

Doctoral thesis proposal

Orexin and uncertainty effects on food-seeking behavior

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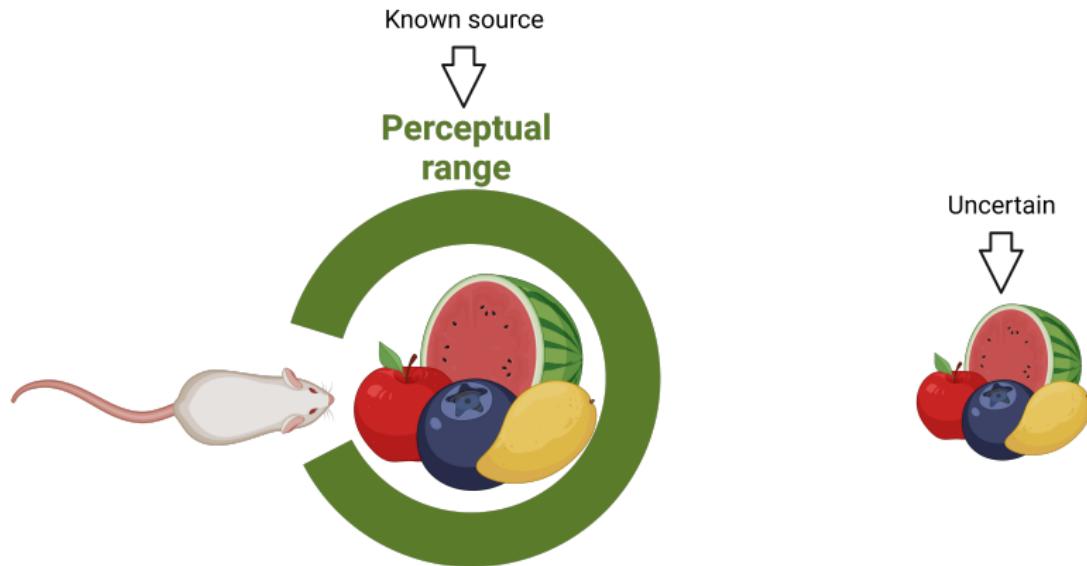
Neurobiology and Obesity (NBO) lab <https://www.nbolab.cl/>

Food-seeking and uncertainty

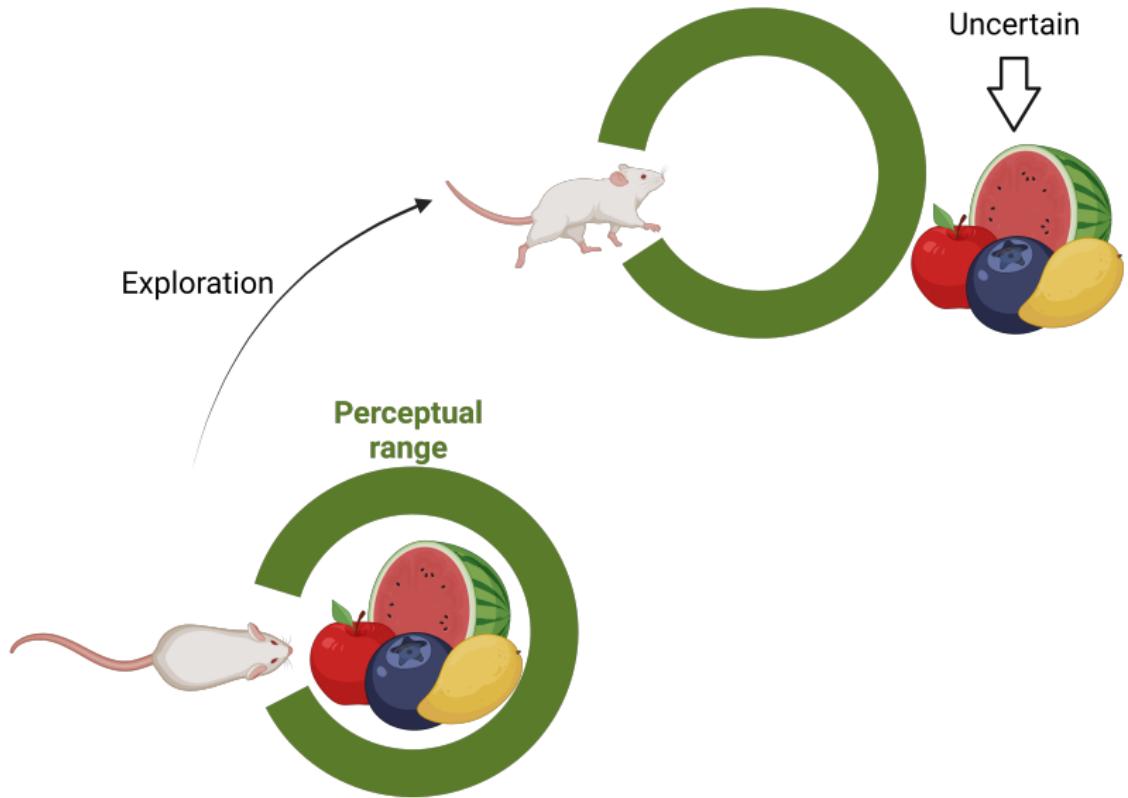
Food-seeking behavior is the coordination of locomotor activity with internal and external cues to procure food



