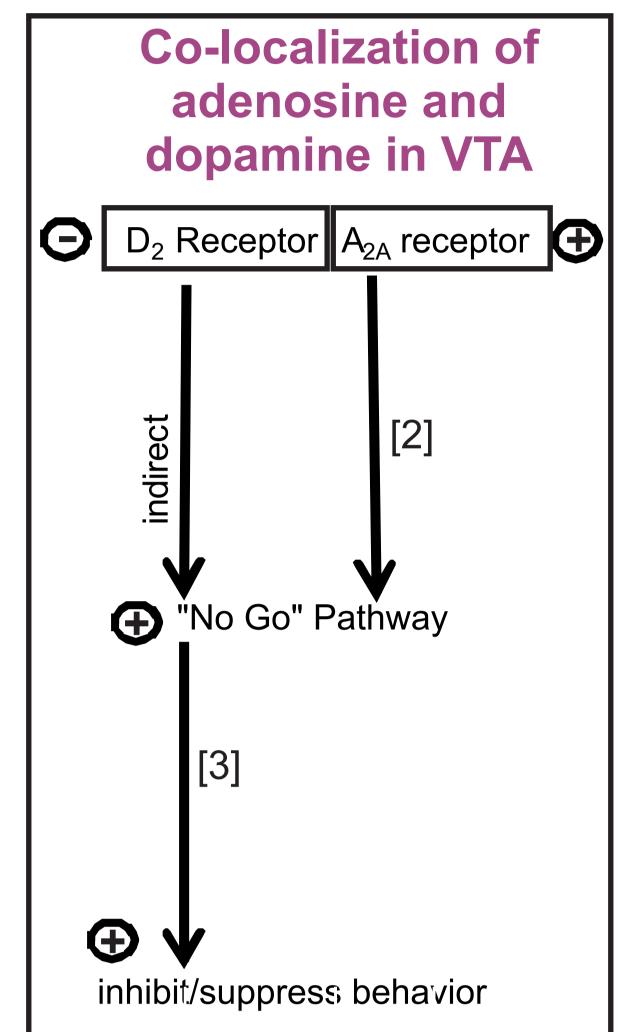
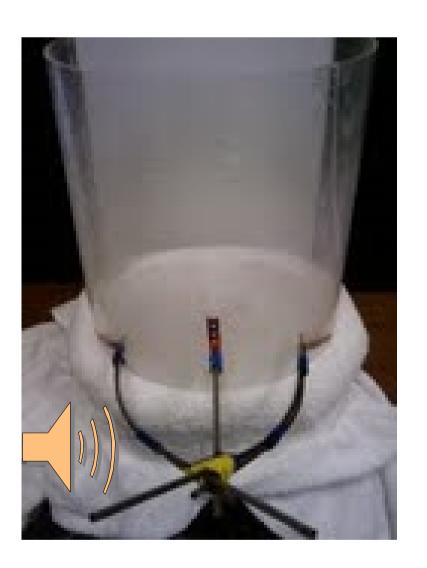
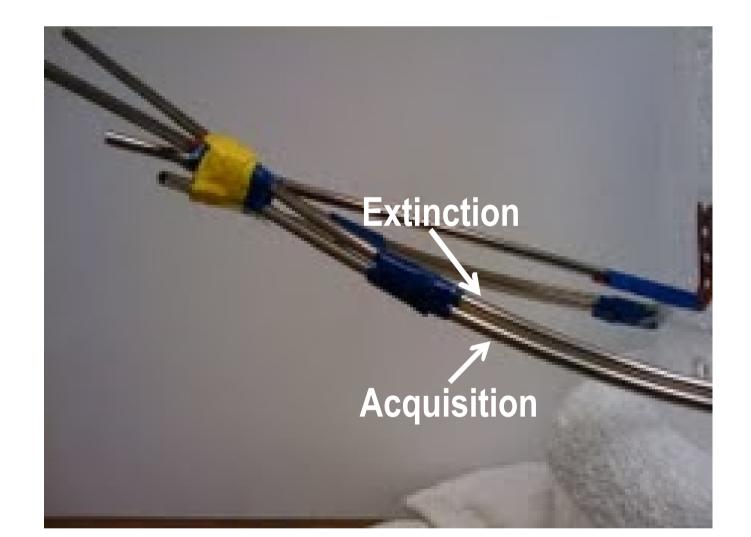
## INTRODUCTION

