

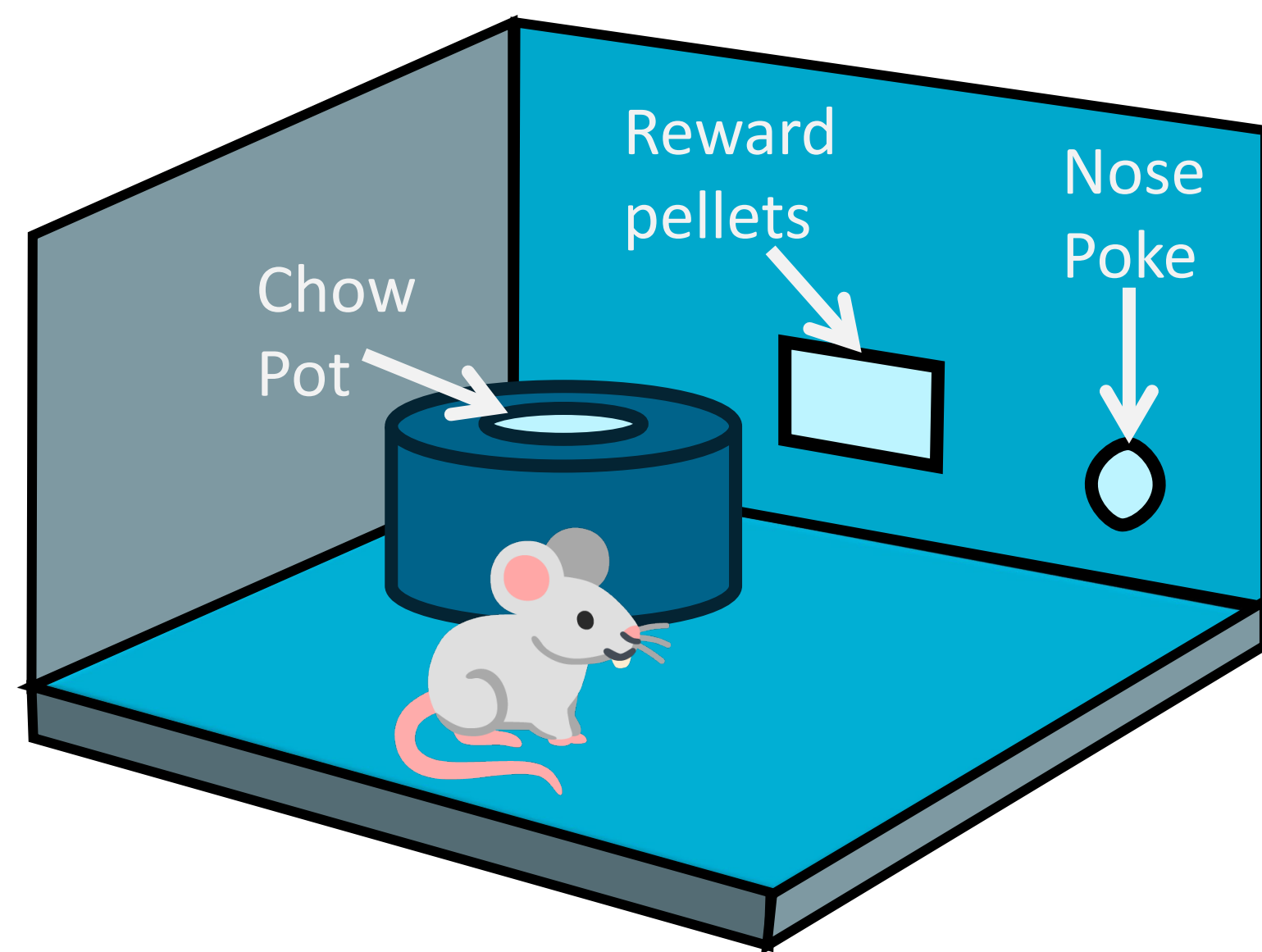
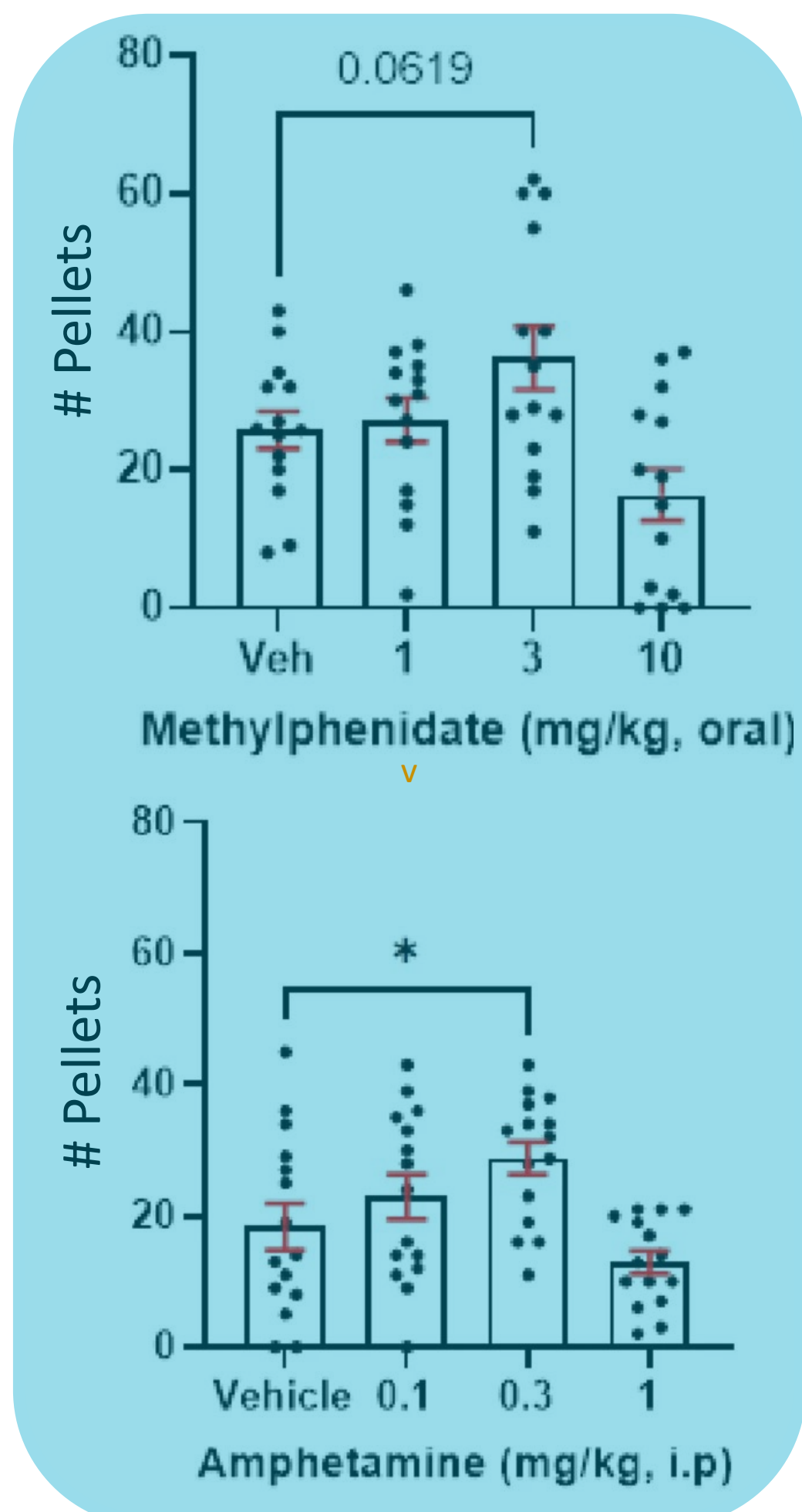
Dissociable Effects of Methylphenidate and Amphetamine on Learning Rate and Reward-Prediction Error