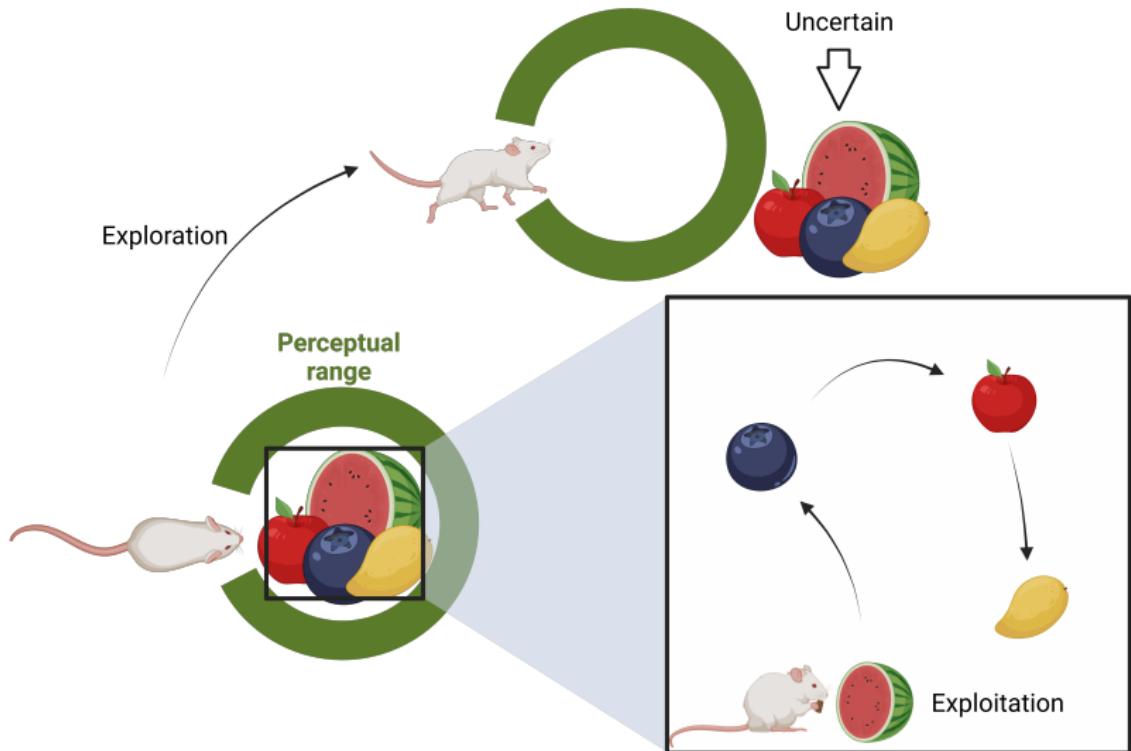
Food-seeking behavior implies a state of partial knowledge



