



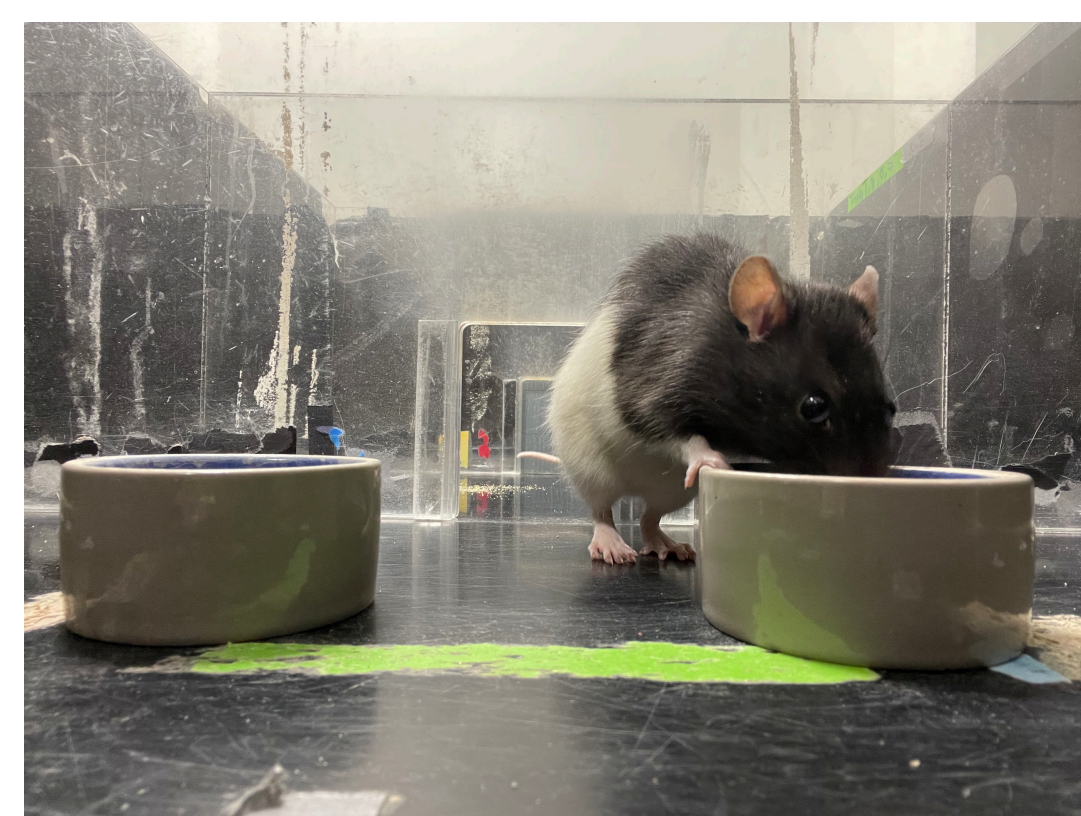
# Transitive Inference in Rats

Jose A. Pena, Laura G. Betances, Yamilet Nieves, Victoria L. Templer

Department of Psychology, Providence College, Providence, RI

The aim of this study was to determine if rats use transitive inference (TI) to respond to novel items in a list (e.g., B>D) based on inferred order of a list learned through premise pair training (A>B, B>C, C>D, D>E). Selecting one item over another on non-differentially reinforced within-list probe tests (e.g., B>D) can be based on inferred relationships between stimuli and/or based on associative values derived from reinforcement history.