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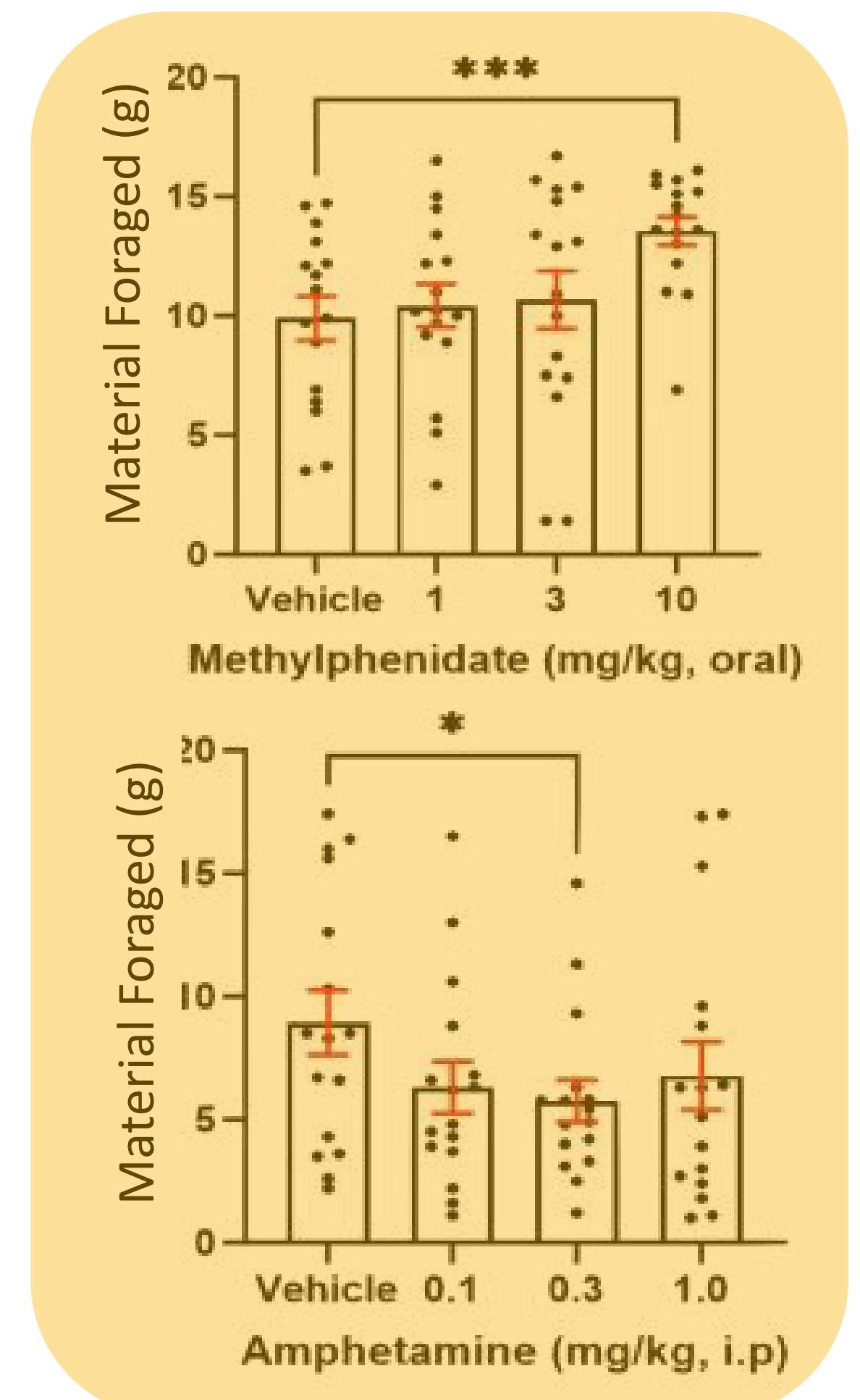
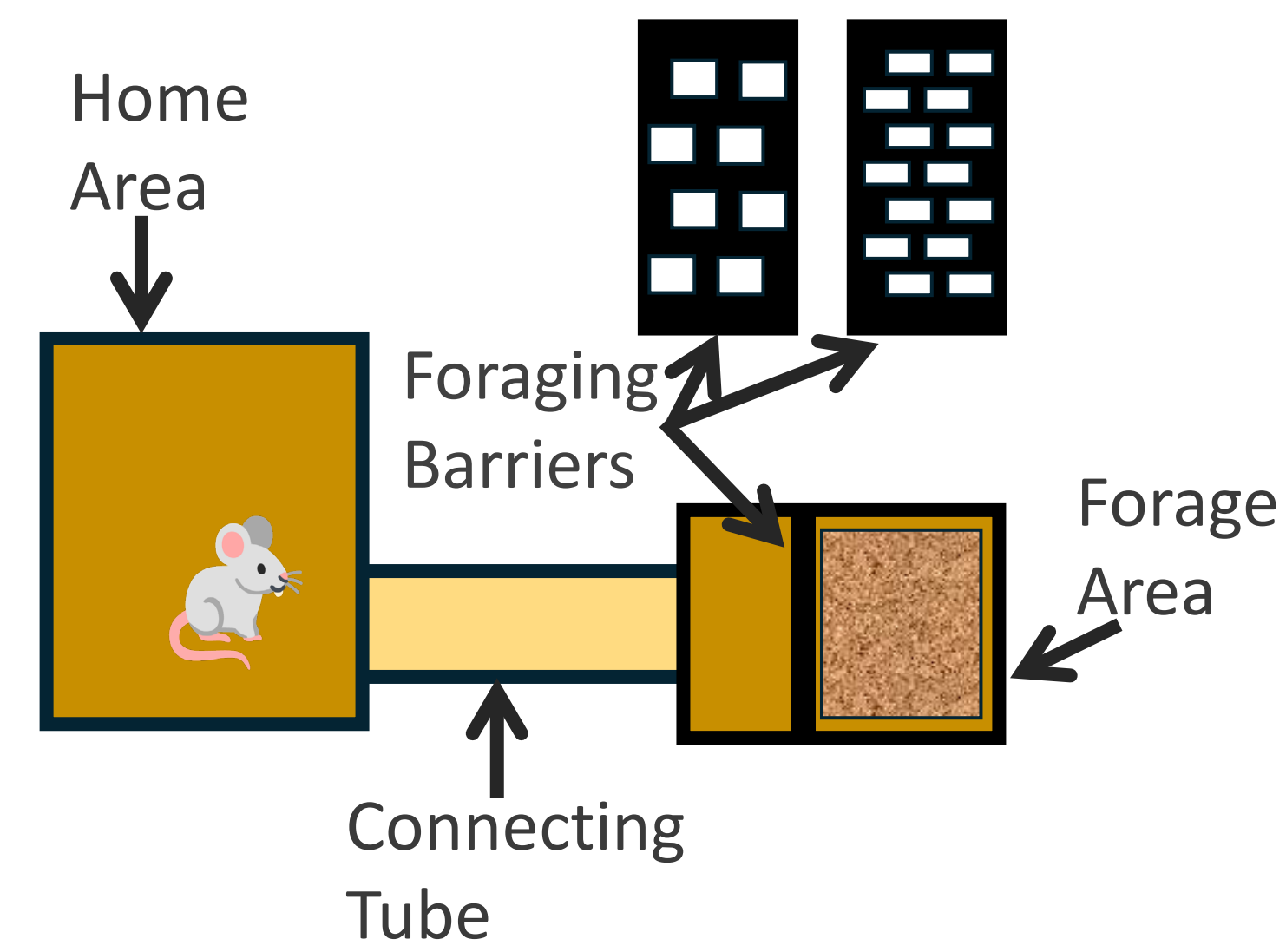