- Worldwide caffeine consumption is rising exponentially. Caffeine has been found to affect cognition
- Extinction is the process of weakening a learned response.
- When making a decision in every day life, the amount of effort one is willing to make depends on the amount and probability of obtaining a reward. We study the effects of caffeine on the extinction of probabilistic events.
- Caffeine is an adenosine A<sub>2A</sub> antagonist. Through this action, it indirectly affects dopamine levels in the ventral tegmental area (VTA) through co-localization of adenosine and dopamine receptors [2].



### Hypothesis: Caffeine impairs extinction of probabilistic rewards.

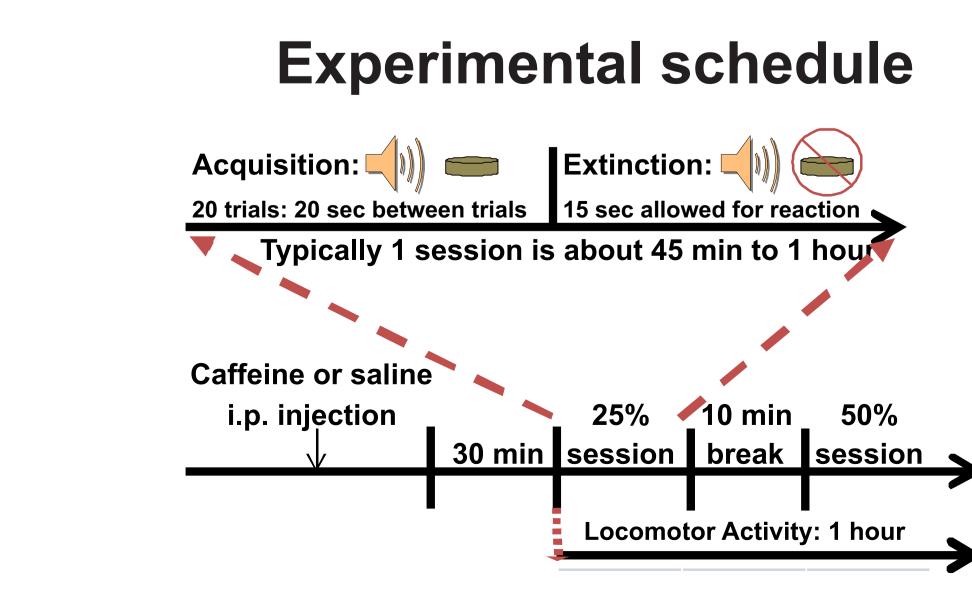




## Experimental design

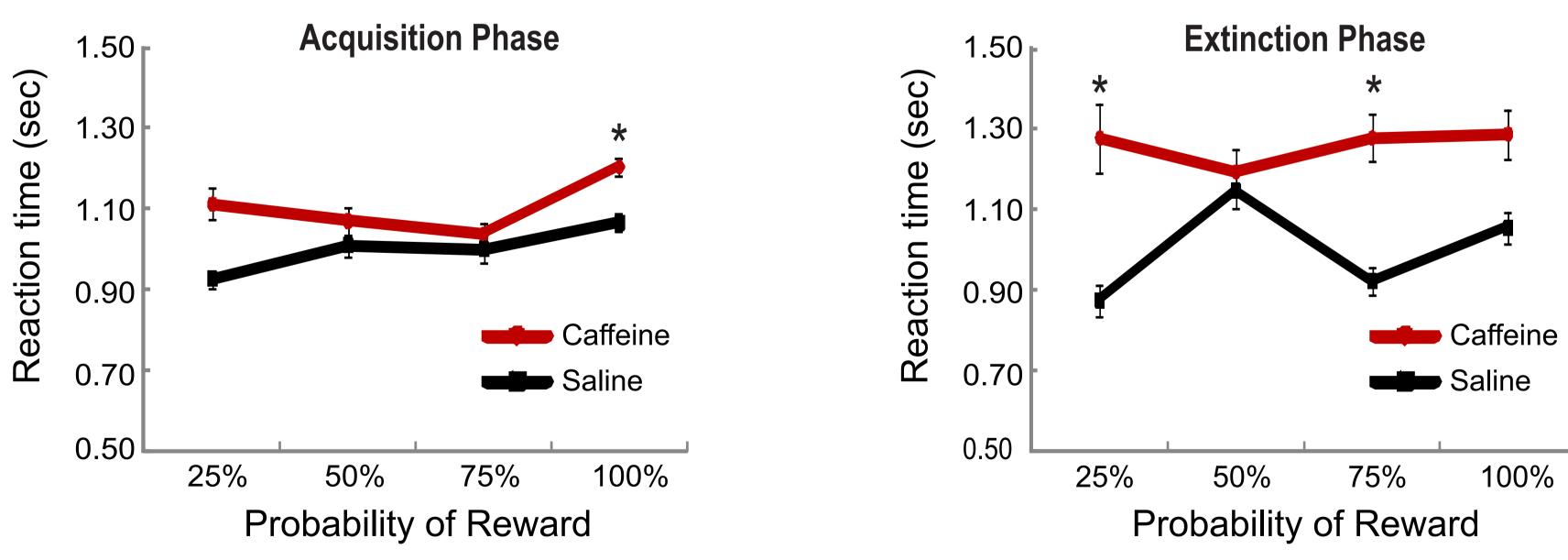