List 1: A>B>C>D>E  
List 2: F>G>H>I>J

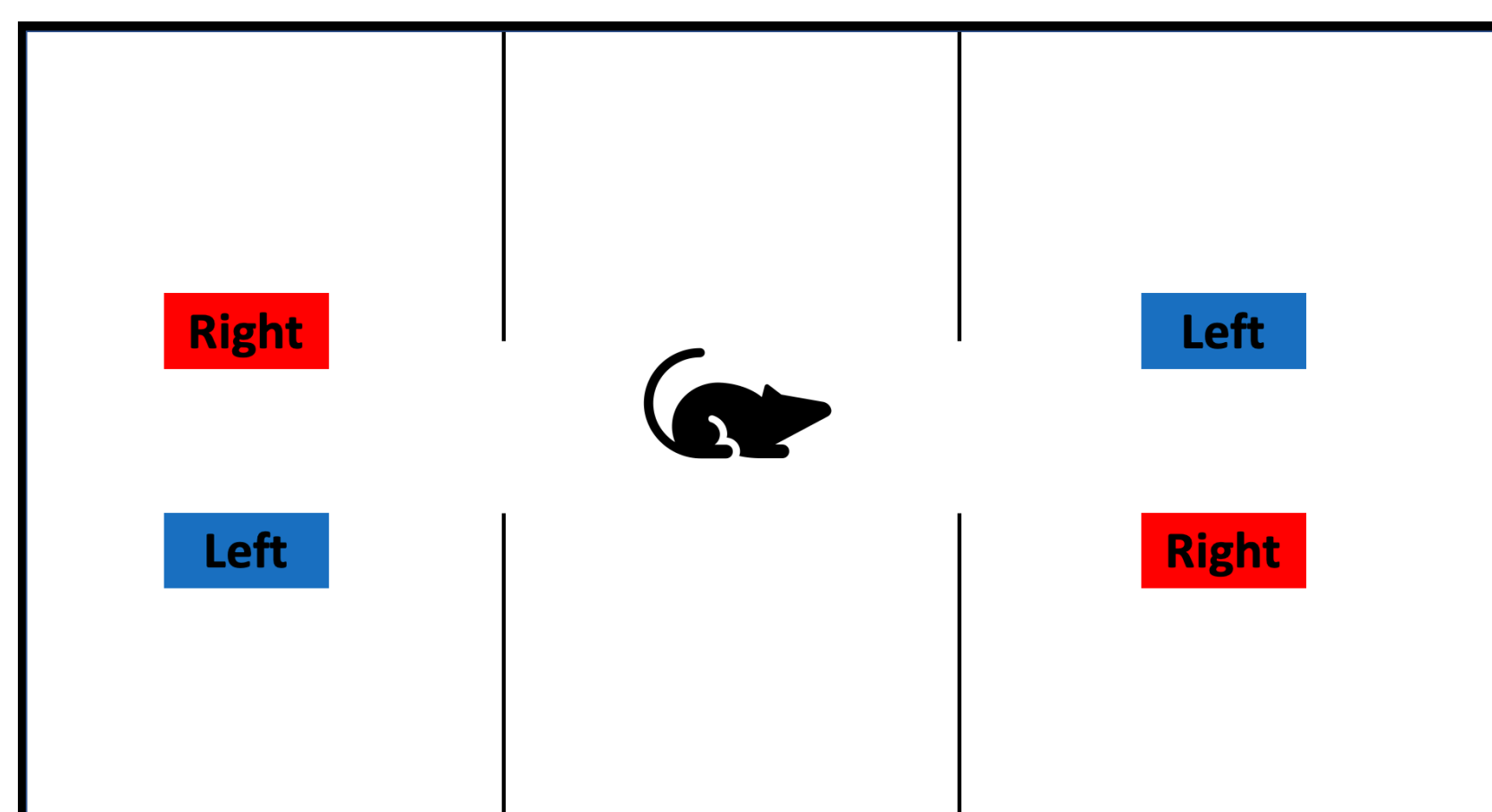


A(Thyme), B(Paprika), C(Cumin), D(Ginger), E(Parsley)  
F(Cinnamon), G(Basil), H(Cocoa), I(Onion), J(Oregano)

## Primary List: Non-Spatial Arrangement with Alternating Sides

Counterbalancing testing apparatus side afforded less habitual, automatic responses, and side-biases. The criterion for premise pair training was 80% accuracy.