Background – Task-Dependent Dopaminergic Drug Effects in Behavioural Experiments

Effort-for-Reward (EfR) - Nose-poke for pellets vs. Eat chow
Both Methyl and Amph increase number of pellets obtained. [1]



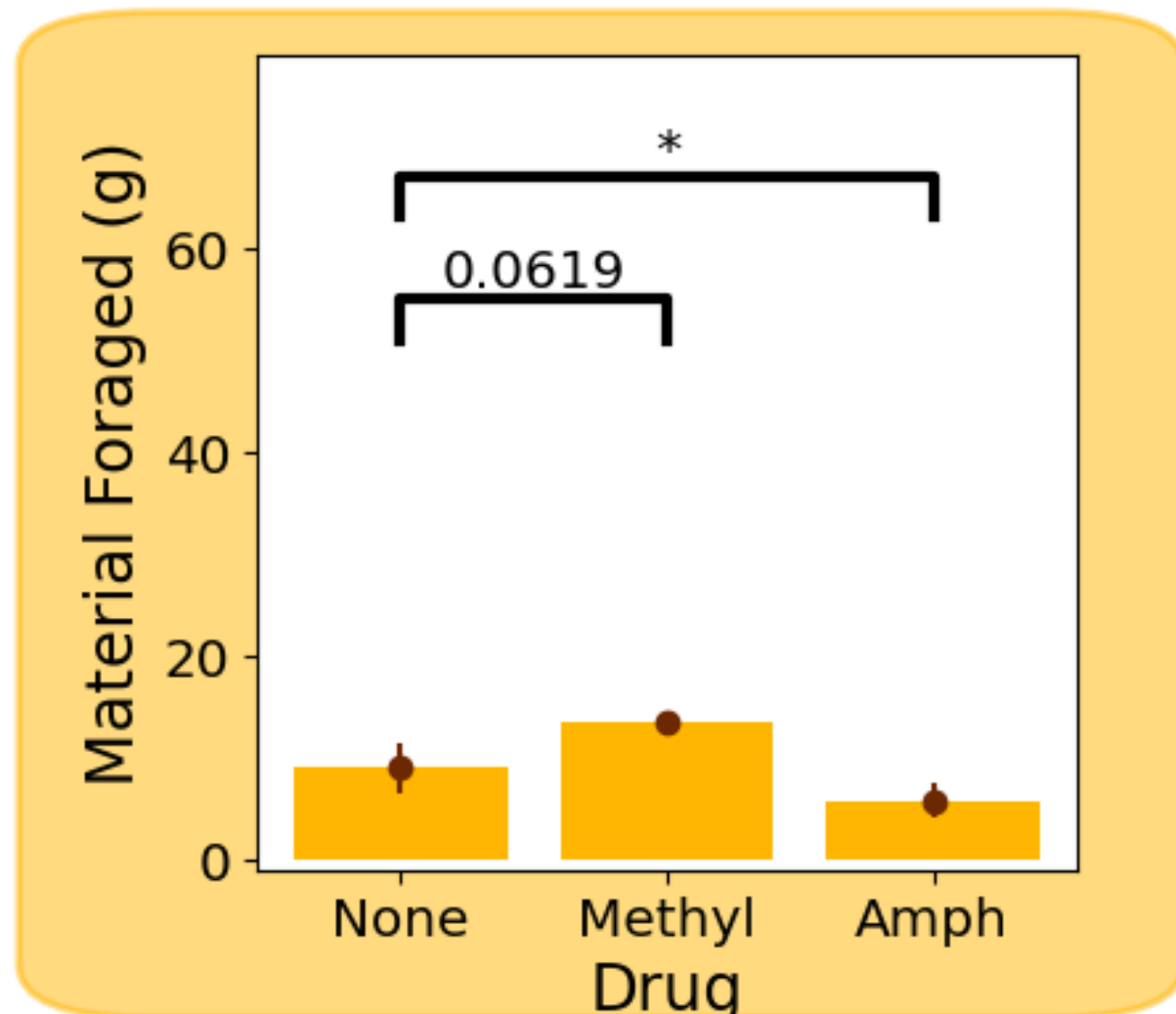
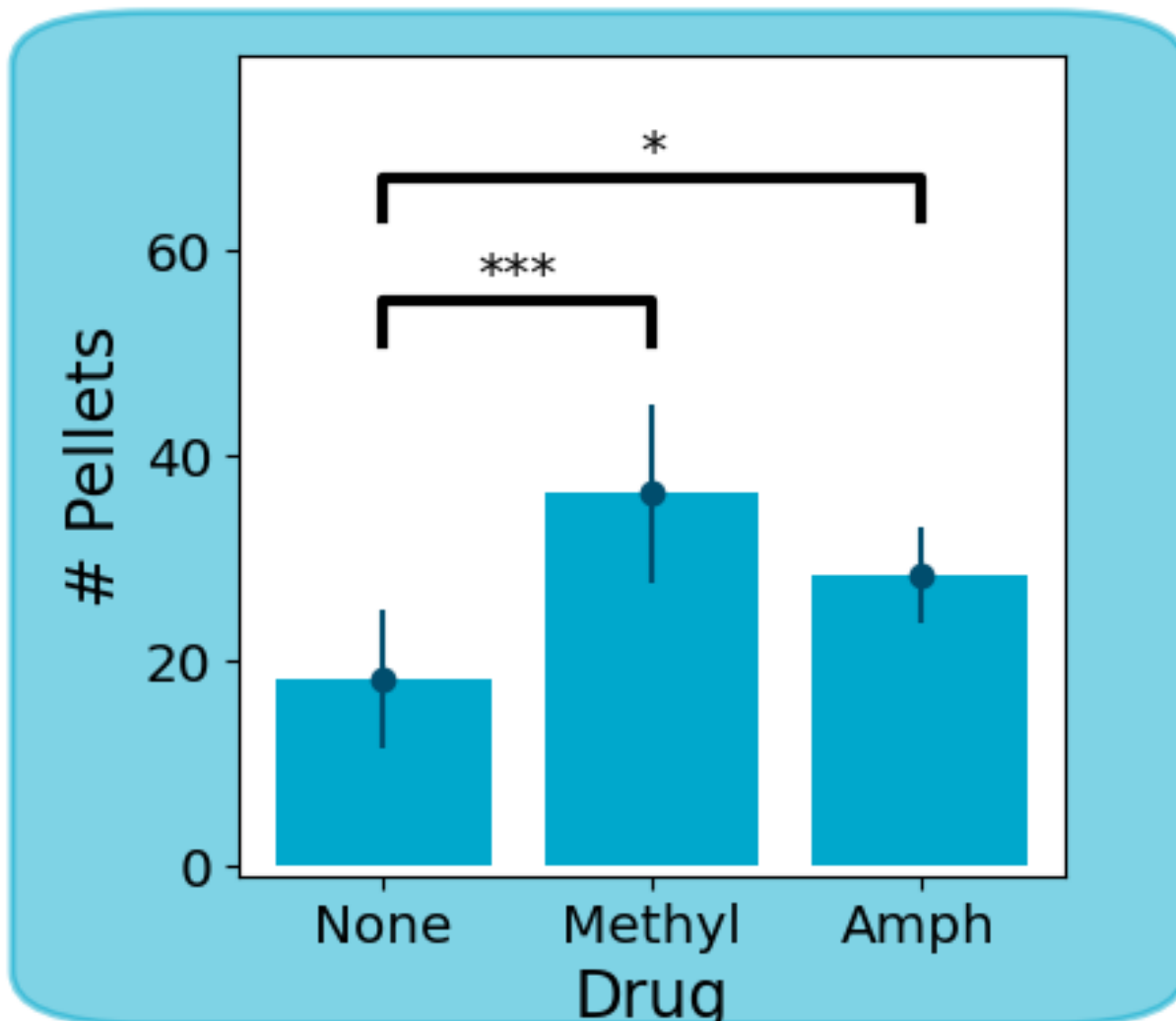
Effort Based Foraging (EBF) – Forage for nesting material
Methyl increases and Amph decreases foraging behaviour. [2]



