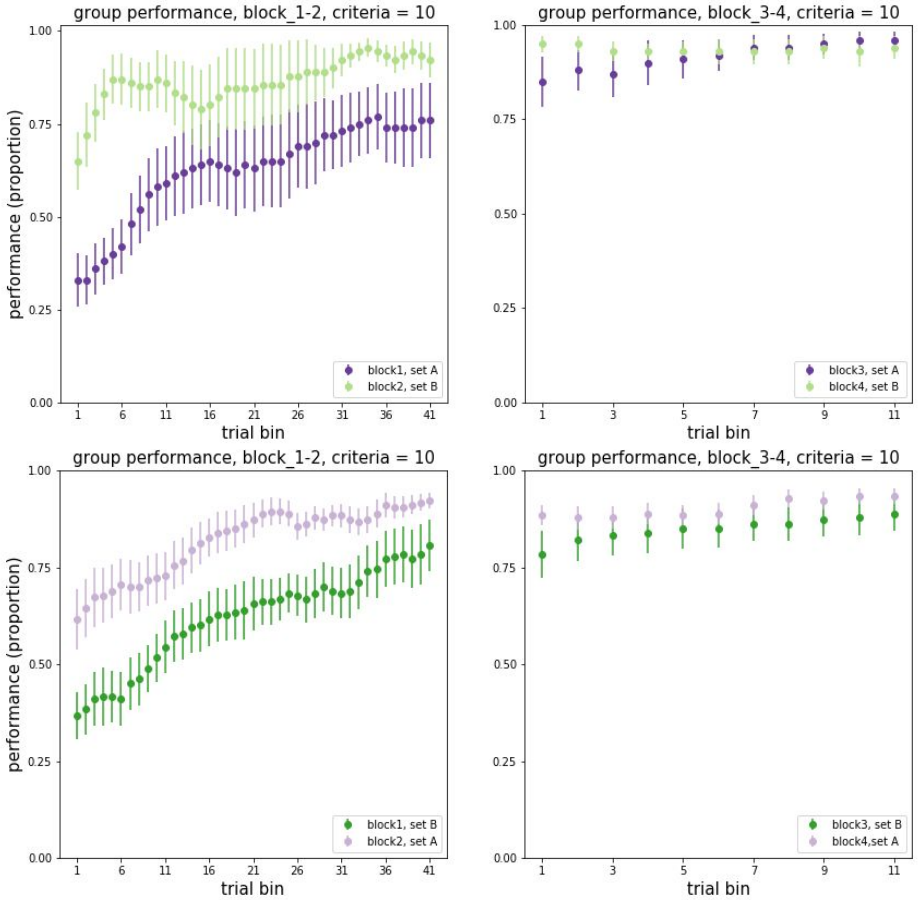


Increased learning performance in the later trials and blocks

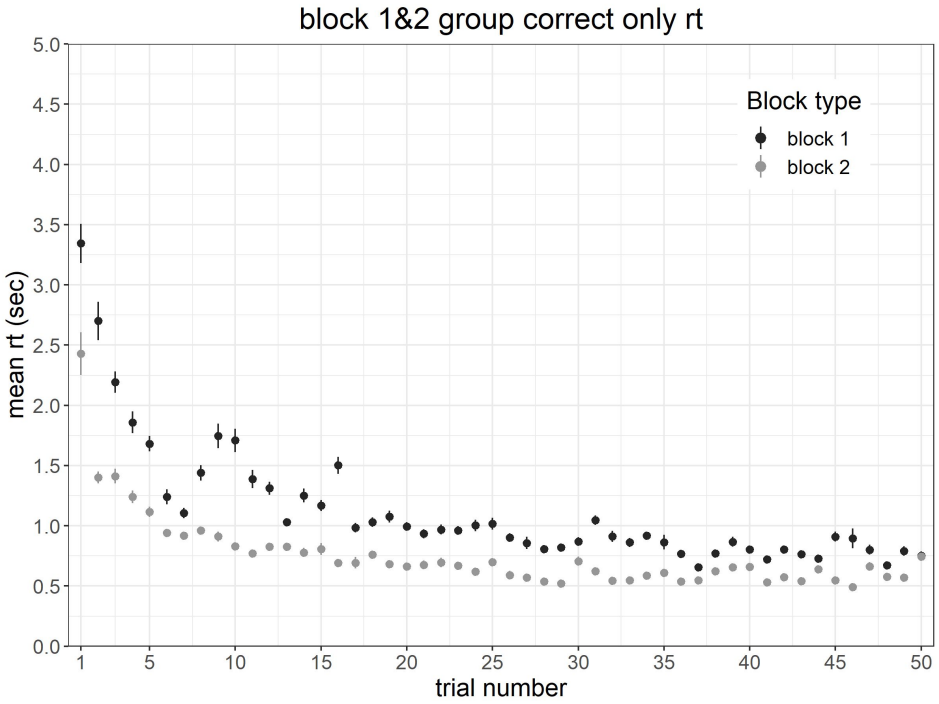


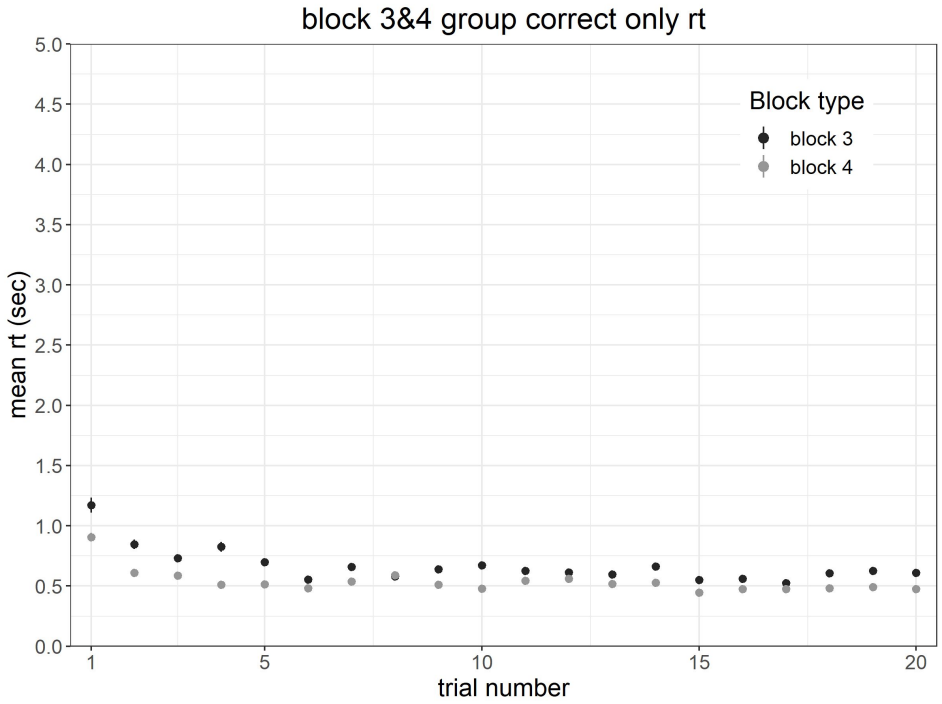