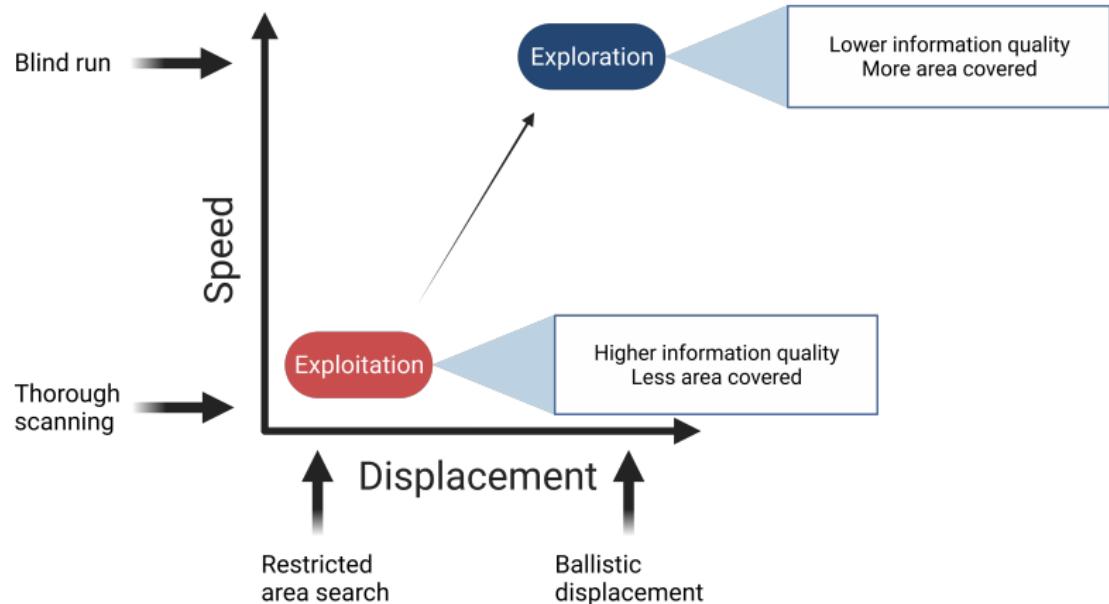
Partial knowledge forces animals to explore for new food sources



At some point animals need to stop exploring and start exploiting



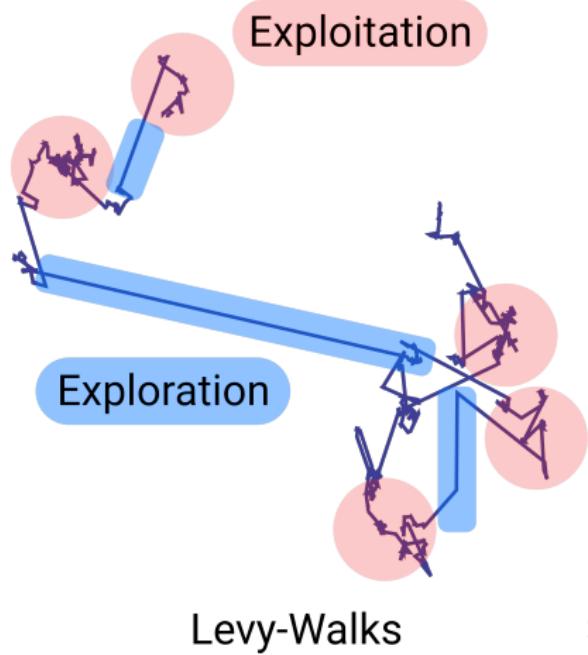
Uncertainty is inherent to food-seeking behavior



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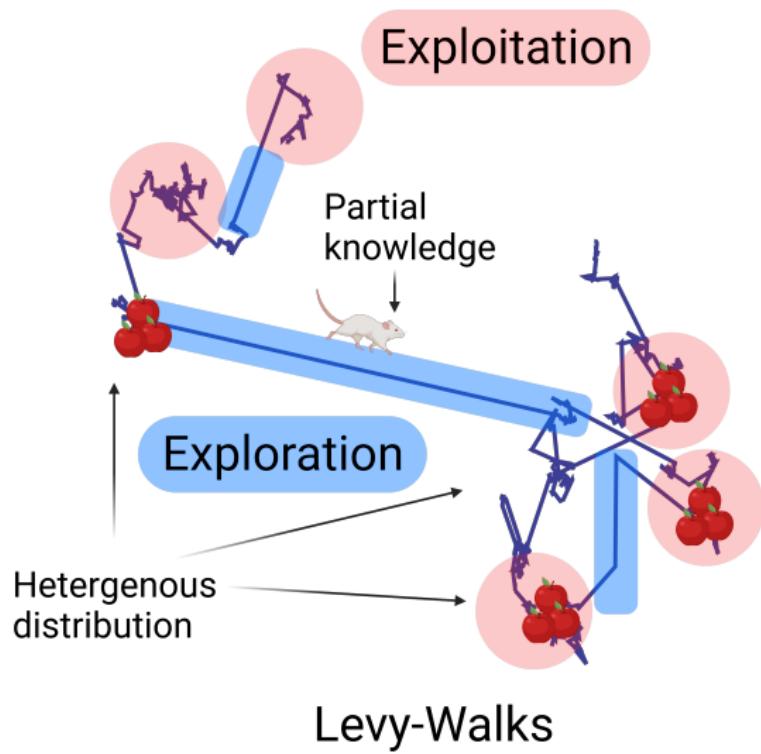
¹Bartumeus et al. (2014)

