

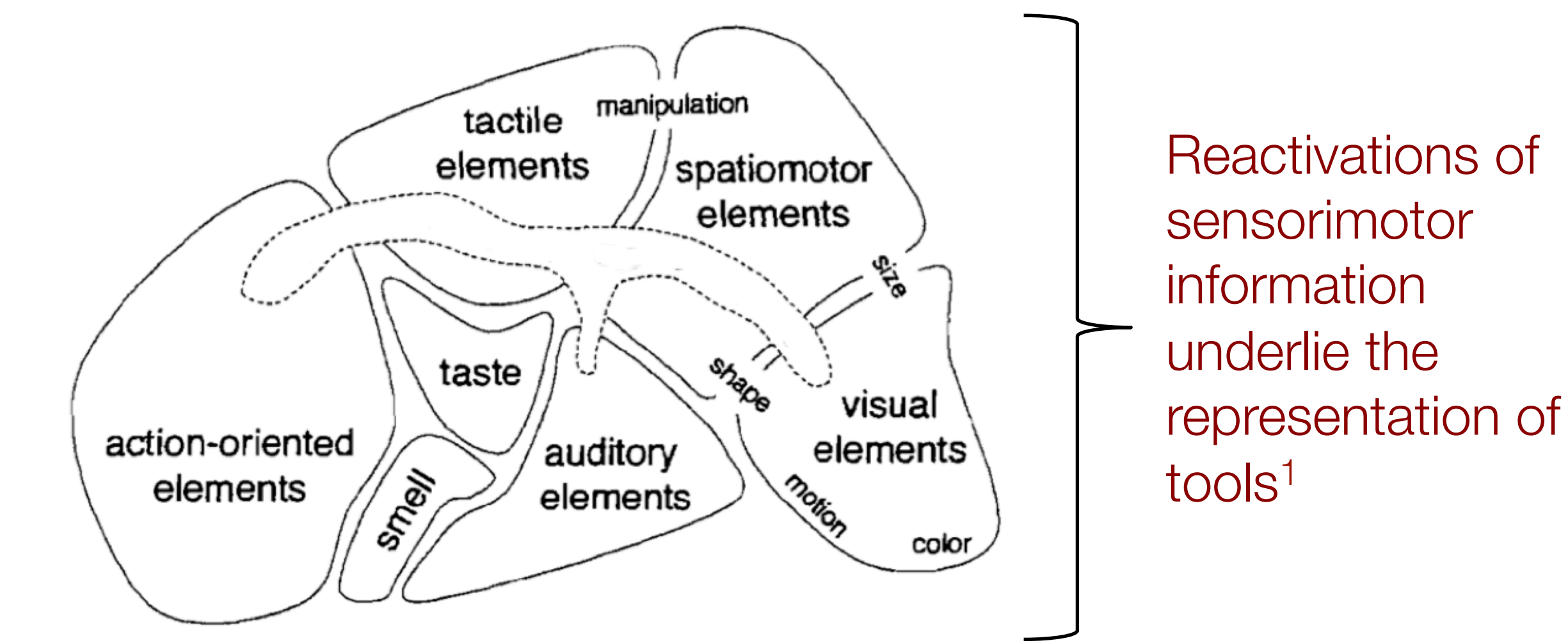
Becoming a Martian archeologist: A concurrent motor task affects conceptual judgments of learned tools