Increased learning performance for different image sets

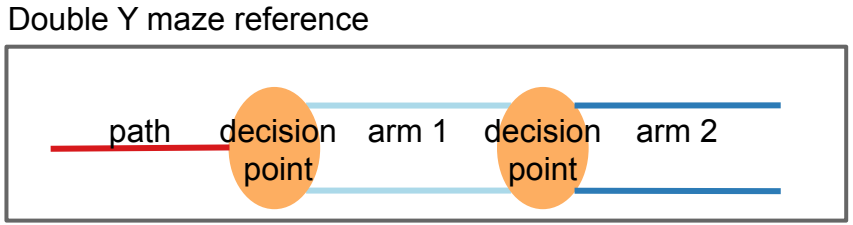


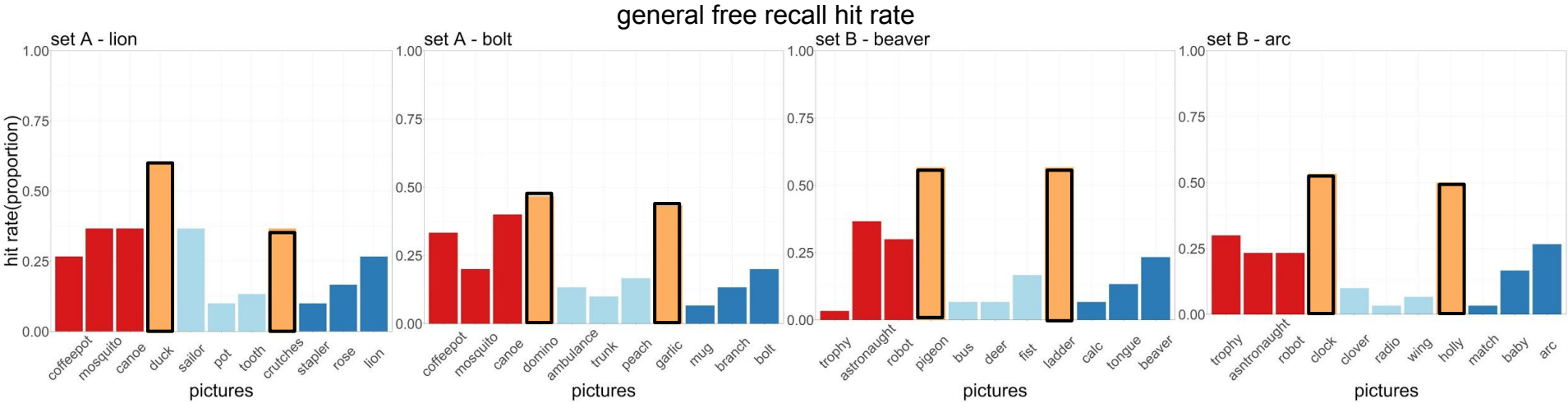
Faster response time with higher performance accuracy