Food-seeking behavior evolved to deal with uncertainty,
balancing between exploration and exploitation



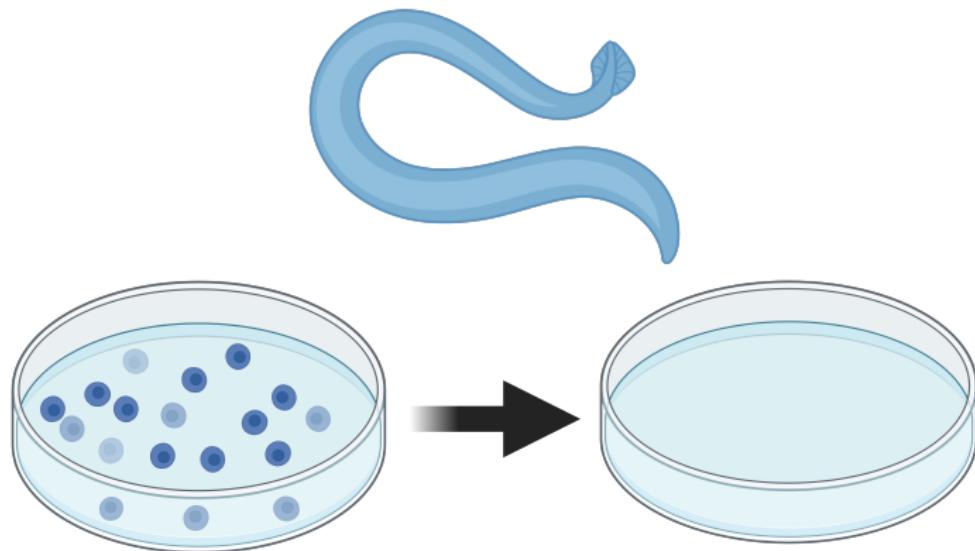
²Sims et al. (2014); Raichlen et al. (2014); Wosniack et al. (2017)

Food-seeking behavior evolved to deal with uncertainty, balancing between exploration and exploitation



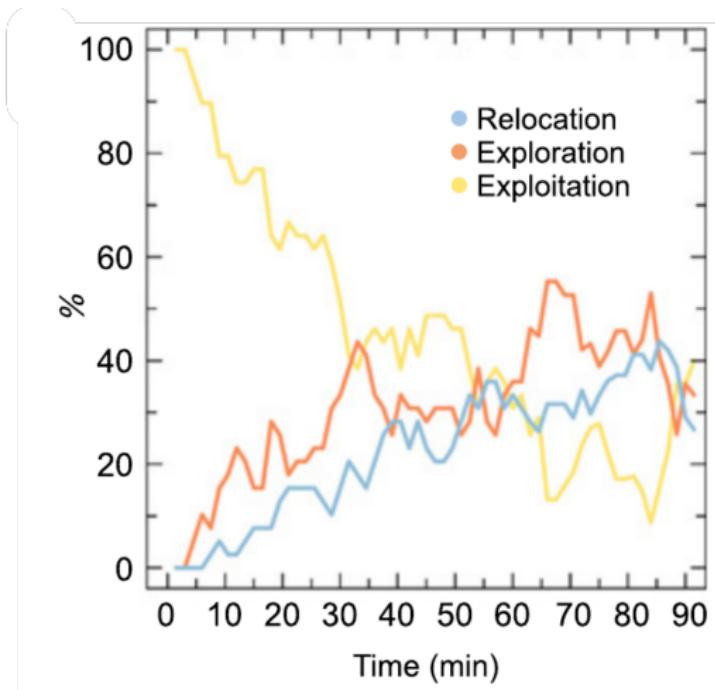
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Dealing with uncertainty is inherent to food-seeking behavior