Day	Session probability	Acquisition phase	No tomporal gap	Extinction phase
1	25%	20 trials; 5 rewards		Sound without
	50%	20 trials; 10 rewards		pellet until the rat
1 Day Break			No temporal gap	does not make
2	75%	20 trials; 15 rewards		attempt for 5
	100%	20 trials; 20 rewards		consecutive trials

- Order and pairs of probability are randomized each day.
- Different sounds (beep, bark, cashtill, or drum) for different probabilities.
- Pairing of probability and sound is different for each rat.
- Nine 8 month old, male, Brown Norway.



 Caffeine injections consisted of 25mg/kg caffeine mixed in 0.9% saline Statistics: t-test; \*=p < 0.05;</li>

# 0.00



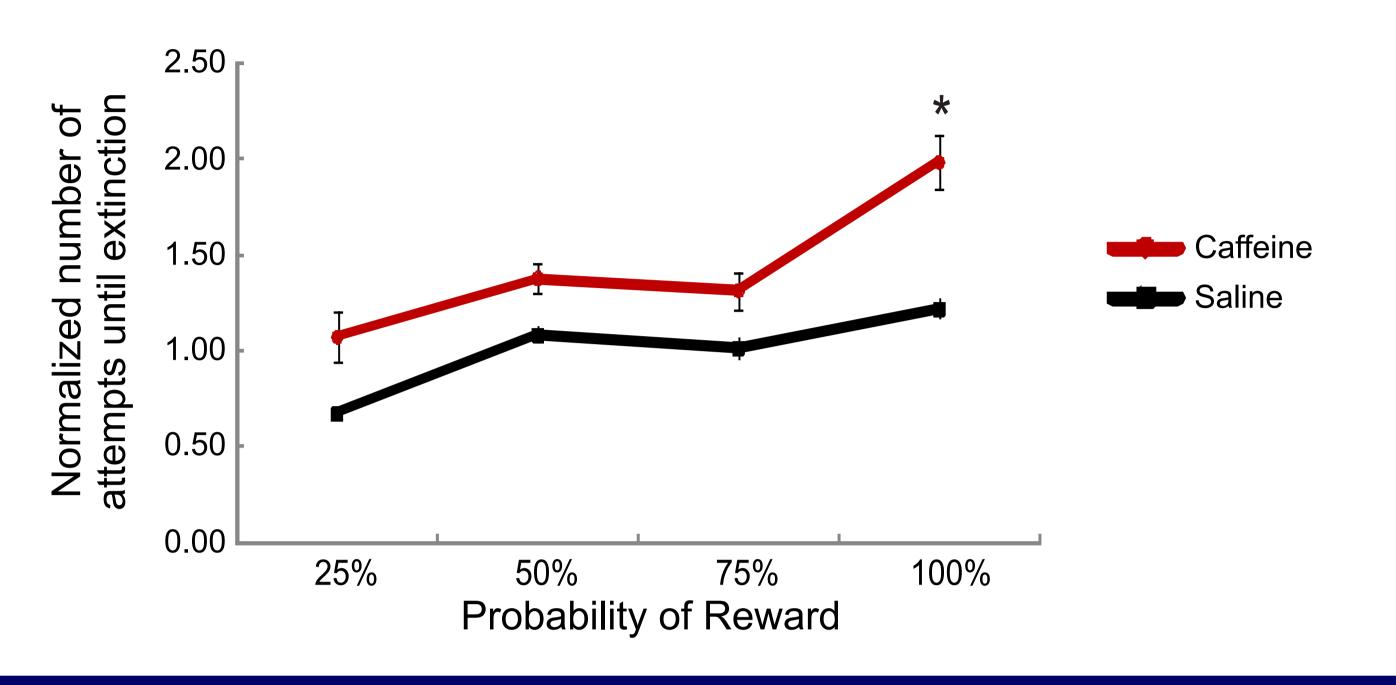
# The Effect of Caffeine on Memory Extinction