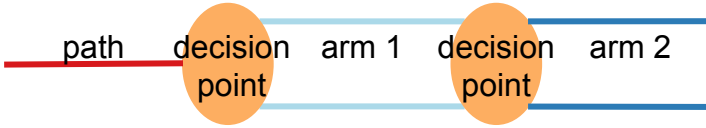


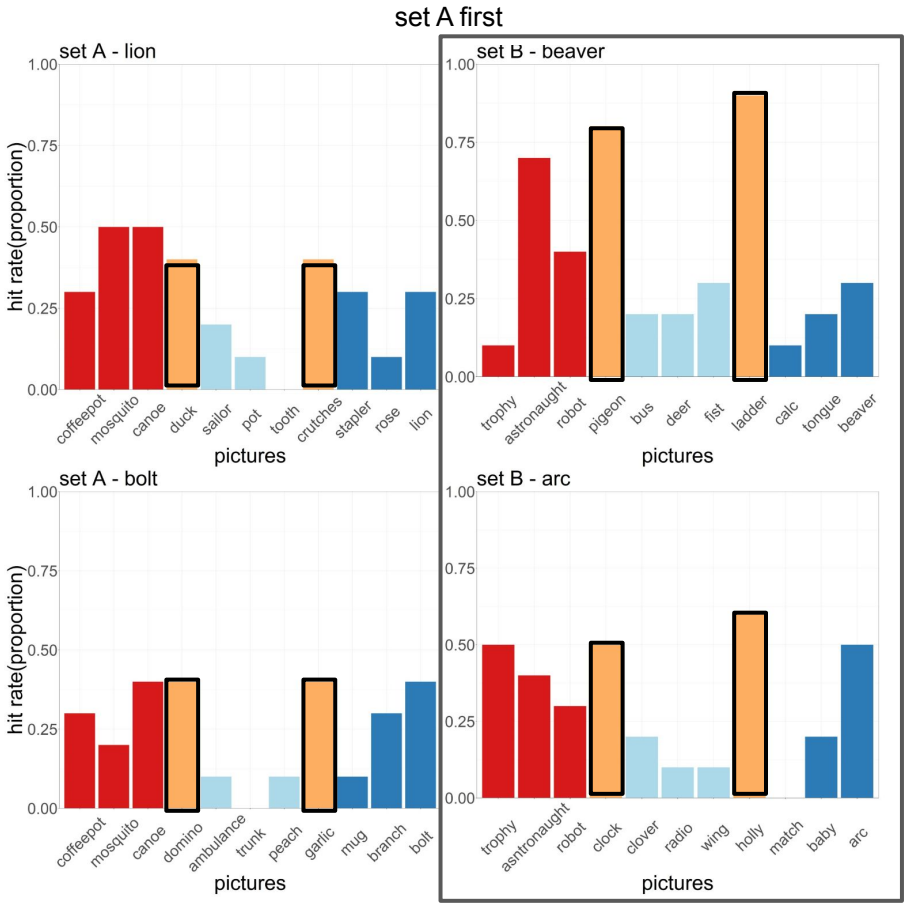
Long-term memory performance

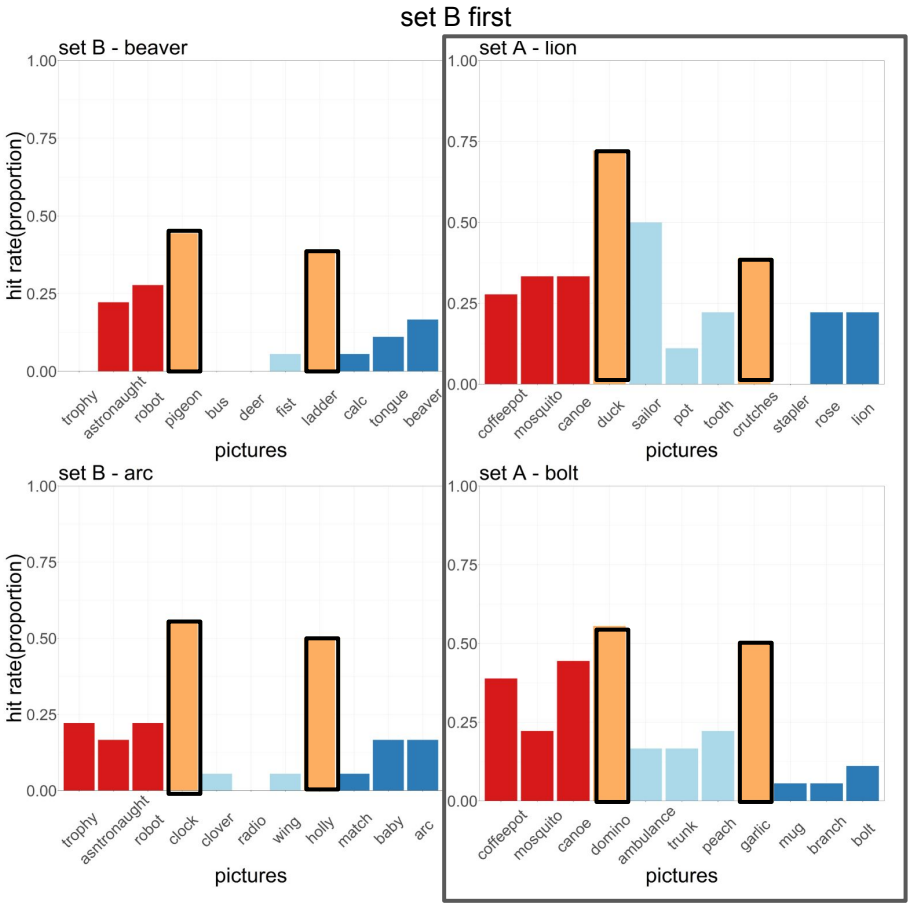




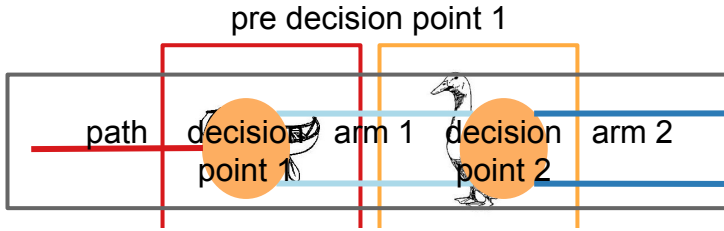
Higher free recall hit rate in later image set