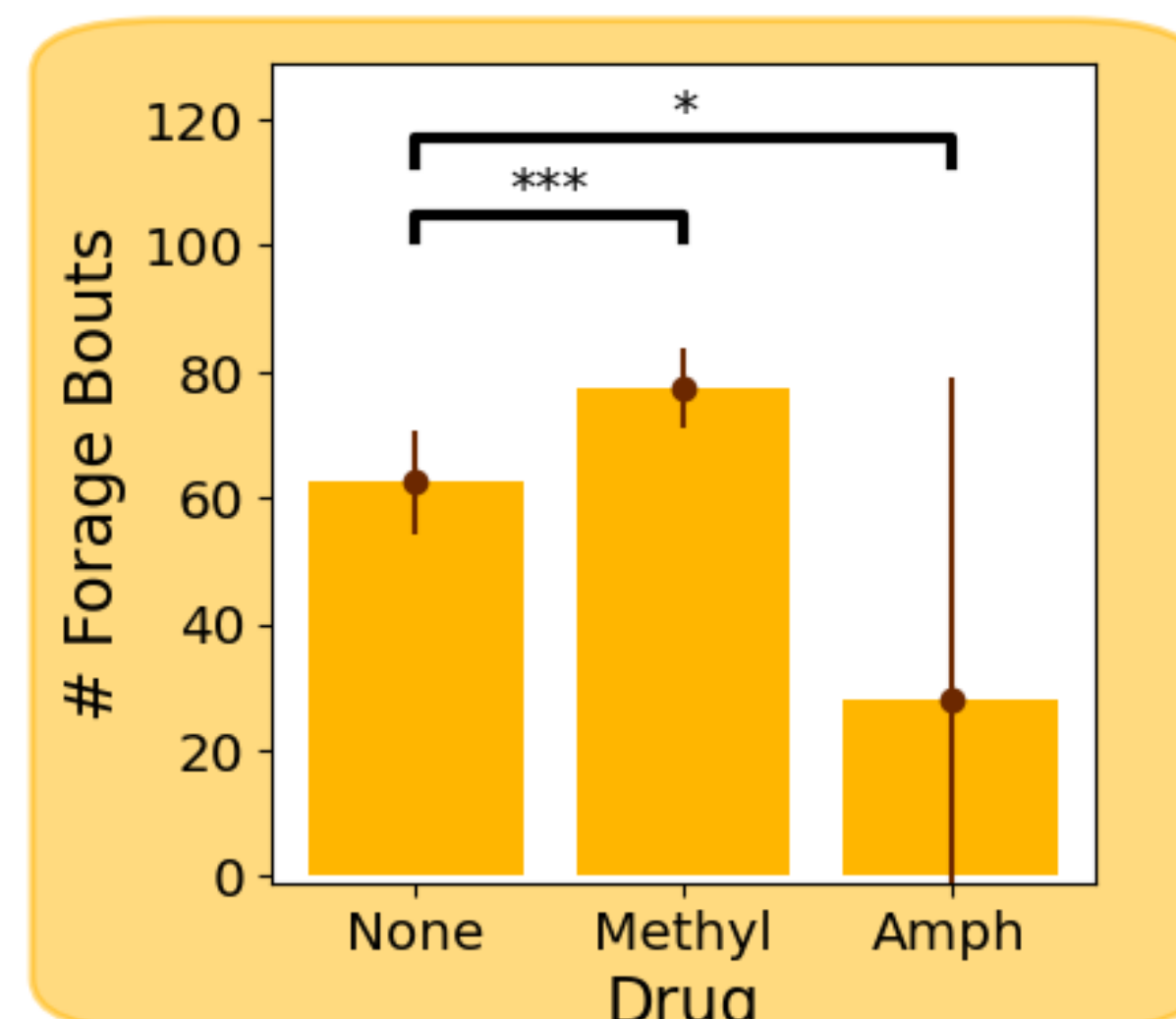
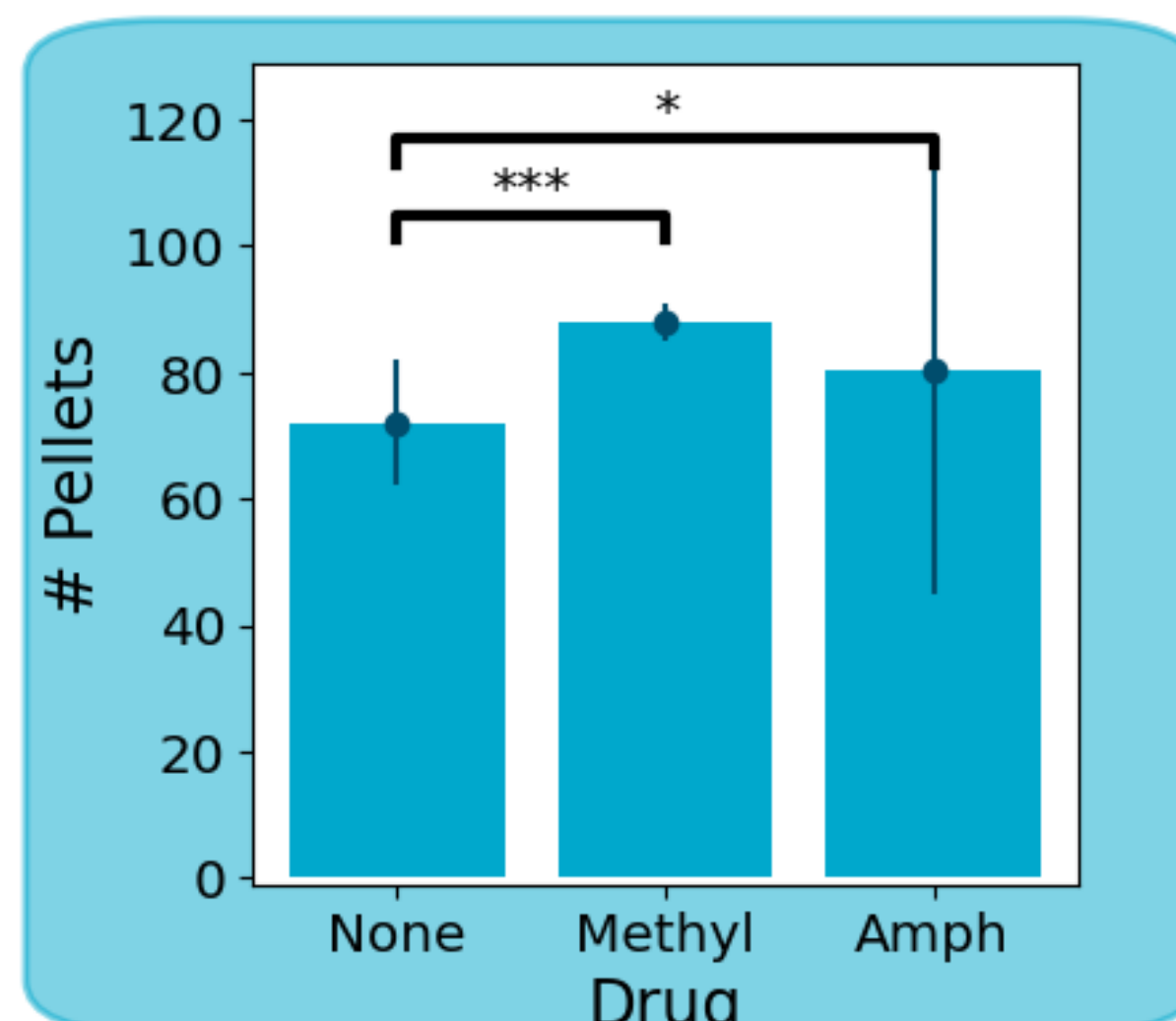
Question
Does the interaction between different drug-action models and the temporal horizon of the task explain the task-dependent dissociation?