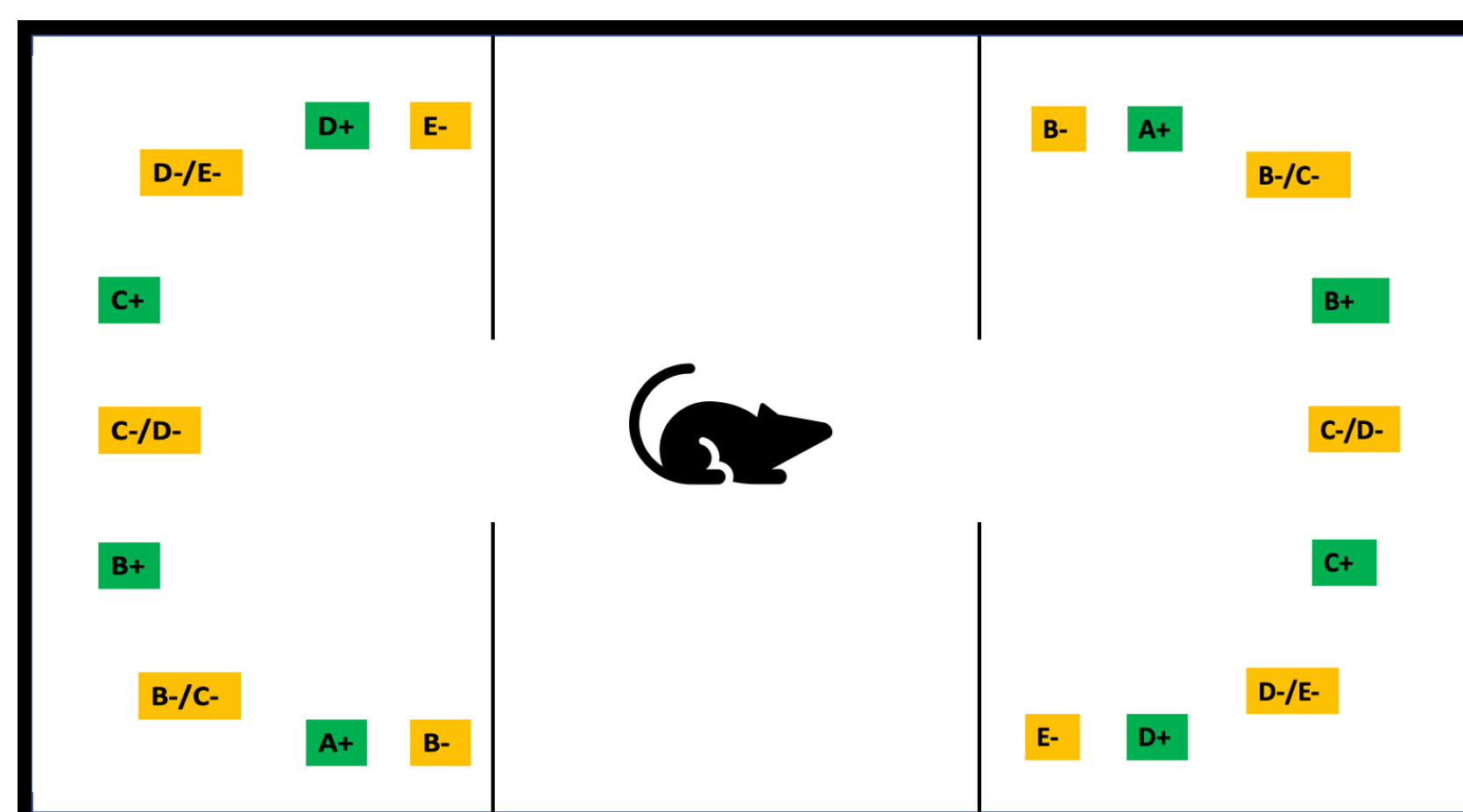
N=10  
Average # of sessions until criterion: M= 97, SD=17  
# of trials per premise pair session: 8  
# of trials per probe test session: 12