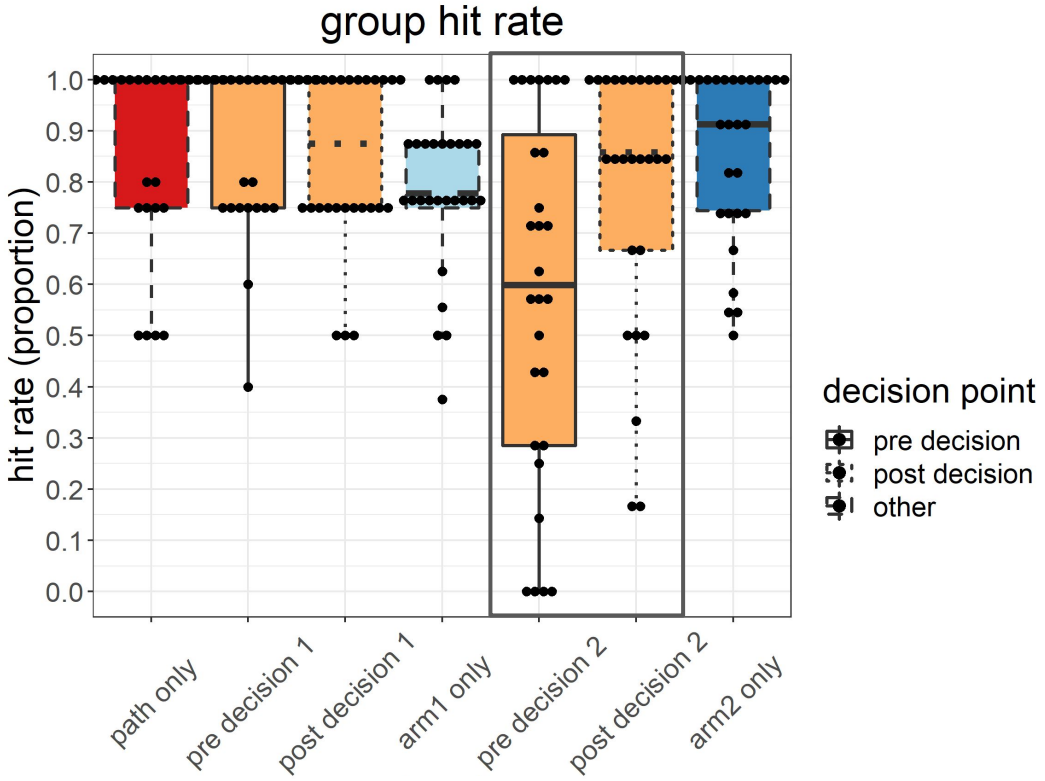


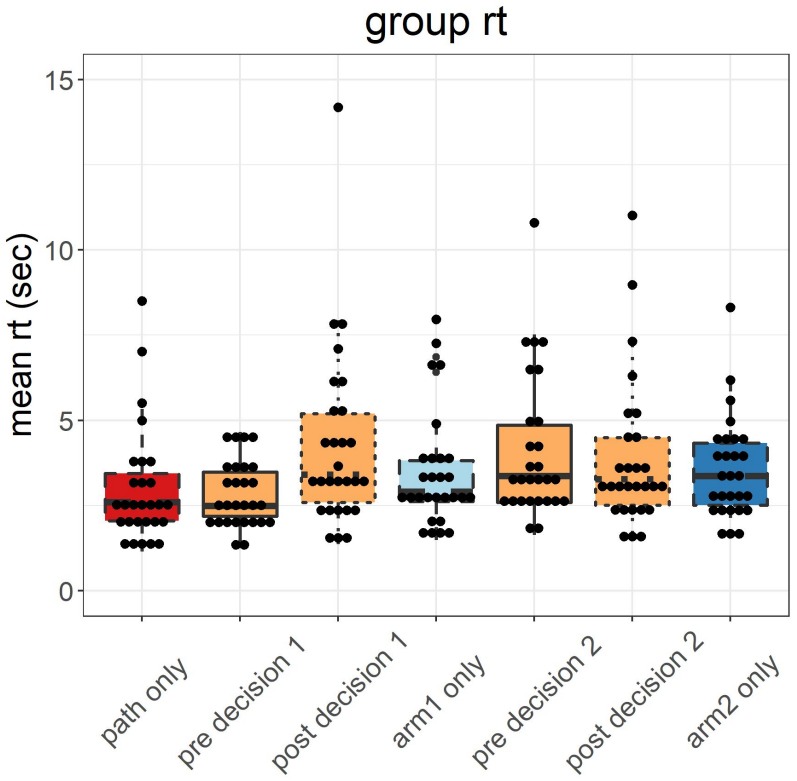




High hit rate variation with low rt variation



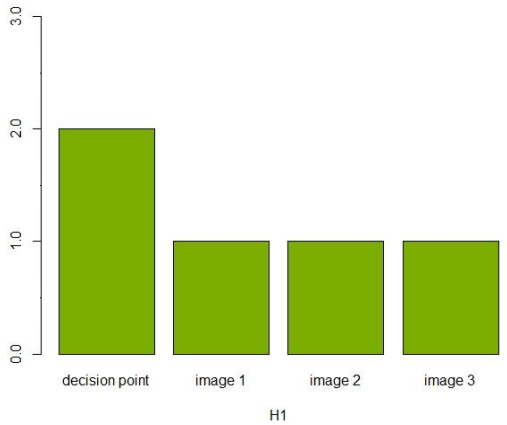




Memory Sequencing Templates

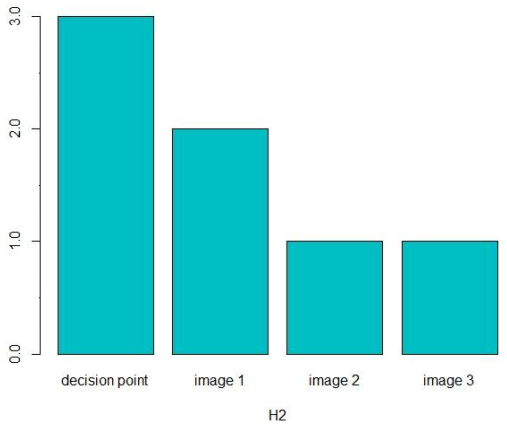
Hypothesis 1:

Participants treat decision points and all consecutive items as one sequence.



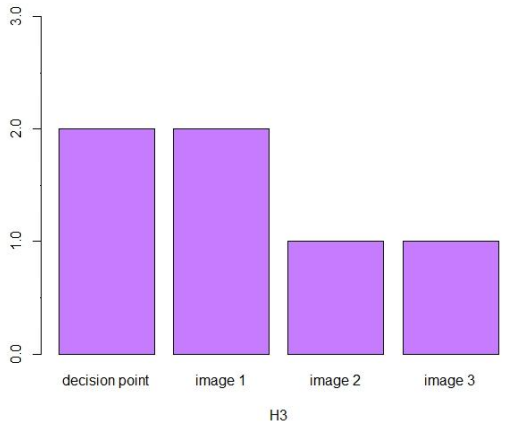
Hypothesis 2:

The consecutive items after decision point is an embedded sequence as part of a hierarchical sequence.

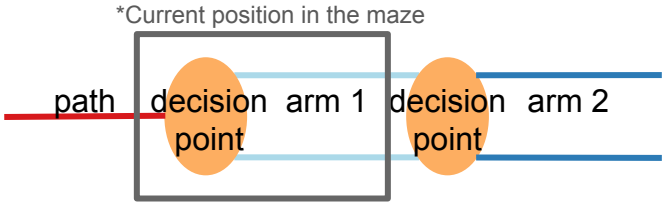


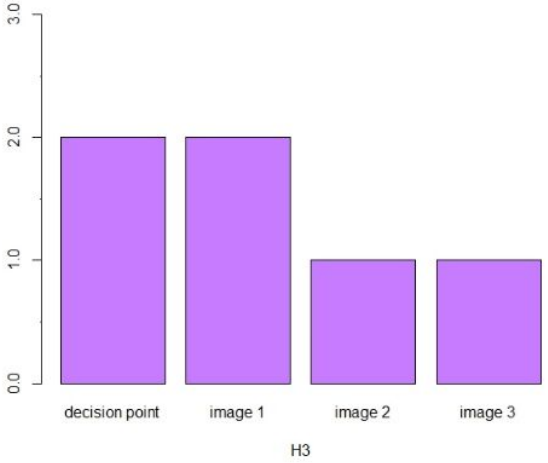
Hypothesis 3:

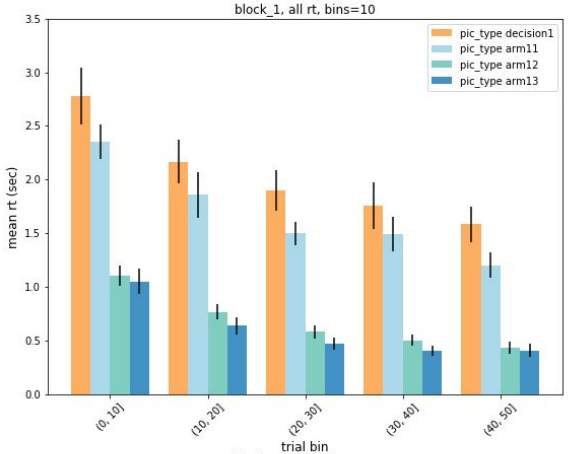
Participants treat the decision point as one segment, and the rest as another segment.