# Megan Waterkotte<sup>1</sup>, Minryung Song<sup>2</sup>, and Jean-Marc Fellous<sup>3</sup>

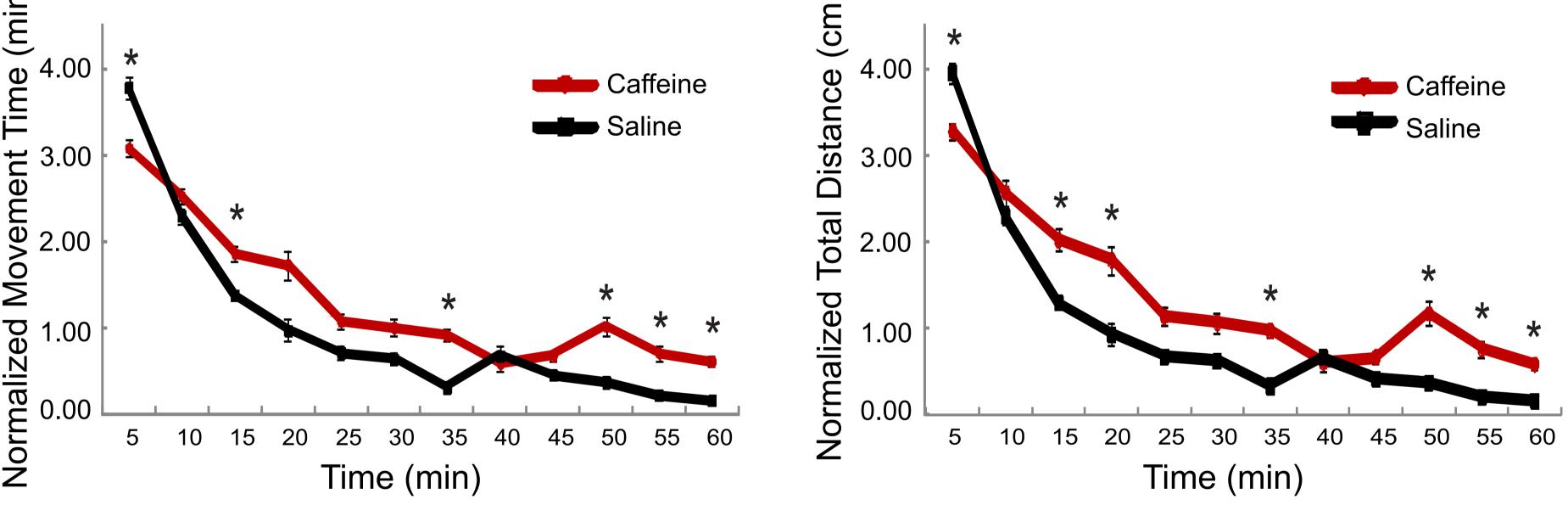
1: Undergraduate Physiology and Psychology Research Program in Neuroscience, 3: Departments of Psychology and Applied Mathematics, University of Arizona, Tucson, AZ