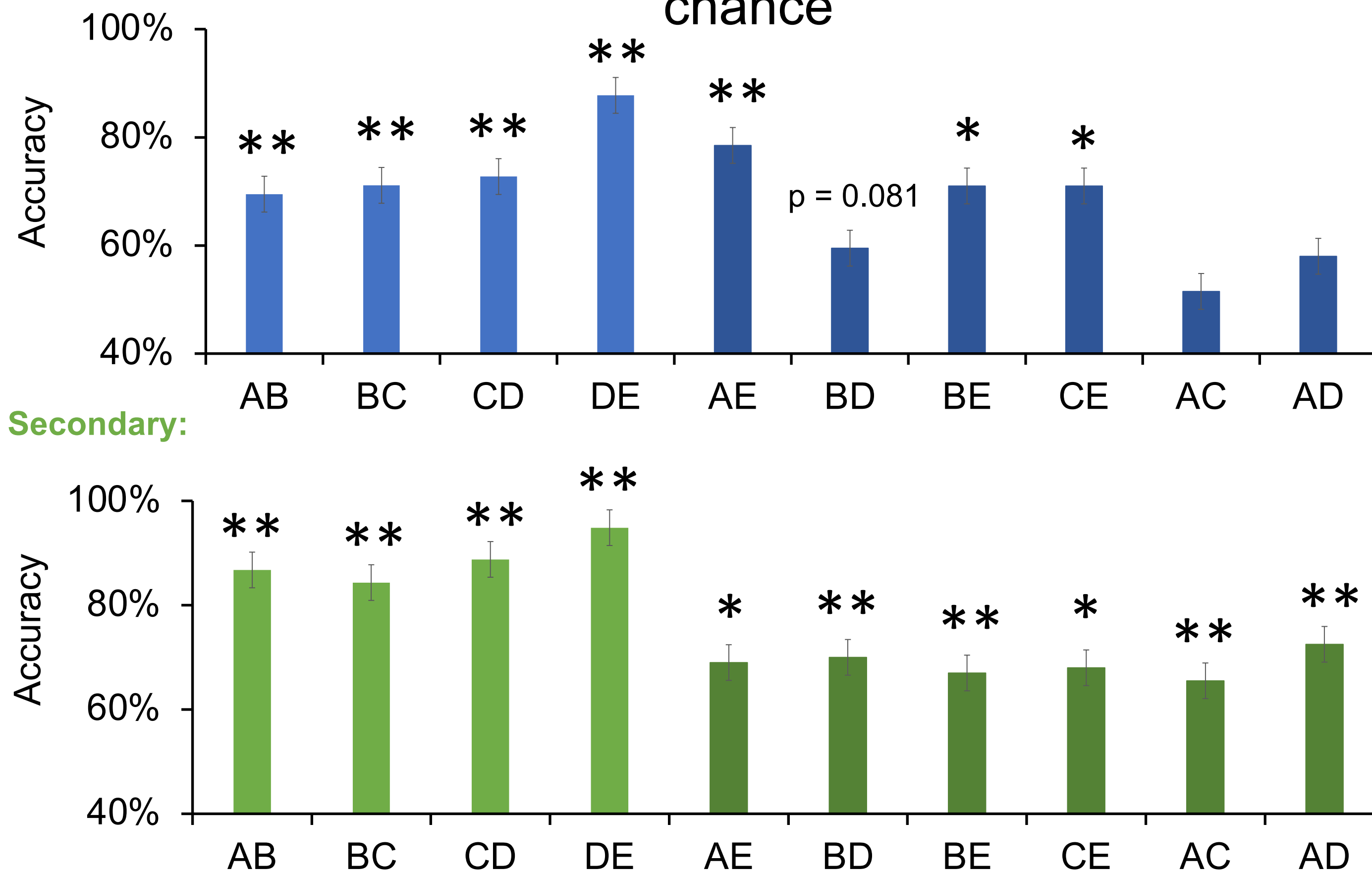
## Secondary List: Spatial Arrangement

Previous research suggests a common magnitude system underlies representation of order and space and that spatial training can increase speed of acquisition of inferred lists (Roberts and Phelps, 1994; Gazes, Templer, Lazareva, 2023). Spatial trials were performed until the subject reached 80% accuracy on two blocks. Non-spatial re-criterion trials followed until the subject reached a criterion of 80% correct on two consecutive blocks. All non-adjacent probe tests (e.g. AE) presented non-spatially.