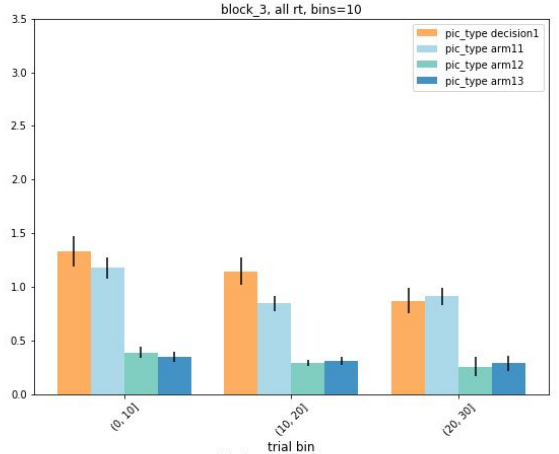


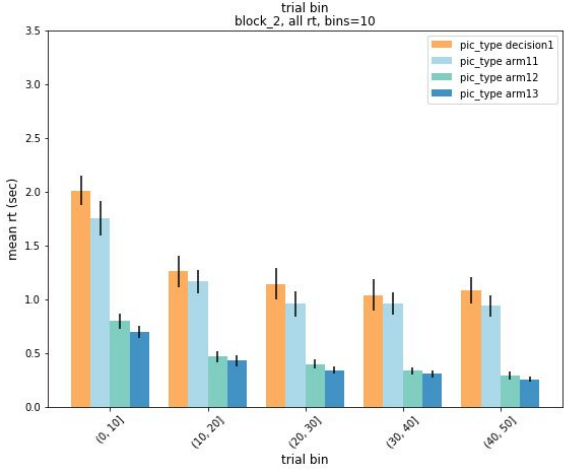
Decision point 1 sequence rt

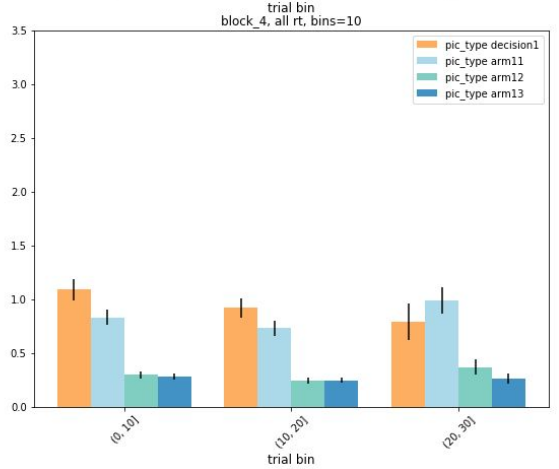




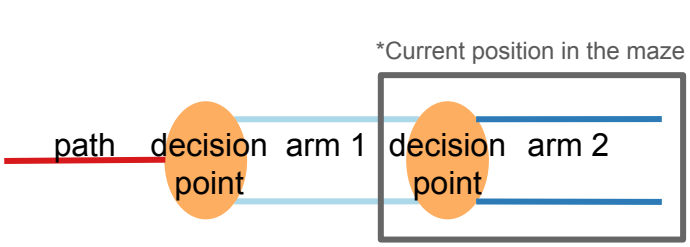


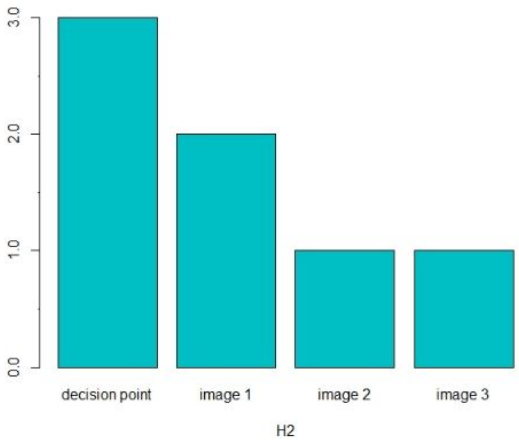


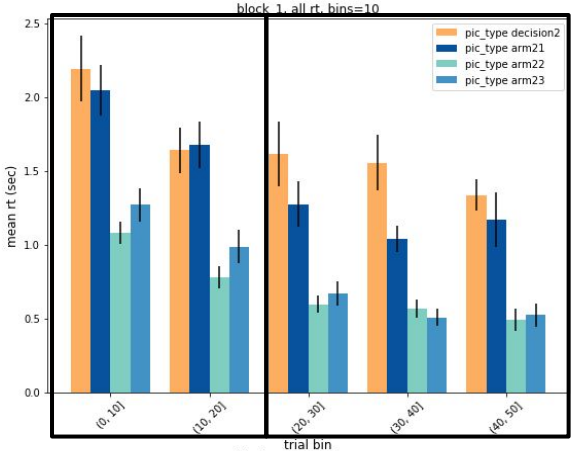


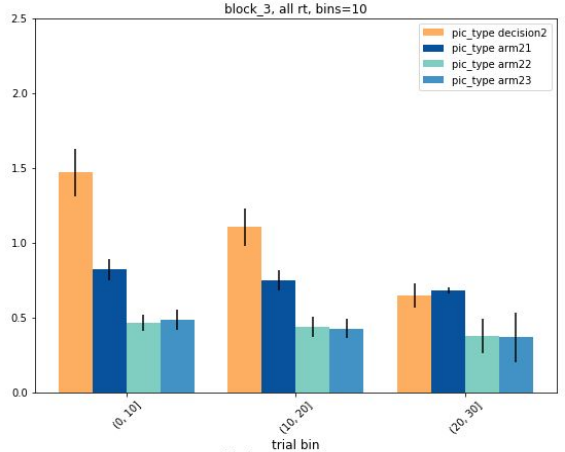