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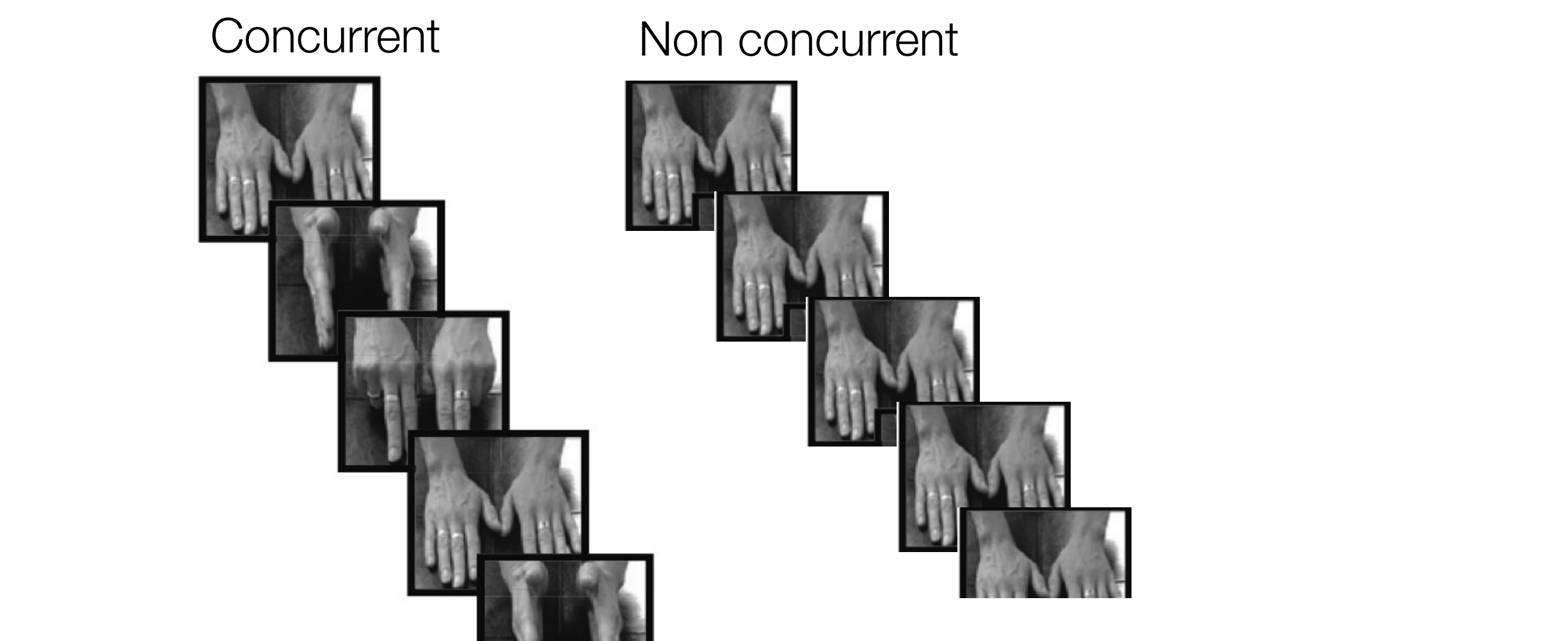
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Introduction

- Does motor experience influence object representations?
- Theories of embodied cognition propose that we recognize tools by