Results – Successfully Replicated the Effects Observed in Xeni et al., (2024)

Behavioural Results [2]



Simulation Results



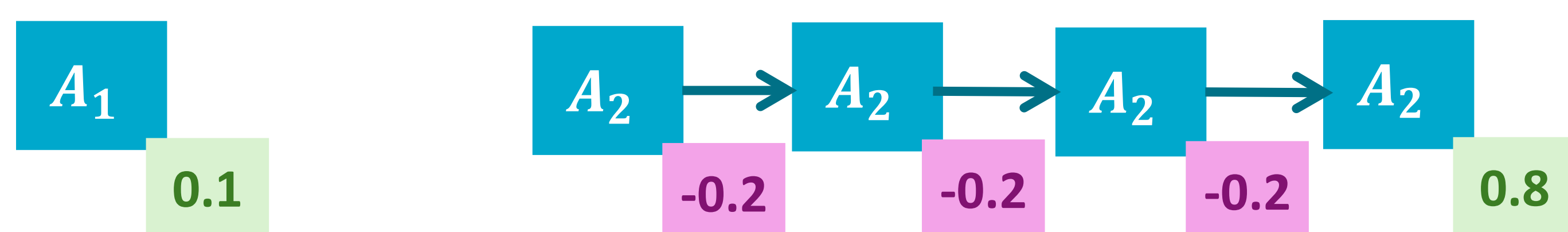
Conclusions

- Ethological validity reveals interactions that are masked by contrived tasks.
- Longer temporal horizons allow for more interference from the noise term ϵ .

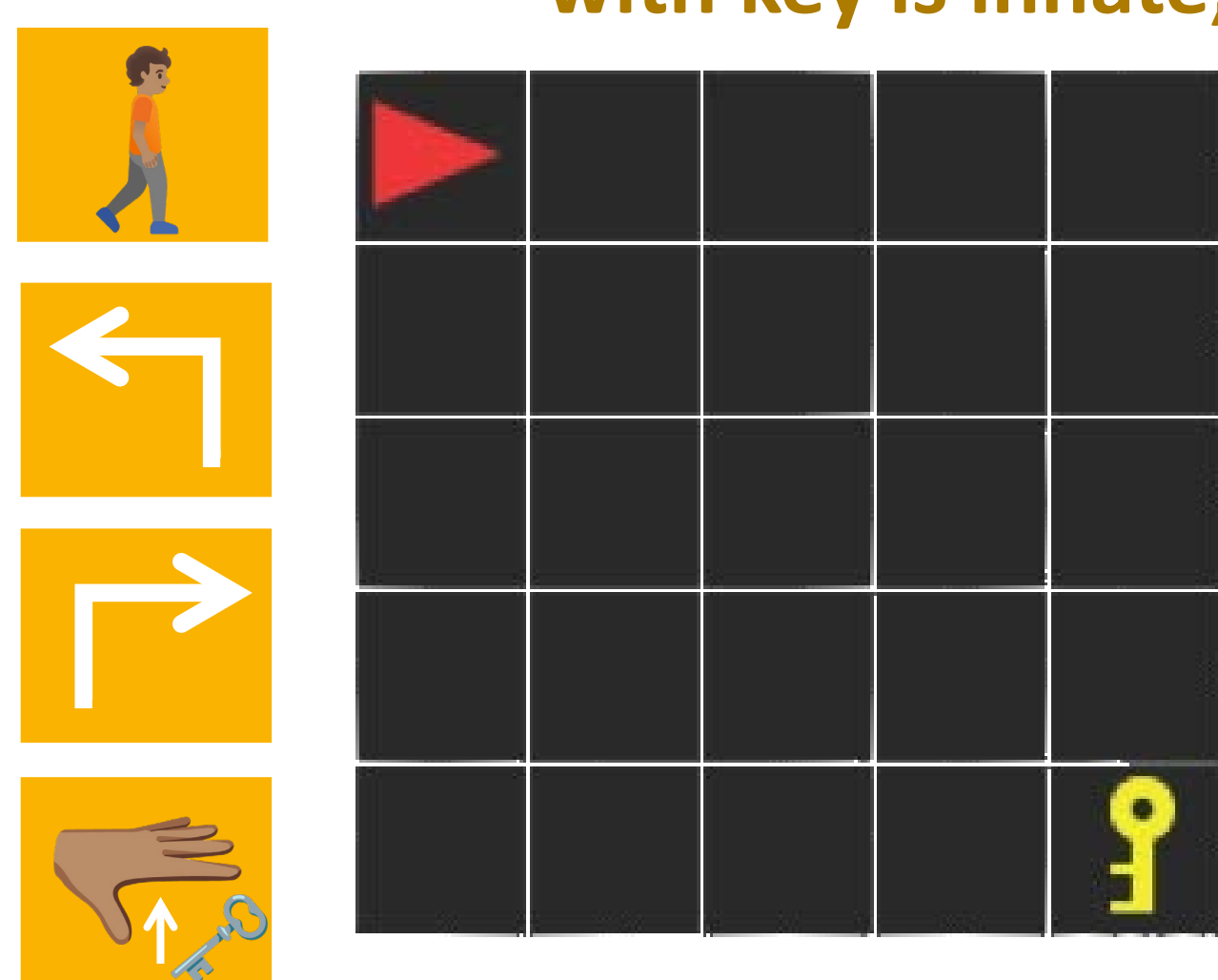
Methods – Simulating Task-Dependent Dopaminergic Drug Effects

1. Simulate the two tasks using TD(0) based Reinforcement Learning (RL) agents.
2. Compare the effects of modelling the two drug effects.