# RESULTS

Caffeine delays extinction of associations that occurred with high probability during acquisition.

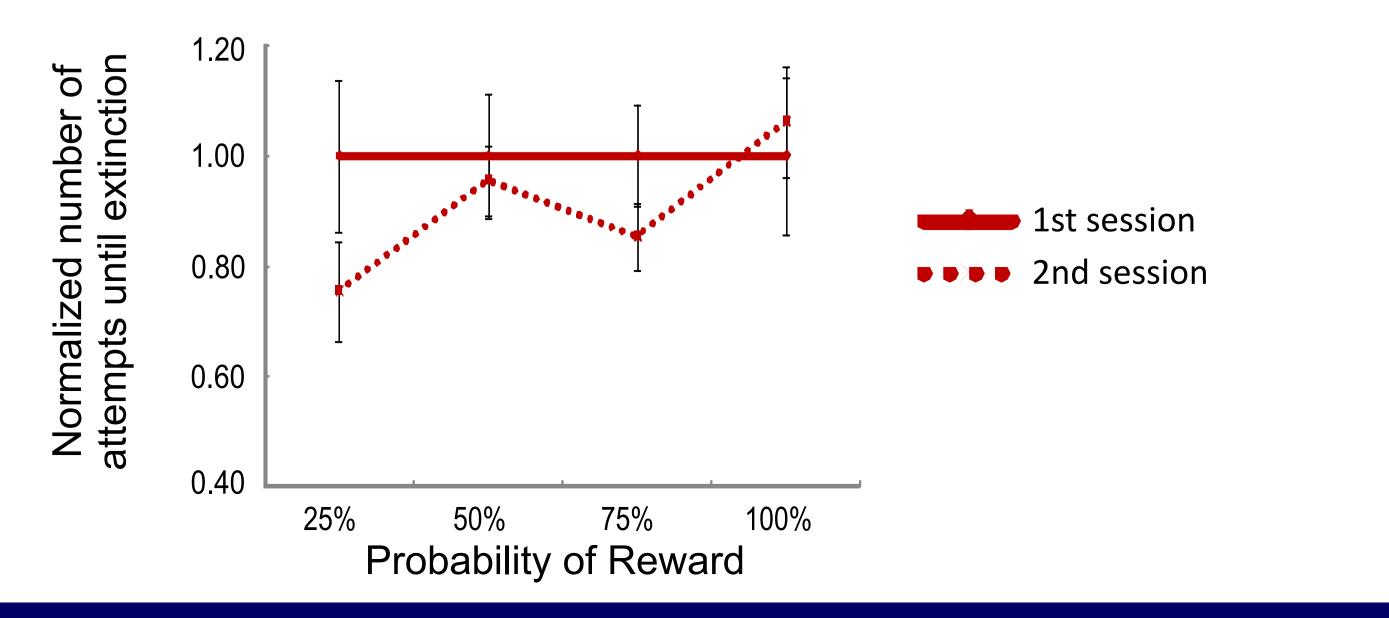