reactivating sensorimotor representations of tool use.



- Consistent with this, performing a concurrent motor task affects conceptual judgments of tools, but not other objects.²



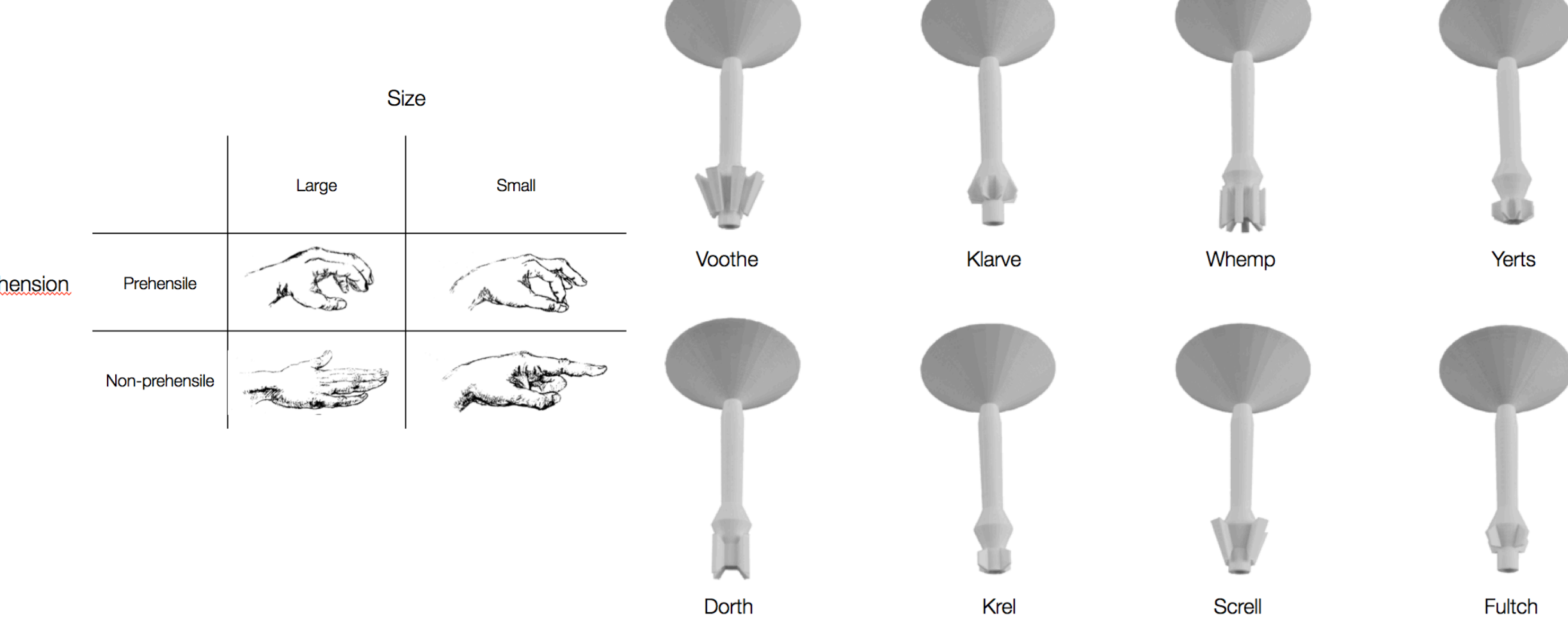
Slower to categorize object names Faster to categorize object names