Simulated EfR – low effort action (A_1) for low value reward vs. high effort action (A_2) for high value reward



Simulated EBF – navigate to and collect the key. Returning to home with key is innate, not learned

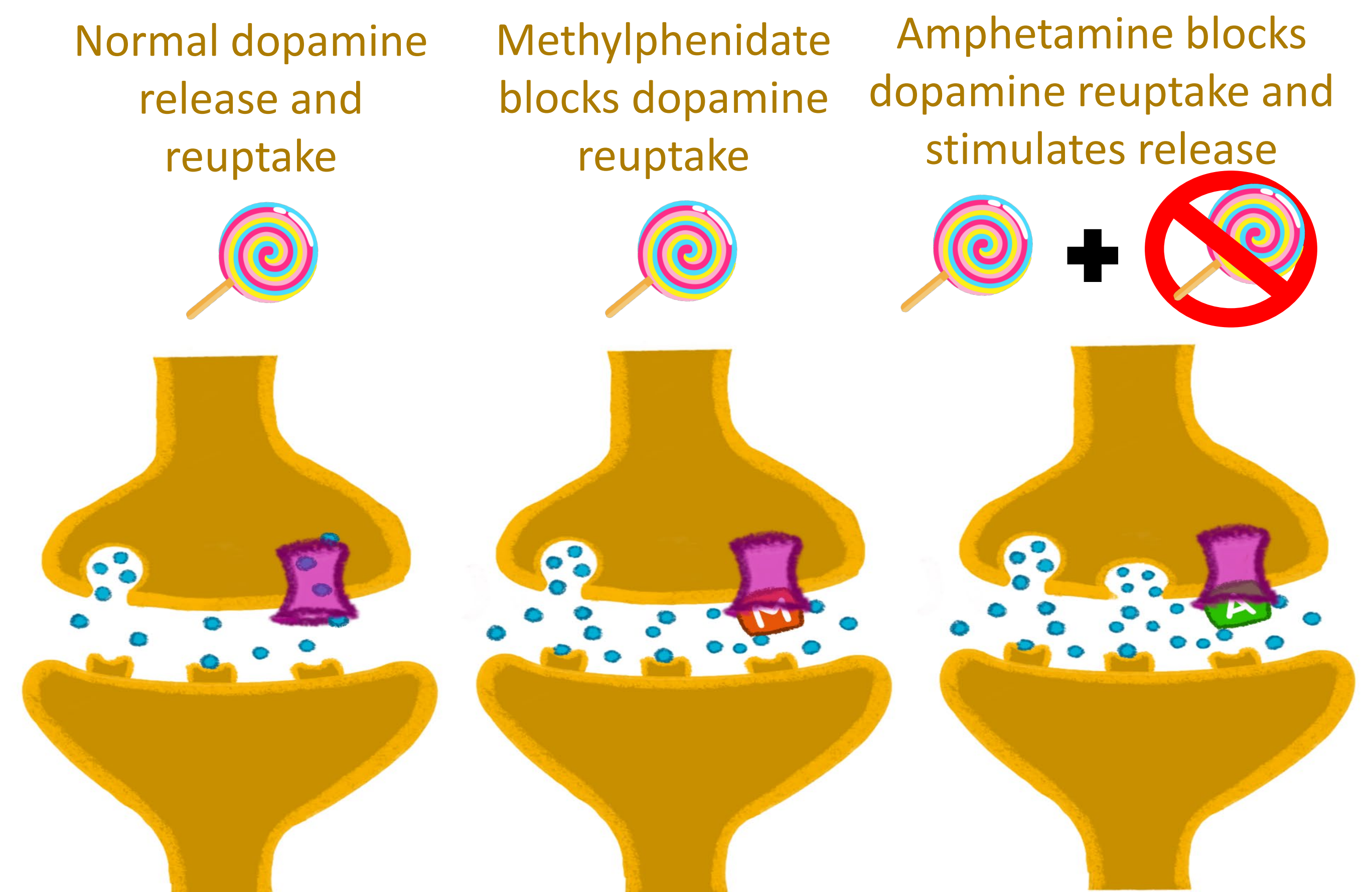


Temporal Horizon

- The minimal necessary actions needed to obtain high-value reward.
- EfR min actions = 4
 - EBF min actions = 9

Drug Effects

Effects on Dopamine Release



Effects on the TD(0) Learning Rule

$\alpha = 0.01$ $\delta = R_t - V(S_{t-1})$ $V(S_{t-1}) = V(S_{t-1}) + \alpha\delta$ Normal TD(0)	$\alpha = 0.01 + 0.6$ $\delta = R_t - V(S_{t-1}) + \epsilon$ Methylphenidate increases learning rate (α)	$\alpha = 0.01 + 0.6$ $\delta = R_t - V(S_{t-1}) + \epsilon$ Amphetamine increases learning rate (α) and adds noise (ϵ) to error
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[1] Marangoni, C., Tam, M., Robinson, E.S.J. et al. Pharmacological characterisation of the effort for reward task as a measure of motivation for reward in male mice. *Psychopharmacology* 240, 2271–2284 (2023).

[2] Xeni, F., Marangoni, C., & Jackson, M. G. (2024). Validation of a non-food or water motivated effort-based foraging task as a measure of motivational state in male mice. *Neuropsychopharmacology*, 49(12), 1883–1891.