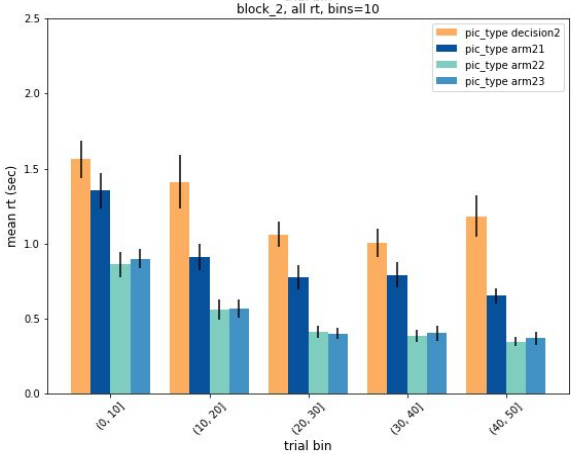
Decision point 2 sequence rt

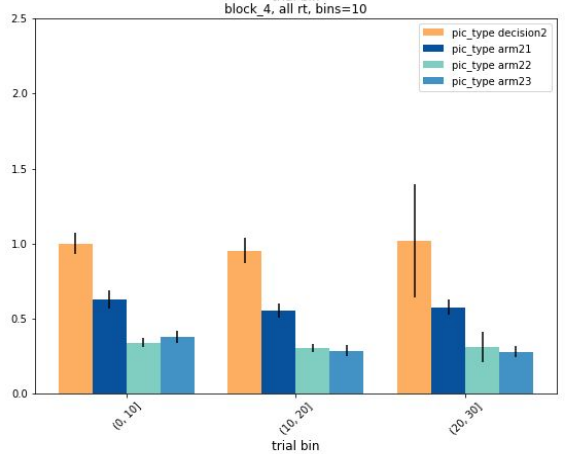




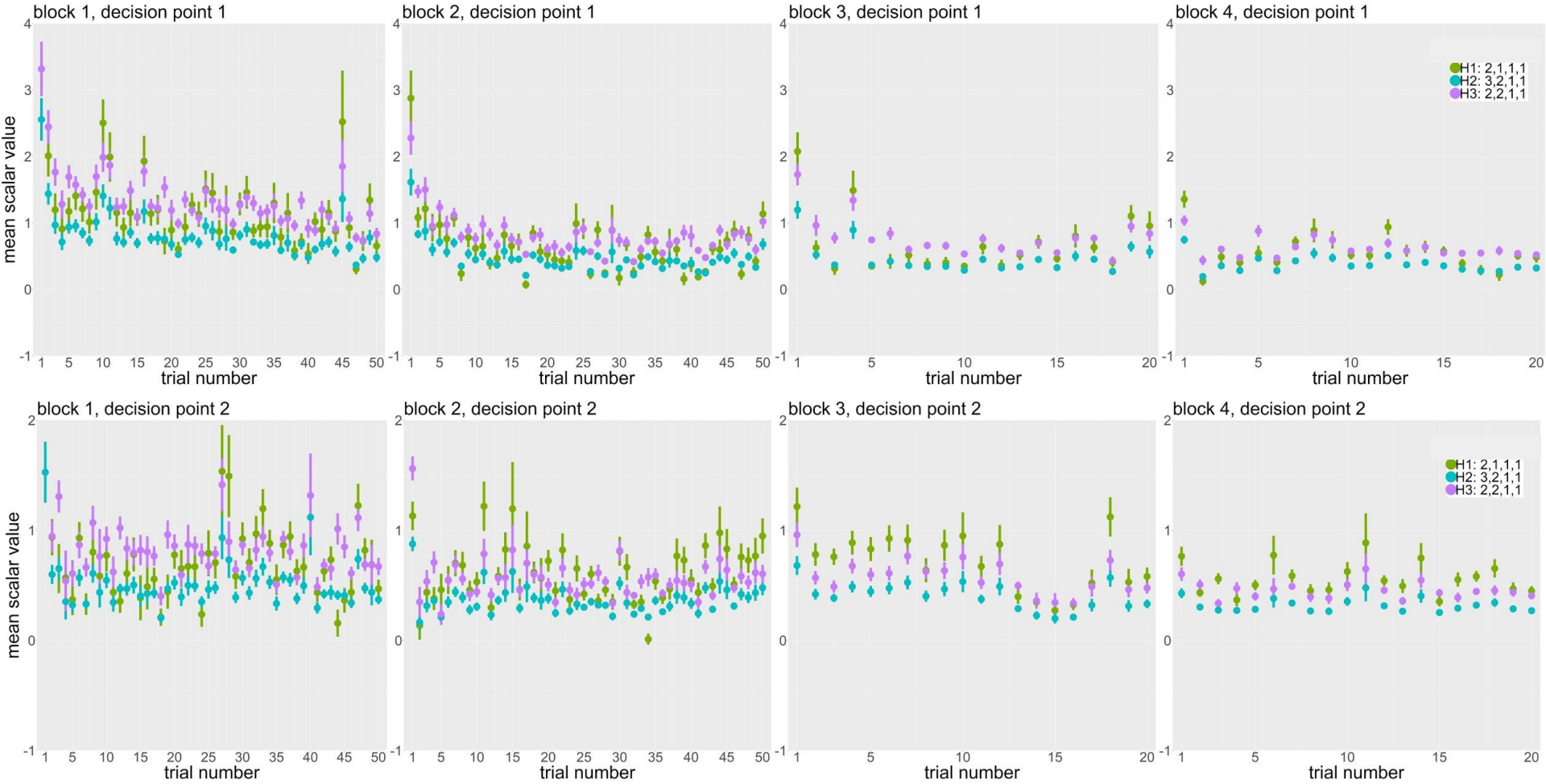




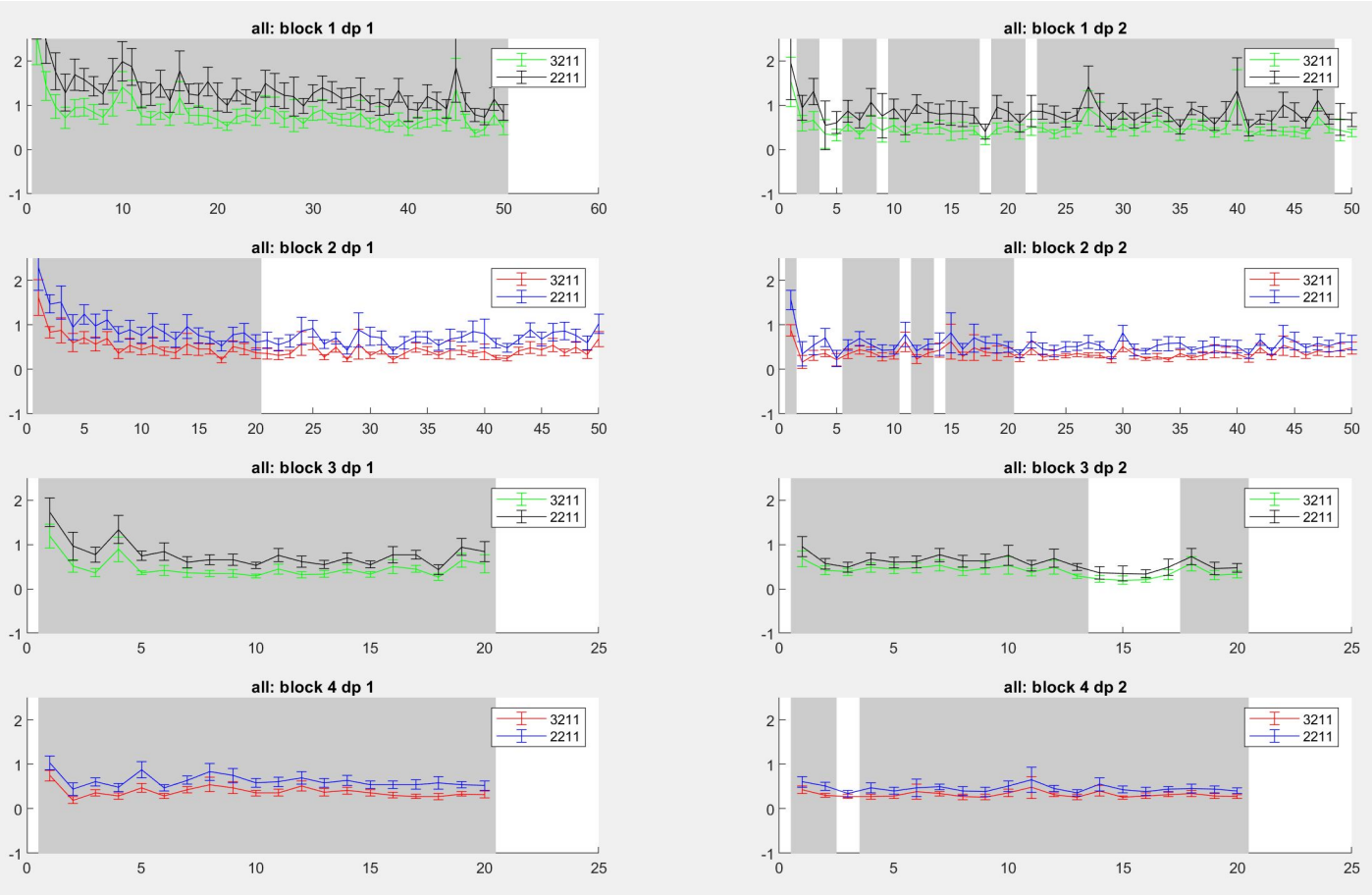




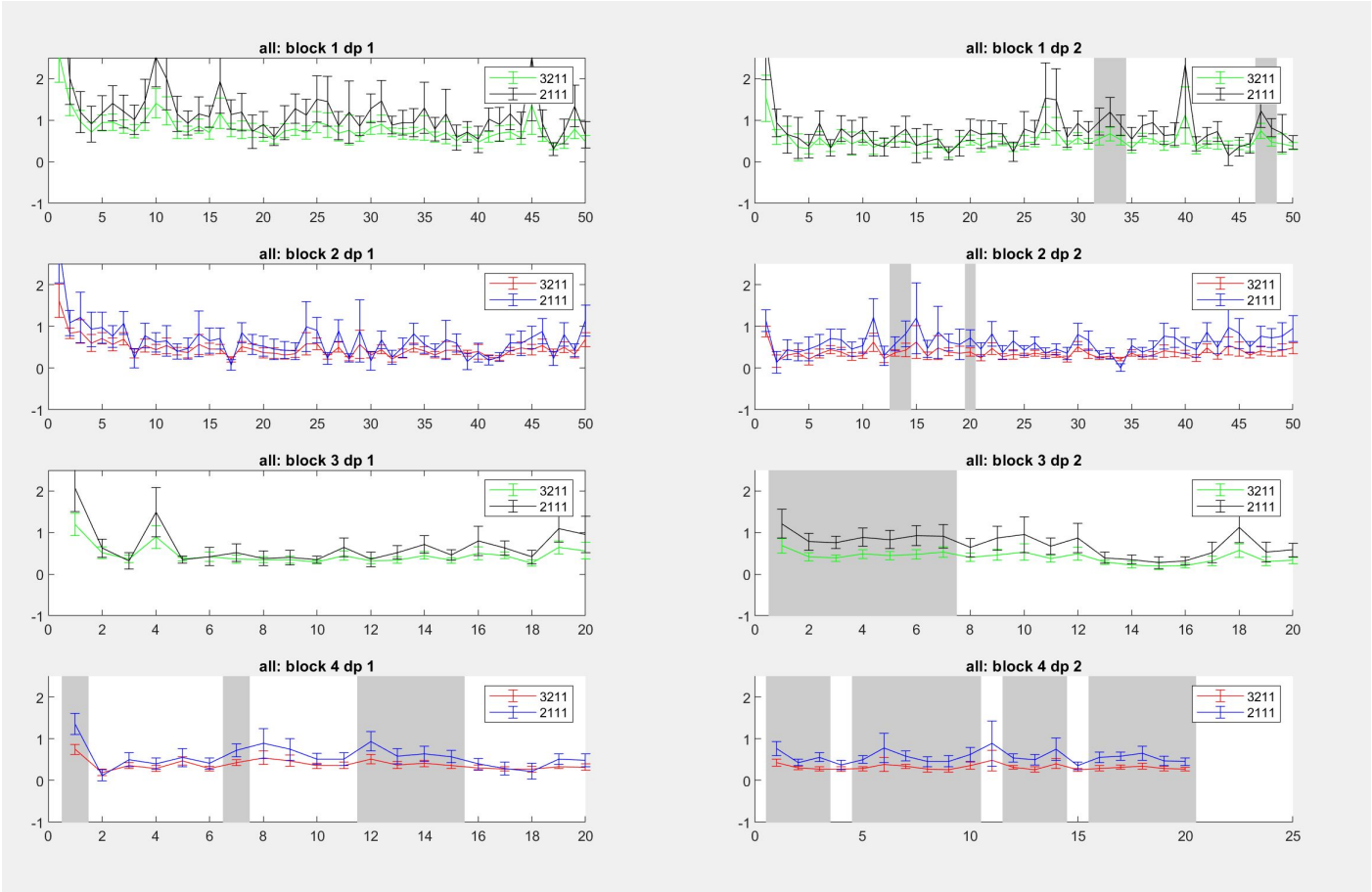
Averaged group scalar template fitting