- We sought to test the hypothesis that a concurrent motor task modulates conceptual processing of learned vs. non-learned objects by directly manipulating the embodied experience of participants.

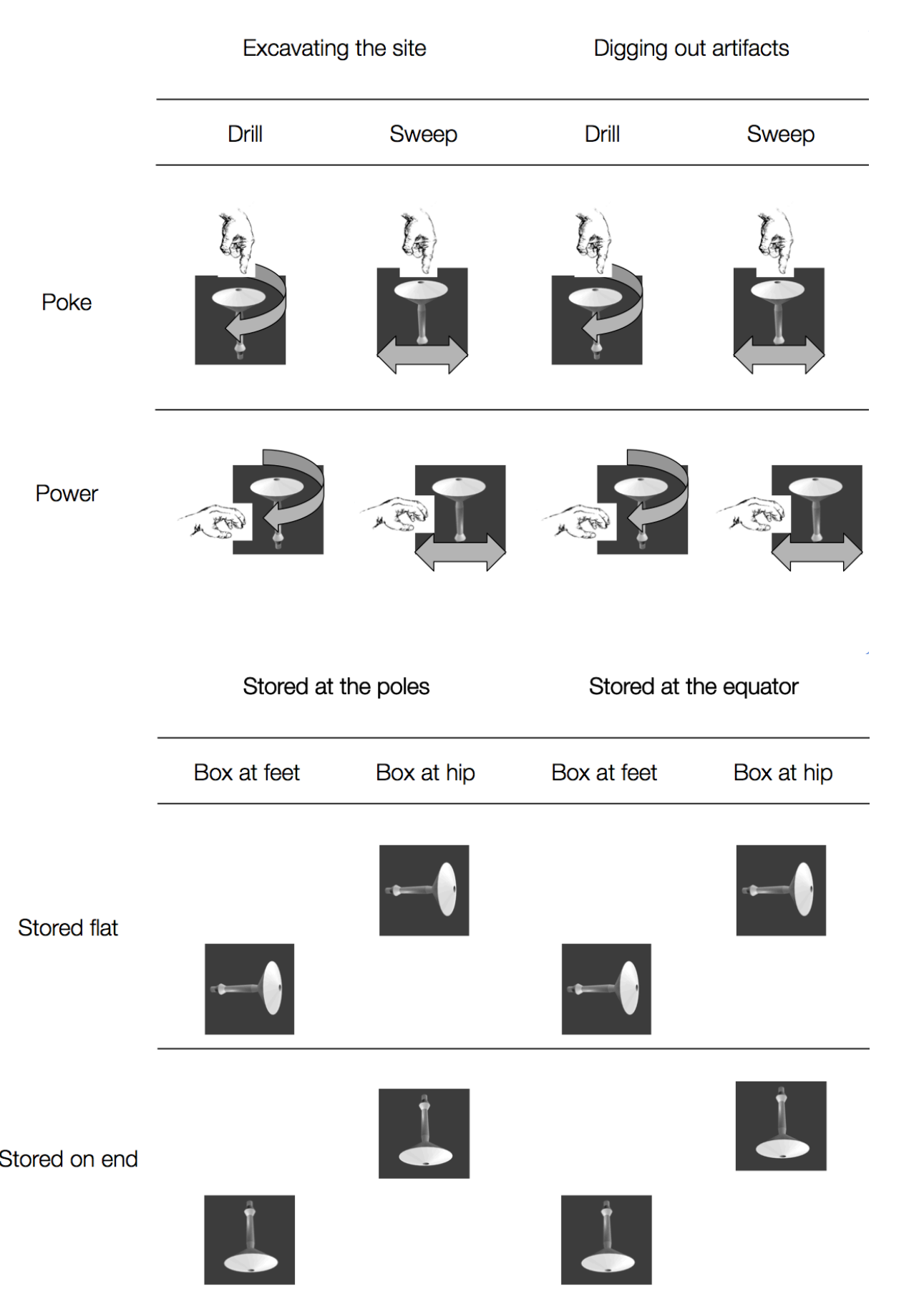
Methods

- Participants**
- 25 manipulation group; 24 spatial group
- Stimuli**

- For the manipulation group, functional goals, arm actions and hand postures³ were parametrically mapped onto 3-D printed tools; for the spatial group, environment, storage location, and tool placement were parametrically mapped.



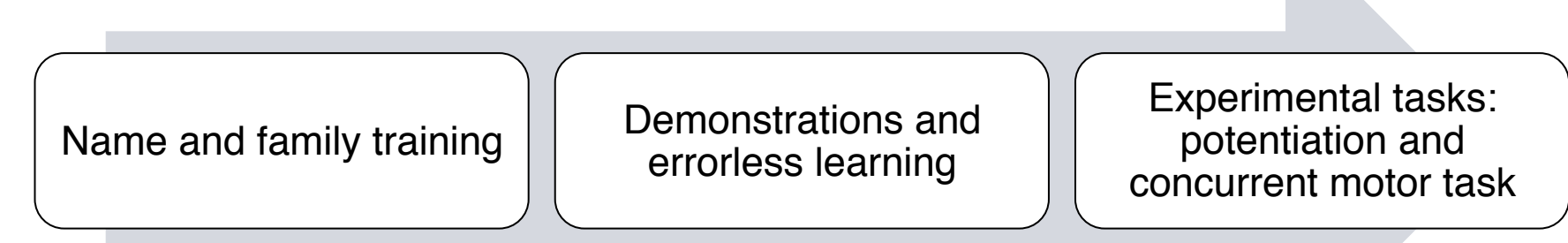
- Manipulation group: 2 (hand posture: prehensile vs. poke) X 2 (arm action: sweeping vs. drilling) X 2 (function: excavation vs. digging) factorial