N=10  
Average # of sessions until spatial criterion: M= 26, SD= 11  
Average # of sessions of re-criterion: M=17, SD=6



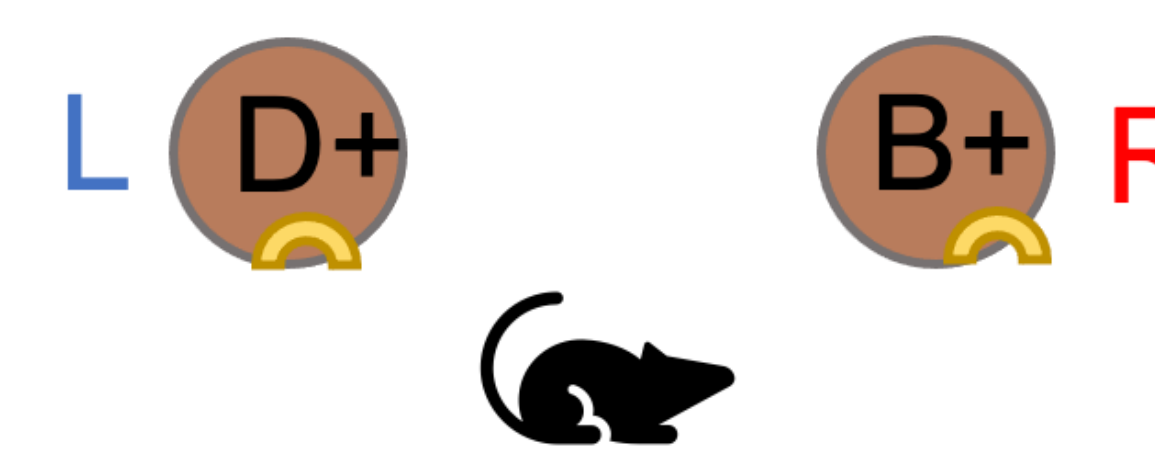
Randomized within-list probes in secondary list (spatial) were all performed significantly above chance