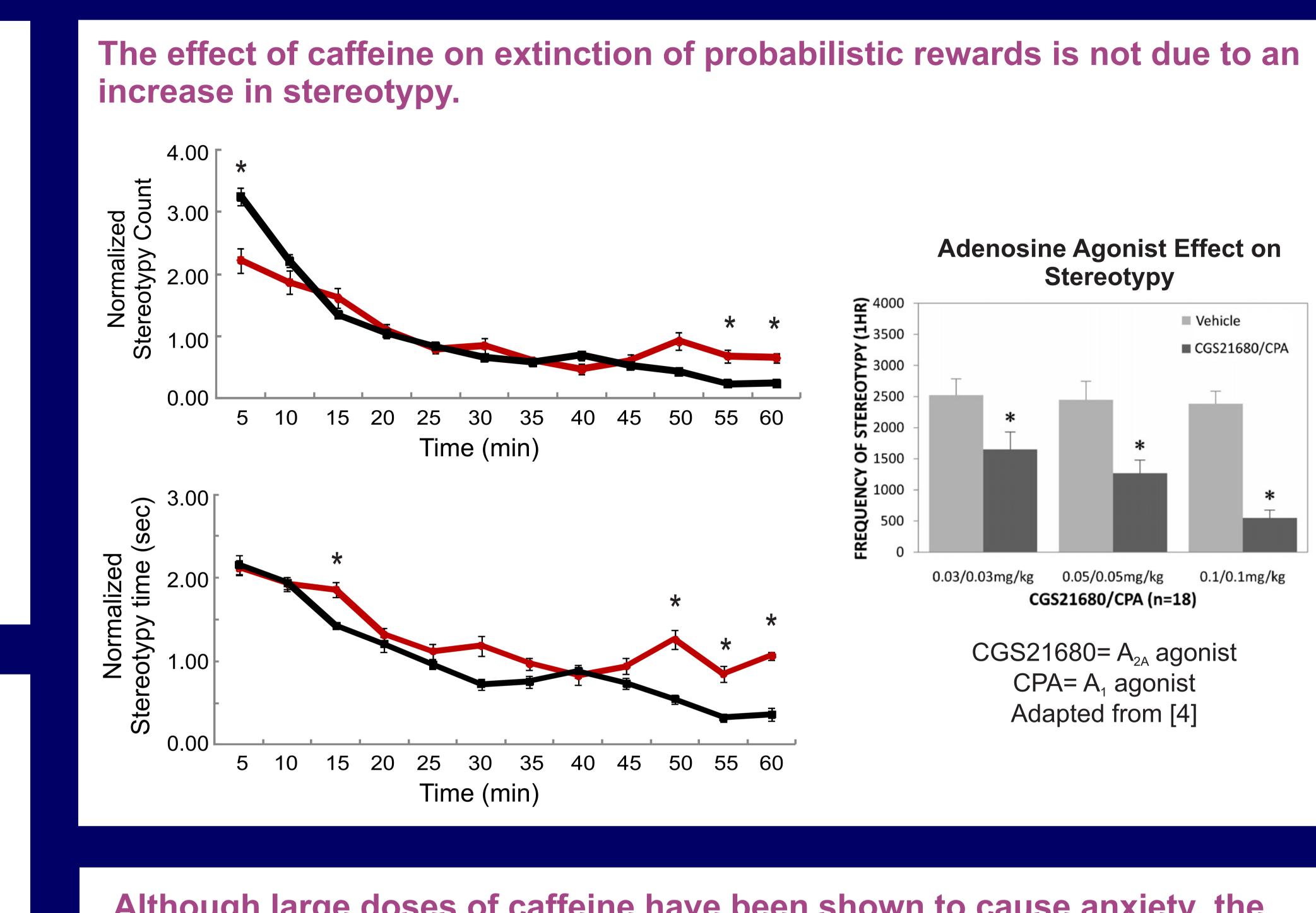
## The effect of caffeine on extinction of probabilistic rewards was not due to a change in locomotor activity.