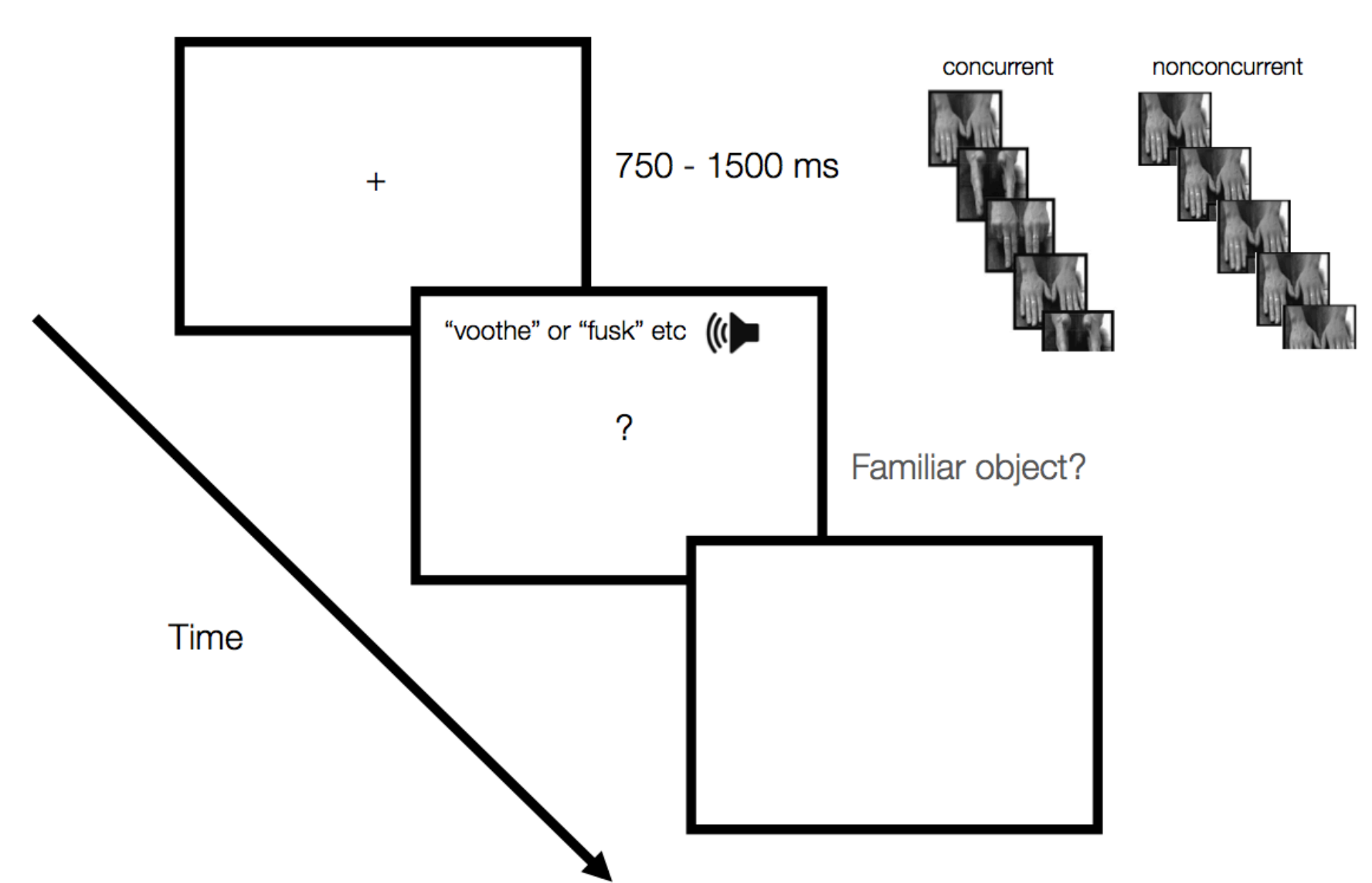
- Spatial group: 2 (tool placement: flat vs. on end) X 2 (storage location: box at hip vs. box at feet) X 2 (environment: poles vs. equator) factorial

Procedure

- On four separate days participants completed a series of training and experimental tasks:

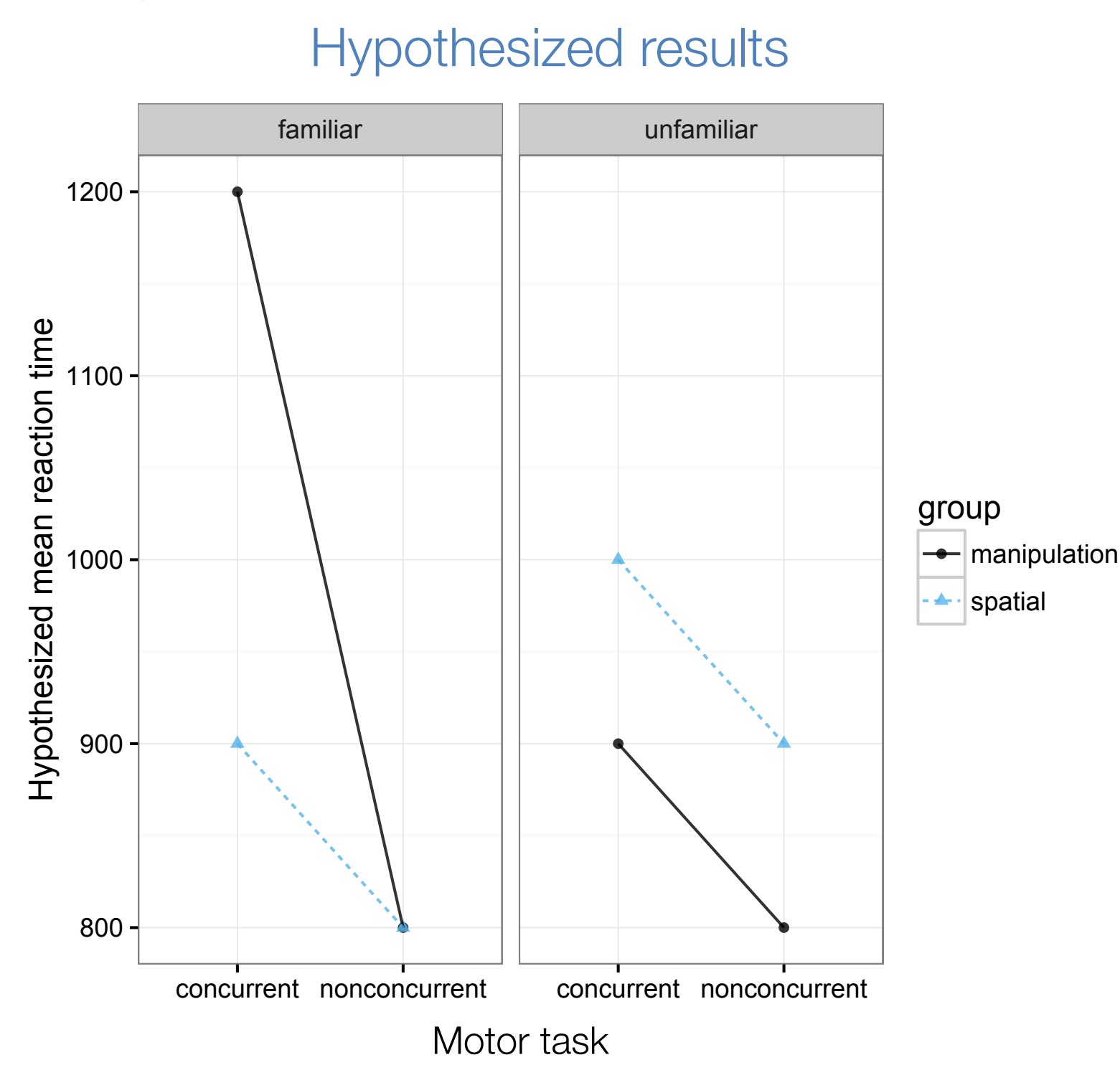


- Only data from the concurrent motor task are shown here. Task details:



Hypothesis

- A concurrent motor task should modulate conceptual judgments more for the manipulation group than the spatial group