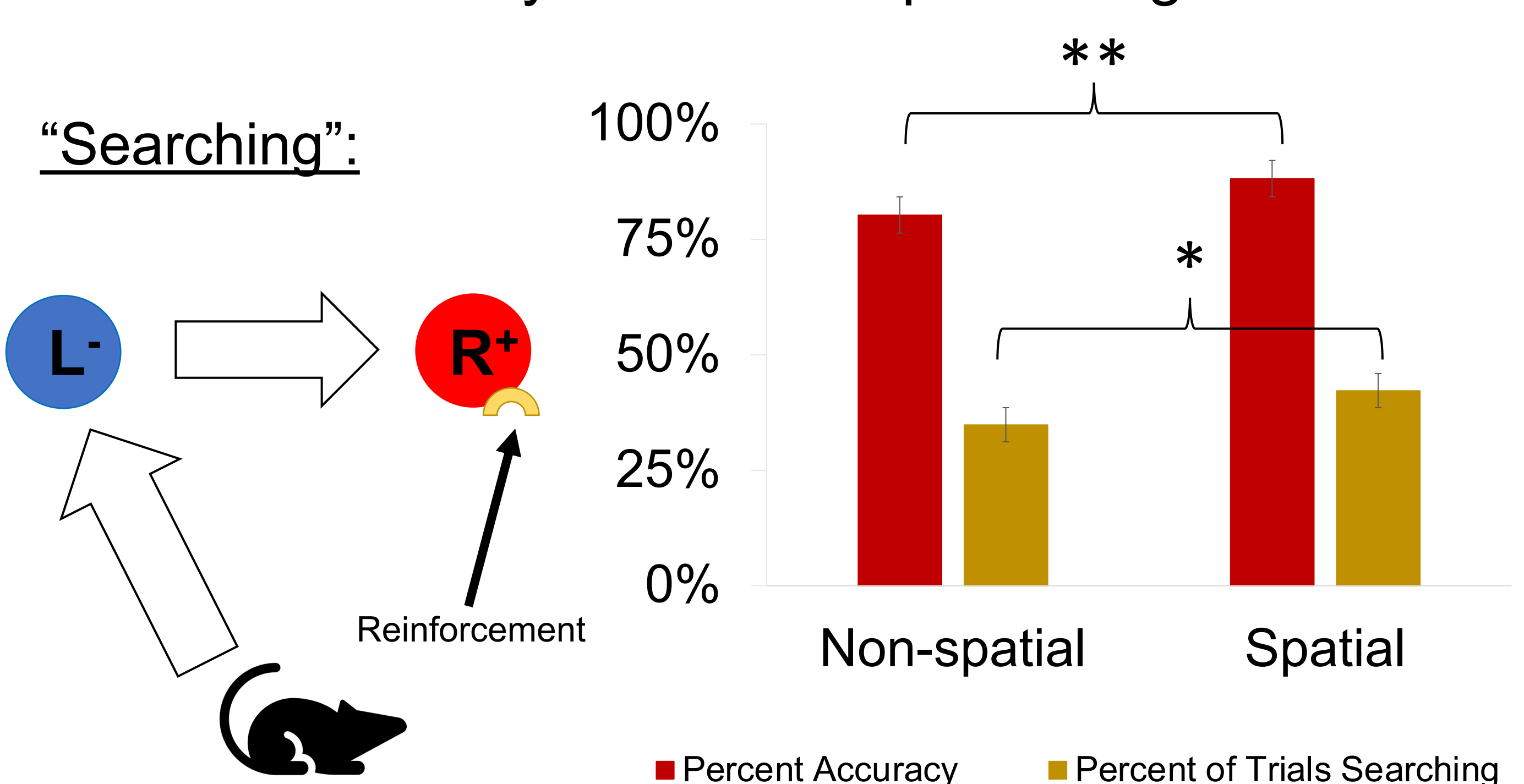
Pair D+E- had the highest accuracy of all premise pairs. This finding aligns with the results from Wynne (1995). \* p<0.05, \*\* p<0.001, one-sample t-tests (N=10).

## All probe tests were non-spatial & non-differentially reinforced:

B>D is a critical nonadjacent test pair because the stimuli are not end-anchors. Choice of B>D is associated with use of TI.