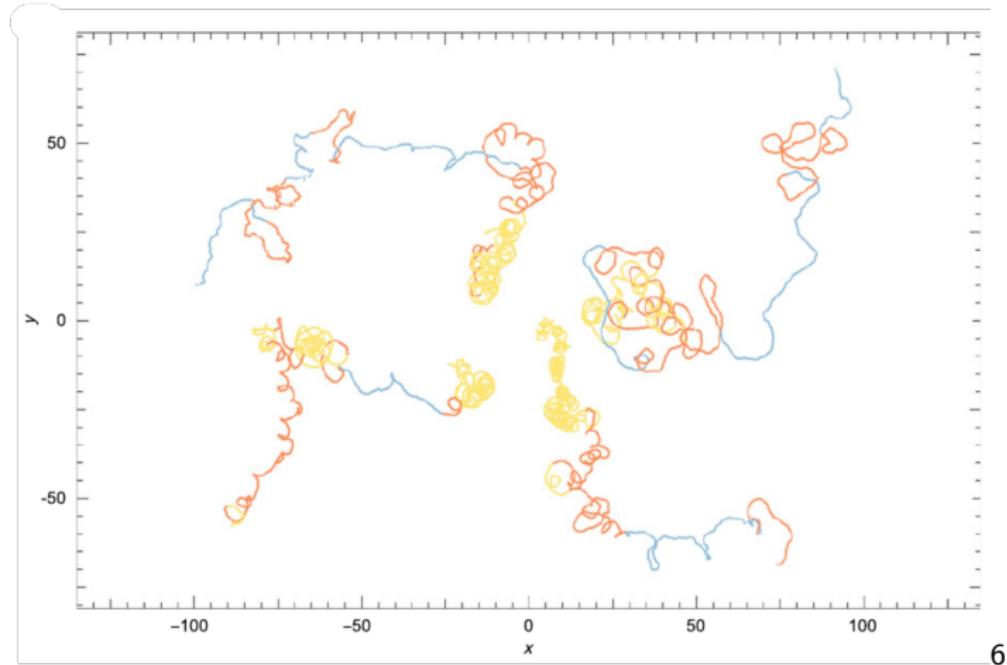
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Dealing with uncertainty is inherent to food-seeking behavior



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Dealing with uncertainty is inherent to food-seeking behavior

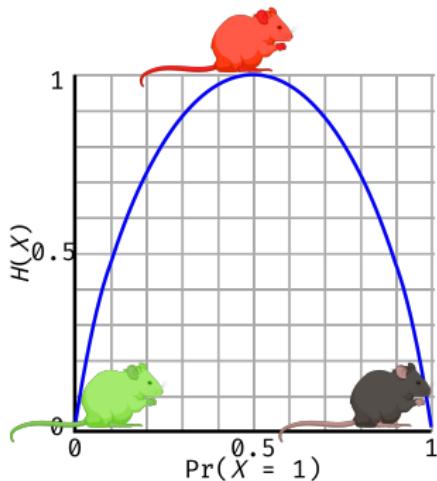


⁶Bartumeus et al. (2014)