Results and Discussion

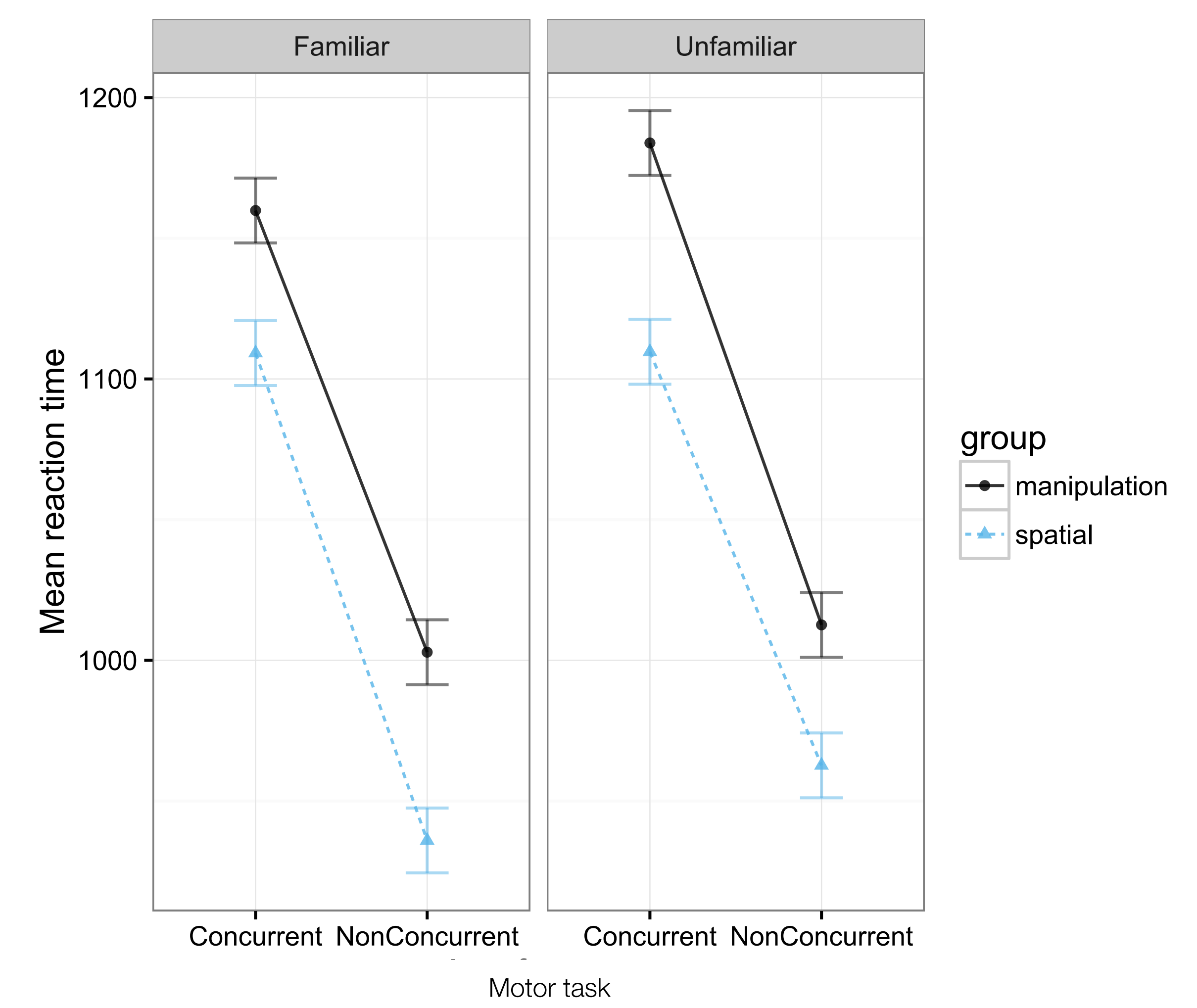


Figure 1. Mean reaction time as a function of the hypothesized group X interference X familiarity interaction. Error bars represent Fisher's Least Significant Difference.

- While a concurrent motor task impairs judgments in both groups, the interference effect is modulated by familiarity differently for each group. This suggests that motor information plays a different role for familiar vs. unfamiliar objects, and the effect of familiarity depends on how the objects were experienced.

Models

- Reaction time data (RT) were analyzed using linear mixed effects models (LME)⁴. Variables of interest were: group (manipulation vs. spatial), interference (concurrent vs. non concurrent) and familiarity (familiar objects vs. unfamiliar objects). The model selection procedure is summarized in table 1.

Model	DF	AIC	BIC	likelihood	deviance	Chi ²	DF	p
1. RT~ Task * Interference + (1 Subject)	4	213470	213500	-106731	213462			
2. RT~ Group * Interference + (1 Subject)	6	213472	213518	-106730	213460	1.46	2	<.48
*3. RT~ Familiarity * Group * Interference + (1 Subject)	10	213464	213540	-106722	213444	16.69	4	.002

- Model selection using AIC and ChiSquared test reveals model 3 as the best fitting model which includes the three way interaction.
- For simplicity, we plot the effect of familiarity (familiar minus unfamiliar) in figure 2.