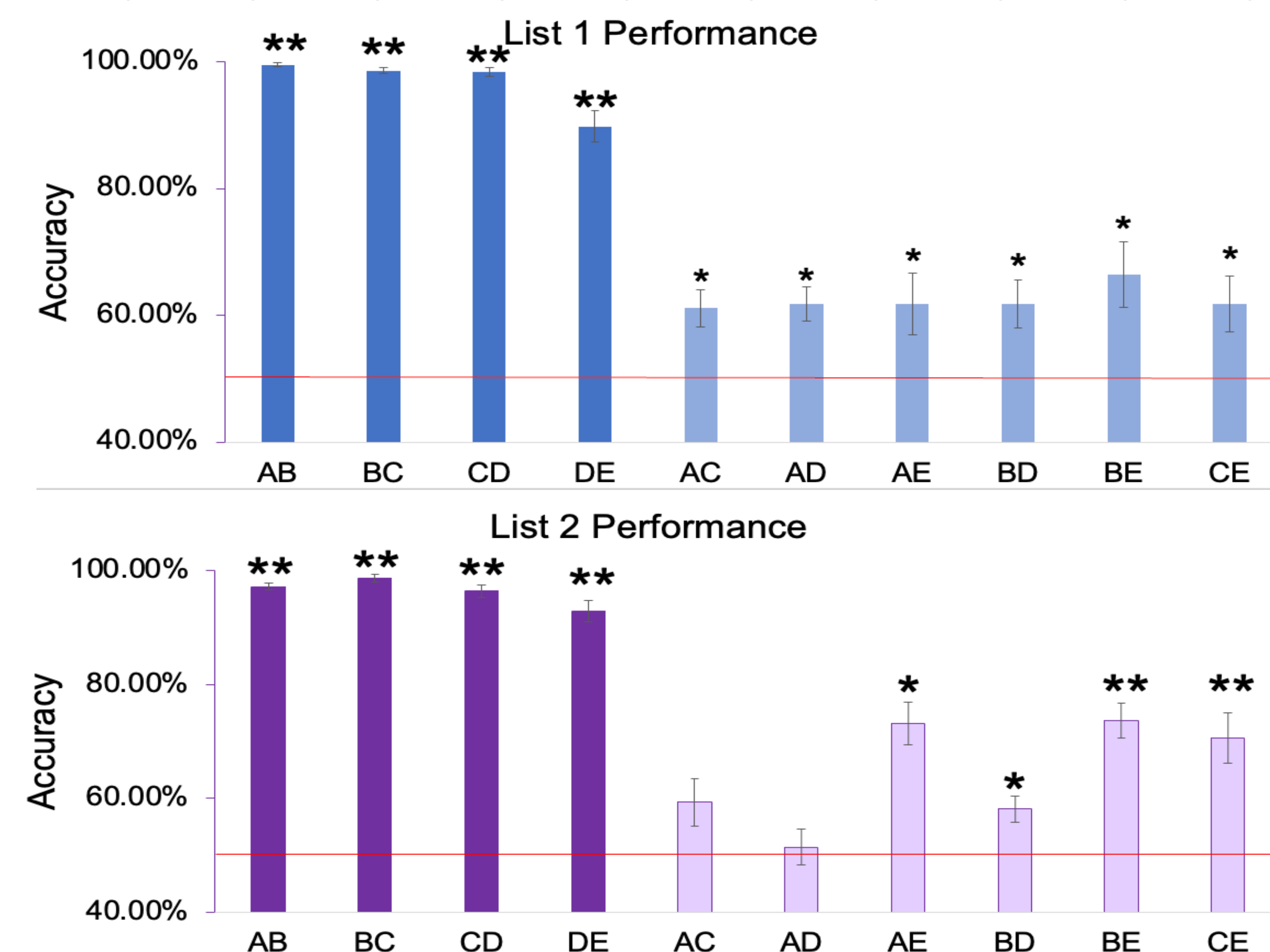
## Spatial trials resulted in significantly higher accuracy and search percentage



\*p<0.05, \*\* p<0.001, paired-sample t-tests. Although there is a significant increase in accuracy and search percentage on spatial trials, results are confounded by order. It therefore cannot be determined if spatial trials or experience of previous training improved acquisition or increased searching (N=10).