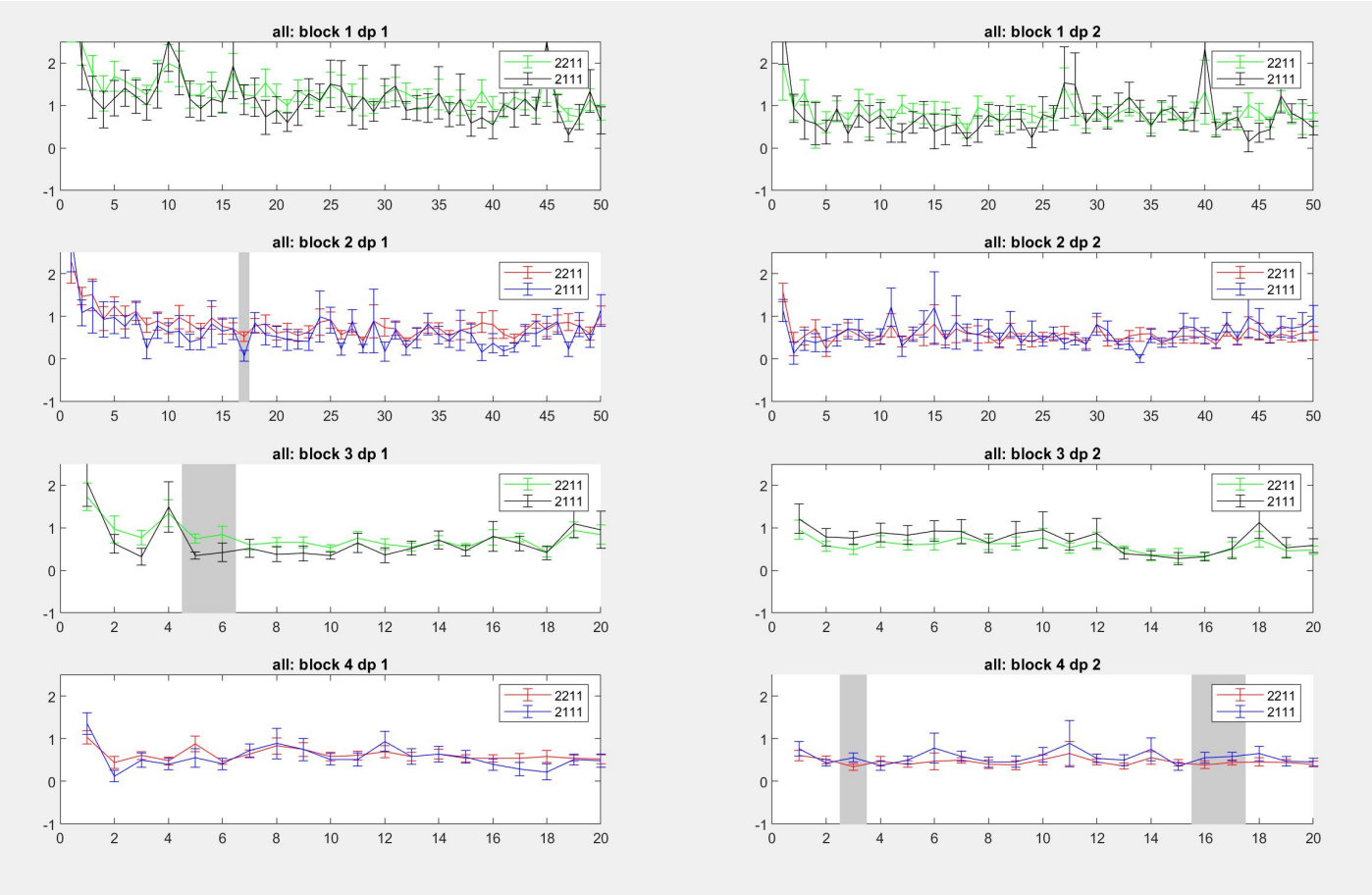
Cluster permutation test: H2 vs. H3



Cluster permutation test: H2 vs. H1



Cluster permutation test: H3 vs. H1

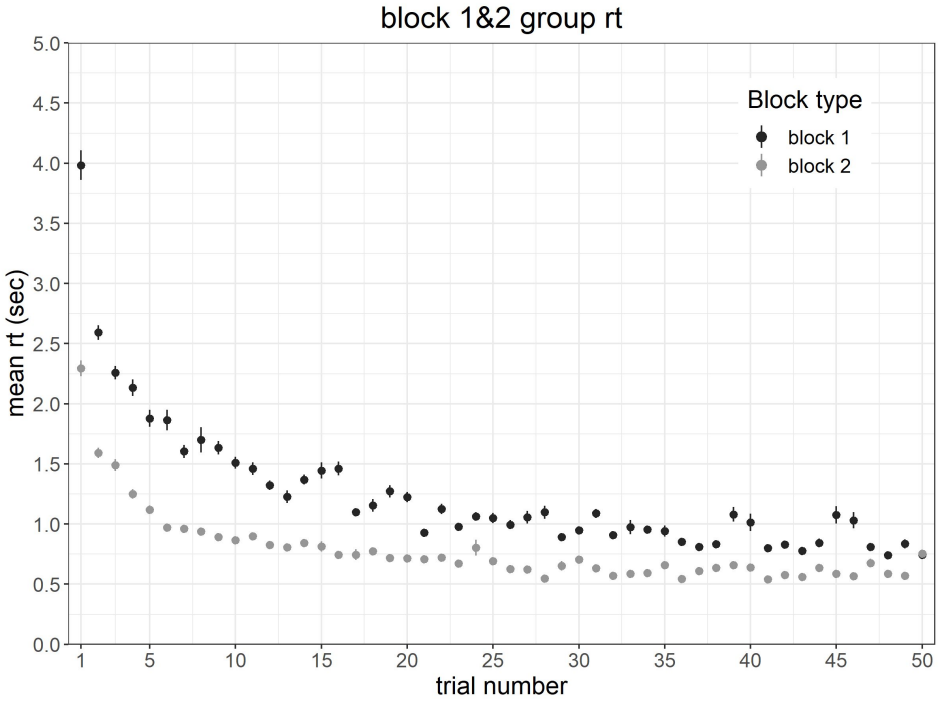


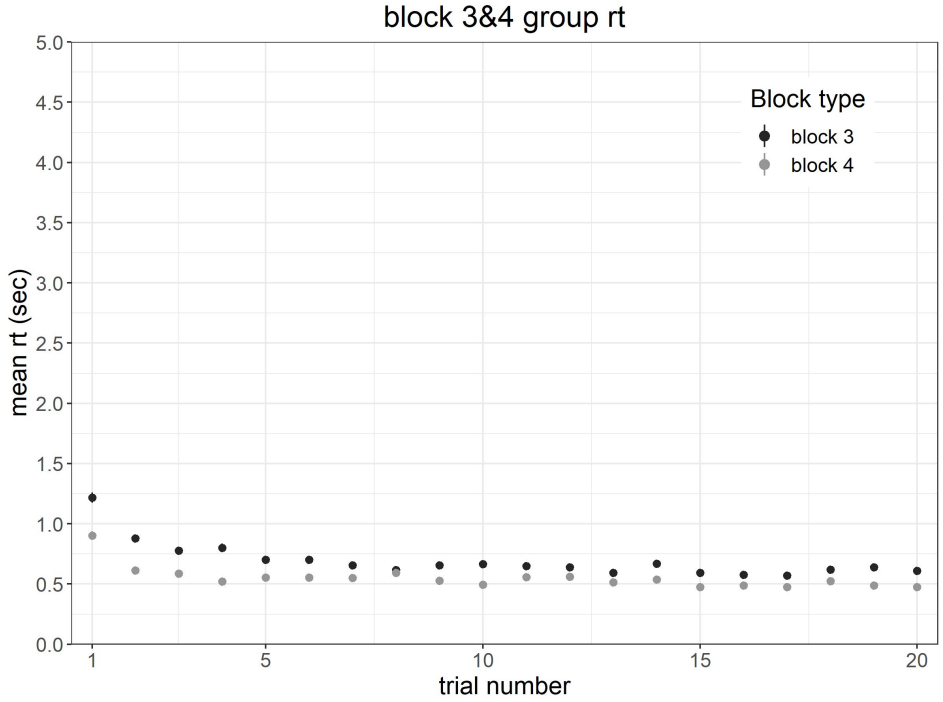
Conclusions

- Participants learned task’s structure
- The retrieval phase results suggest different mechanisms were used for remembering semantic judgements sequences and decision points
- Using reaction time as a template might not be the best way to predict temporal order memory sequencing

Thank you!

Faster reaction time towards the end of trials





Averaged correct only group scalar template fitting