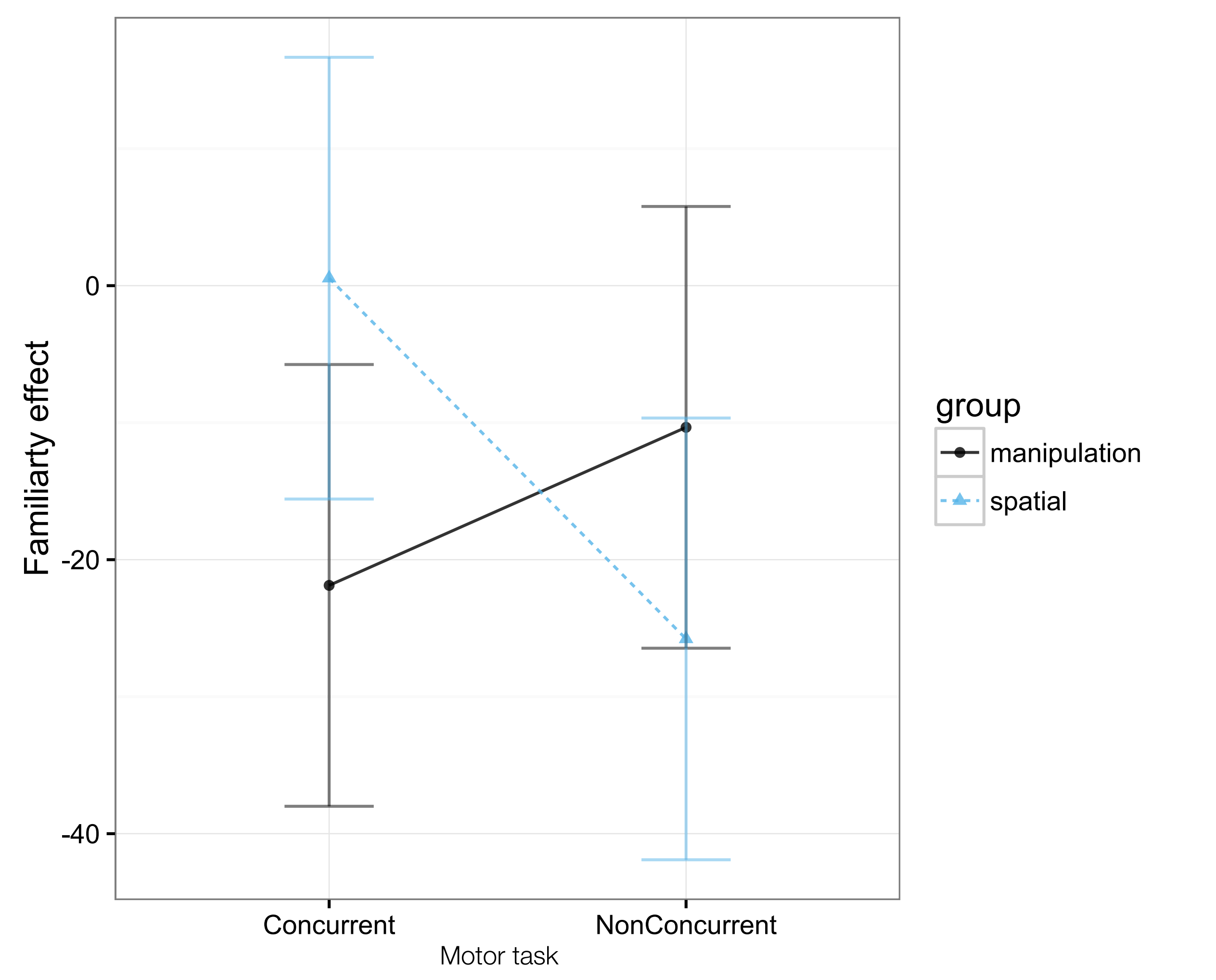


Figure 2. Mean familiarity effect (familiar minus unfamiliar) as a function of the group X interference interaction. Error bars represent Fisher's Least Significant Difference.

- A concurrent motor task facilitated judgments about familiar objects for the manipulation group (i.e. a larger familiarity effect).
- A concurrent motor task impaired judgments about familiar objects for the spatial group (i.e. a smaller familiarity effect).
- The spatial group showed faster judgments for familiar objects when they were not performing a concurrent motor task.

Conclusion

- A concurrent motor task affected conceptual judgments of learned tools, but did so differently for a group that learned about them through manipulation experience.
- We provide evidence that a concurrent motor task can facilitate familiarity judgments in the manipulation group
- While our results do not support a radical embodied hypothesis, they do suggest that motor representations play a different functional role in supporting conceptual judgments in a group that experienced tools through manipulation.

References

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