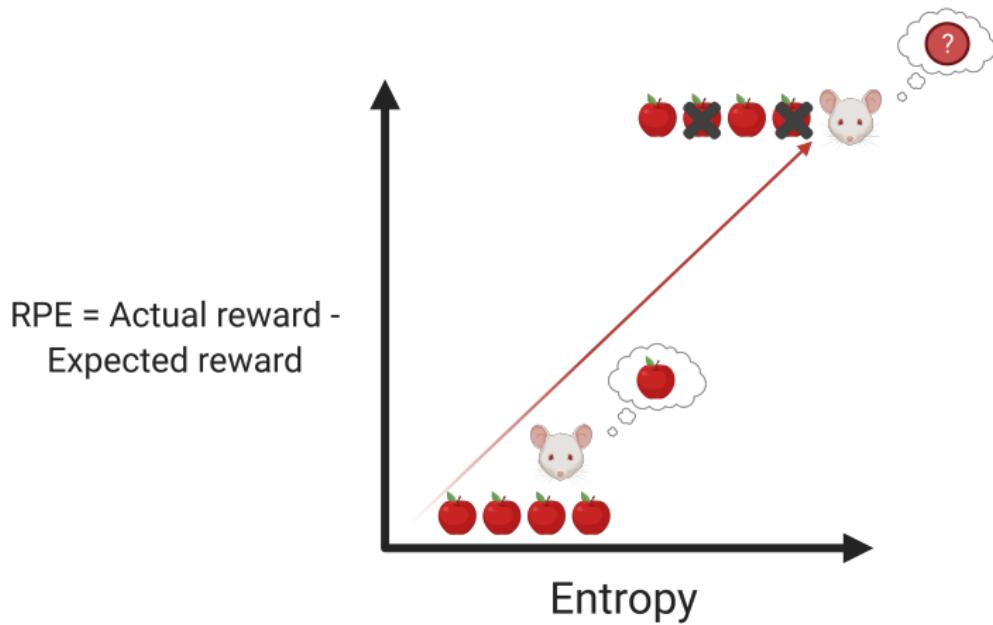
Key points

- 1 Due to limited perceptual ranges, animals must balance between exploration and exploitation
- 2 Exploratory behavior is triggered to reduce uncertainty of unknown food-sources
- 3 Food-seeking behavior adapted to deal with uncertainty by balancing between exploration and exploitation

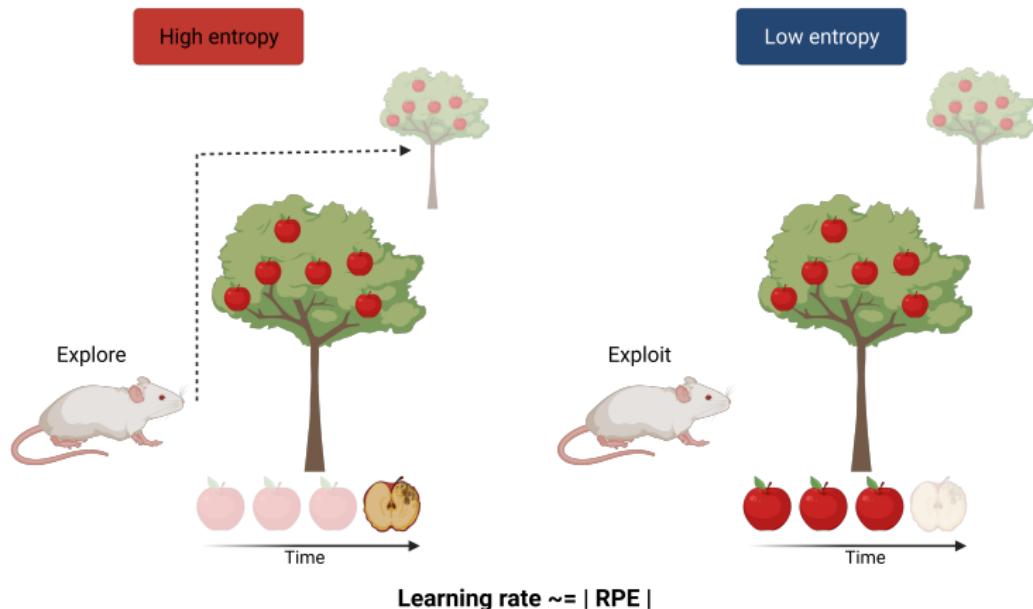
Uncertainty and behavior: entropy relates the probability of obtaining food with uncertainty



Increasing entropy makes prediction harder, leading to larger reward prediction errors



Reward prediction error changes the learning rate, adapting behavior to environment uncertainty



Key points

- ① Entropy allows us to link food-access probability with uncertainty
- ② The reward prediction error offers an indirect measure of environment uncertainty
- ③ The reward prediction error bias exploration/exploitation through the learning rate