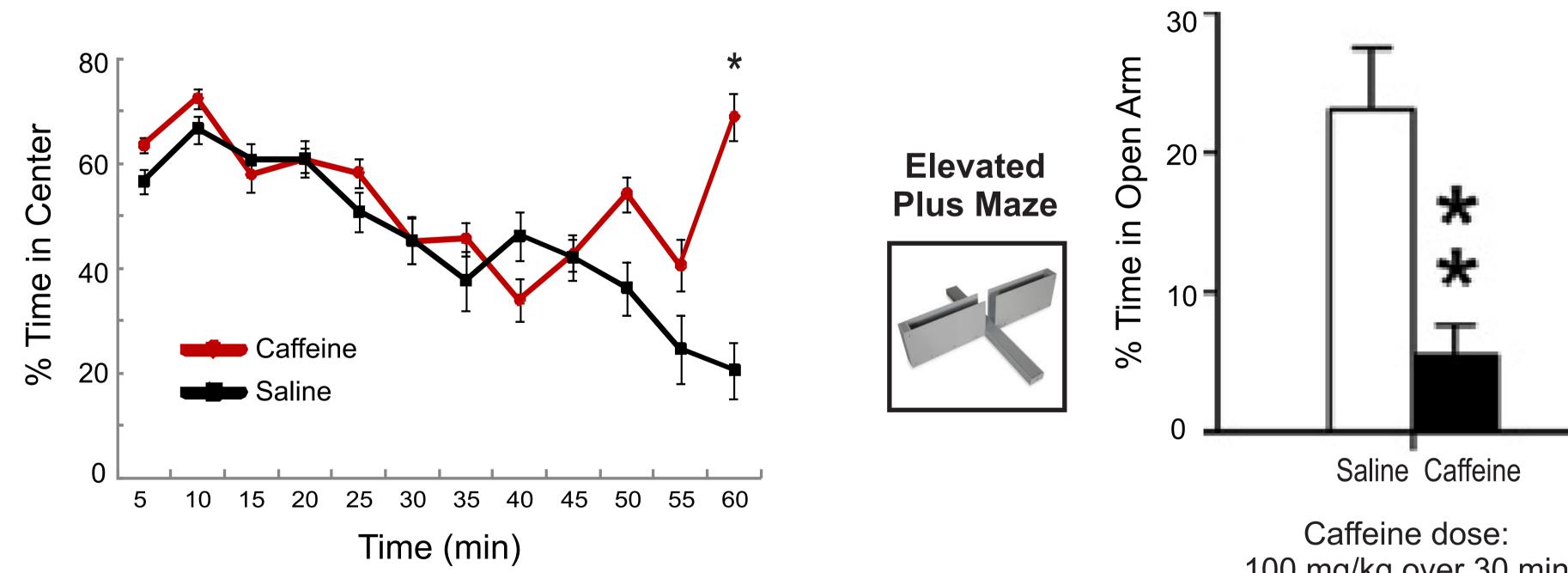
## The effect is not due to differences in reaction times.