## Spatial Premise Pair Lists with Within-list Probes

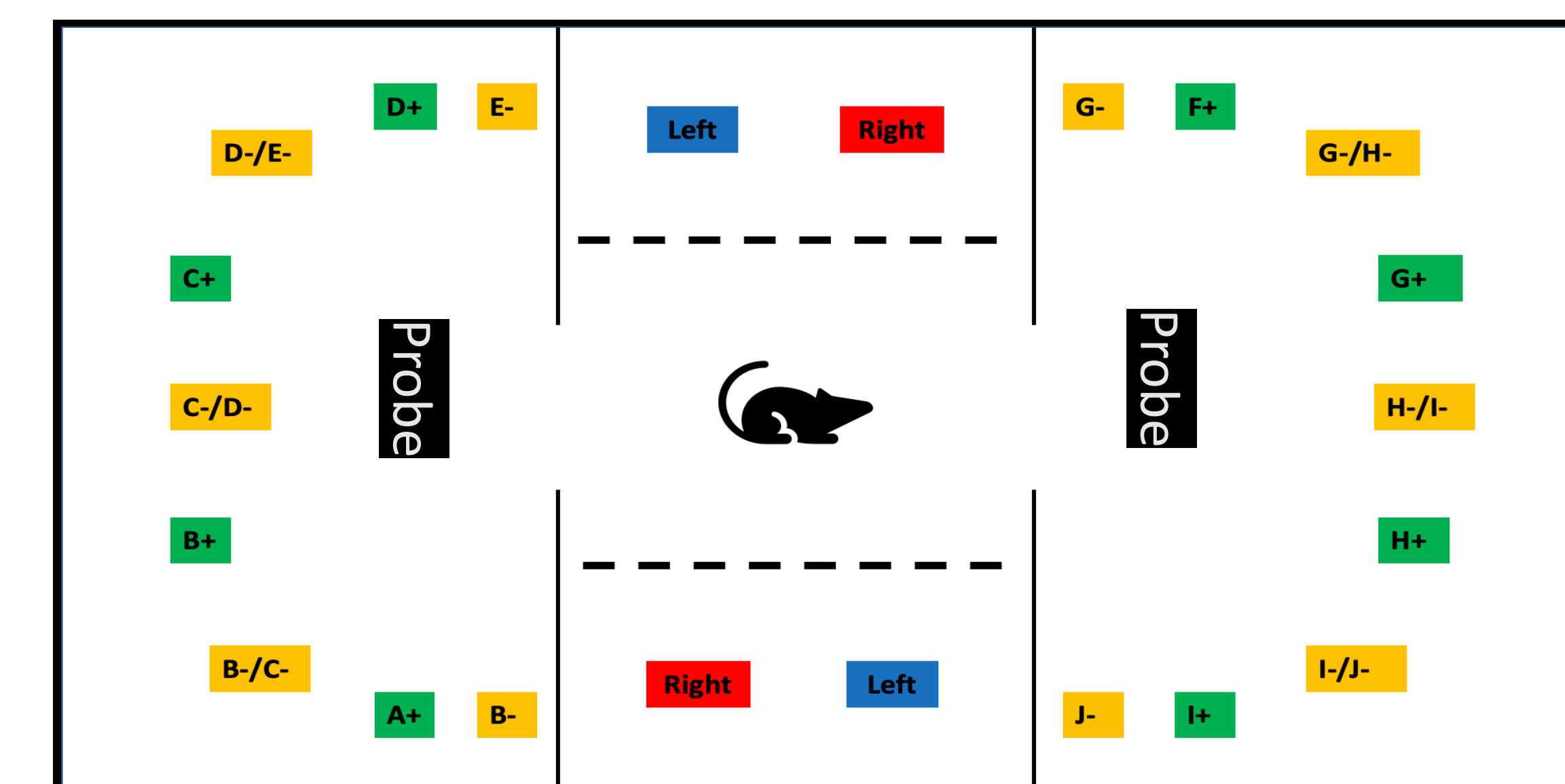
Rats received list retention training on both lists to maintain performance on premise pairs. Rats then received 12 trial sessions with 8 premise pairs and 4 probes for 24 trials for both lists.



Rats performed all premise pairs and probe pairs above chance except for AC and AD. \* p<0.05, \*\* p<0.001, one-sample t-tests (N=10), List 2:F-J.

## Future Directions: Spatial List-Linking

Preliminary results of between-list probes (e.g BI, DG) in Non-Spatial List-Linking indicate that rats may use associative values instead of TI. Subjects have been trained on both lists spatially, and then will be trained on the linking pairs (E+F-) and (C+H-) again on top and bottom sectors to determine if spatial training changes the likelihood that subjects use TI to choose instead of associative values (e.g. D>G rather than G>D).



## REFERENCES

Gazes, R. P., Chee, N. W., & Hampton, R. R. (2012). Cognitive mechanisms for transitive inference performance in rhesus monkeys: Measuring the influence of associative strength and inferred order. *Journal of Experimental Psychology: Animal Behavior Processes*, 38(4), 331-345.  
Gazes, R.P., Templer, V.L. & Lazareva, O.F. Thinking about order: a review of common processing of magnitude and learned orders in animals. *Anim Cogn* 26, 299-317 (2023).  
Roberts, W. A., & Phelps, M. T. (1994). Transitive Inference in Rats: A Test of the Spatial Coding Hypothesis. *Psychological Science*, 5(6), 368-374.  
Wynne, C. D. (1995). Reinforcement accounts for transitive inference performance. *Animal Learning & Behavior*, 23(2), 207-217.

## ACKNOWLEDGEMENTS

RI-INBRE P20GM103430, Colin Call, Channele Kendrick, and Daniel Tyler for help with testing.