Modeling food-seeking behavior in uncertain environments

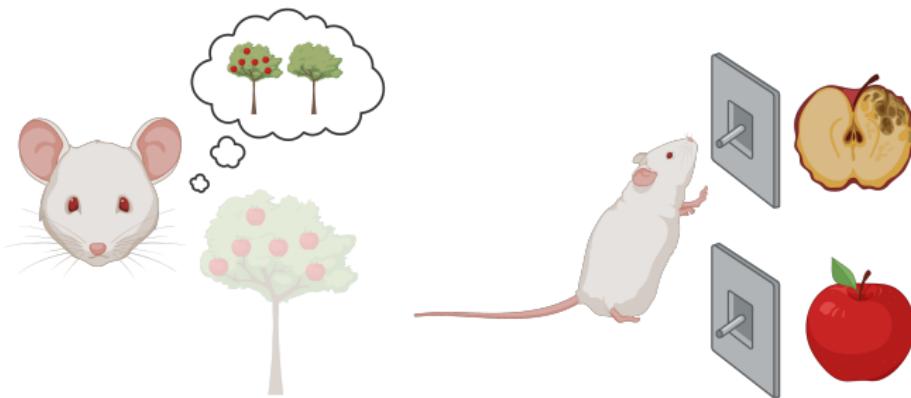
Food-seeking behavior modeling starts by expected value computation



Expected value $\sim=$ Past value + (RPE * Learning rate)

Expected value $\sim=$ Action | State

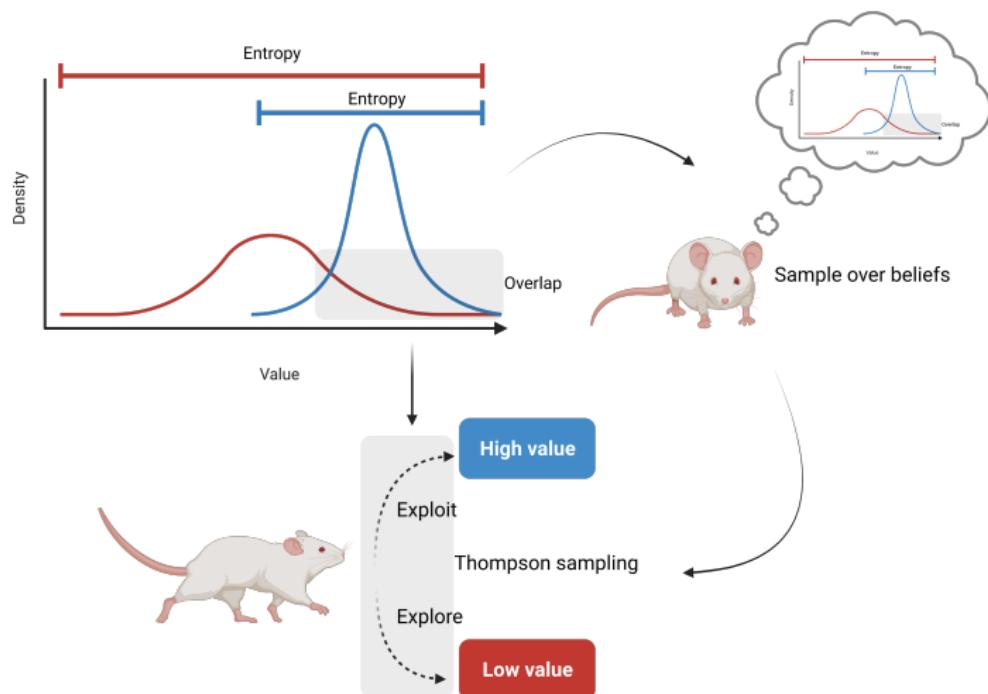
Food-seeking behavior modeling starts by expected value computation



Expected value $\sim=$ Past value + (RPE * Learning rate)

Expected value $\sim=$ Action | State

Food-seeking behavior modeling starts by expected value computation



Key points

- 1 Uncertainty is inherent to food-seeking behavior and forces the animal to balance between exploration and exploitation
- 2 Uncertainty can be sensed indirectly through direct experience
- 3 The main aspects of food-seeking behavior can be modeled with RPE, learning rate and thompson sampling

Neural basis of uncertainty-driven food-seeking behavior

References

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- Sims, D. W., A. M. Reynolds, N. E. Humphries, E. J. Southall, V. J. Wearmouth, B. Metcalfe, and R. J. Twitchett. 2014. "Hierarchical Random Walks in Trace Fossils and the Origin of Optimal Search Behavior." *Proceedings of the National Academy of Sciences* 111 (30): 11073–78. <https://doi.org/10.1073/pnas.1405966111>.
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