## The effect is not due to the order in which probabilities were presented.

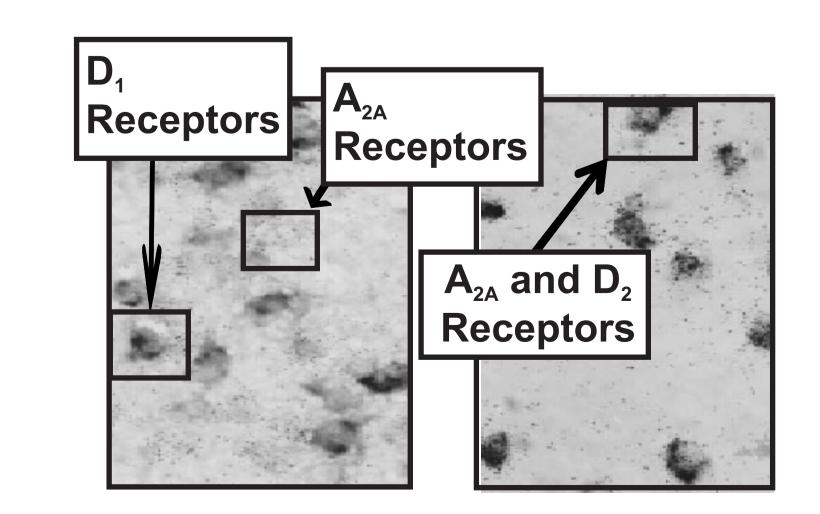




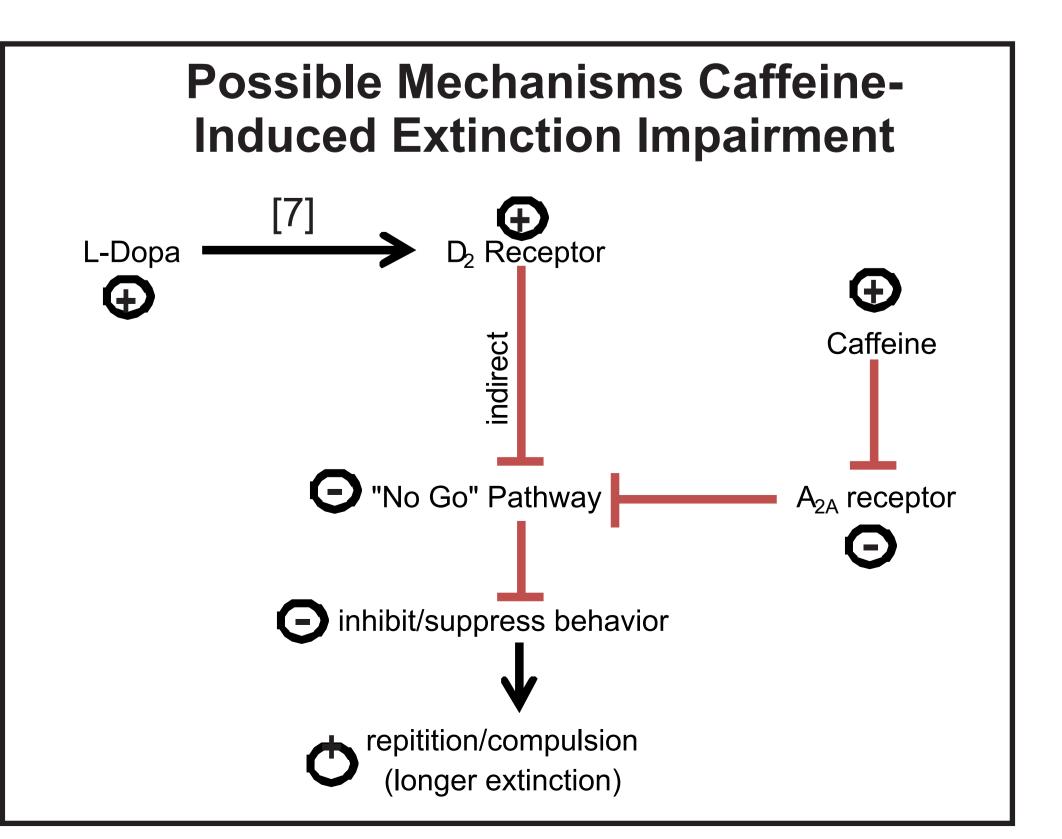
### Although large doses of caffeine have been shown to cause anxiety, the effect of caffeine on probabilistic extinction is not due to caffeine induced anxiety in our experiment.



## **Possible Explanation: Co-localization of adenosine and dopamine** receptors may lead to compulsive behavior (longer extinction).



Hybridization experiments showing lack of co-localization of  $A_{2A}$  and  $D_1$  receptors and presence of co-localization of  $A_{2A}$  and  $D_2$ receptors in rat striatum, Adapted from [6]





100 mg/kg over 30 min Adapted from [5]

# CONCLUSIONS

• Caffeine impairs the extinction of rewards delivered with high probability.

 Caffeine's effect is not due to a change in locomotor activity.

 Although there seems to be a difference in reaction times, it is unlikely to be the reason why extinction was impaired.

 The effect of caffeine was not due to the order of probability presentation.

 Increased repetition in the form of stereotypy does not explain the effect of caffeine.

 High doses of caffeine cause anxiety. However, this does not explain why caffeine impaired extinction in our experiment.

 A possible explanation may be that caffeine affects the D<sub>2</sub> pathway through the colocalization of  $A_{2A}$  and  $D_2$  receptors in the VTA.

# ACKNOWLEDGEMENTS

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