

Doctoral thesis proposal

Orexin and uncertainty effects on food-seeking behavior

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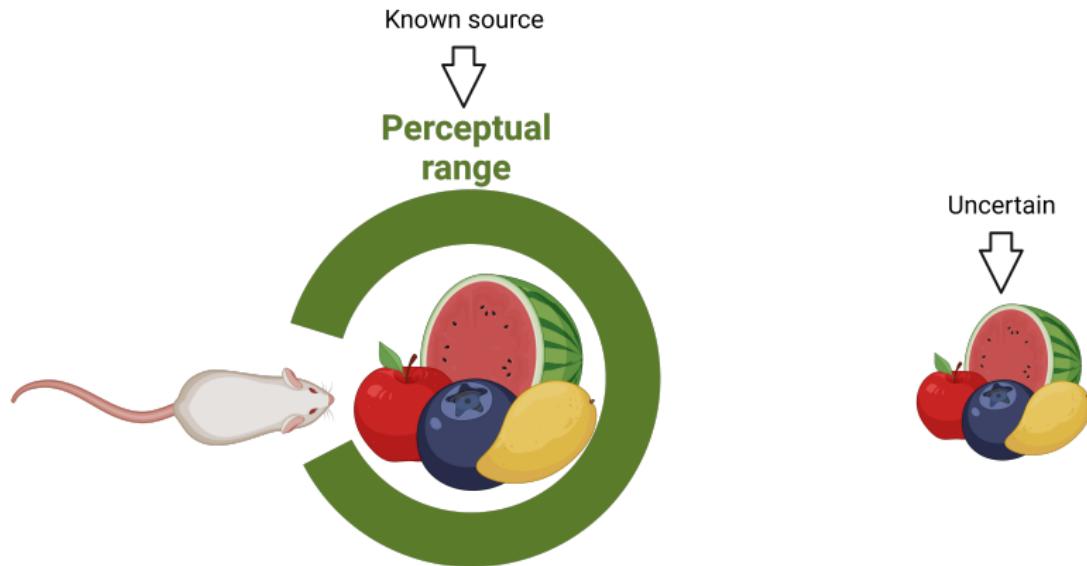
Neurobiology and Obesity (NBO) lab <https://www.nbolab.cl/>

Food-seeking and uncertainty

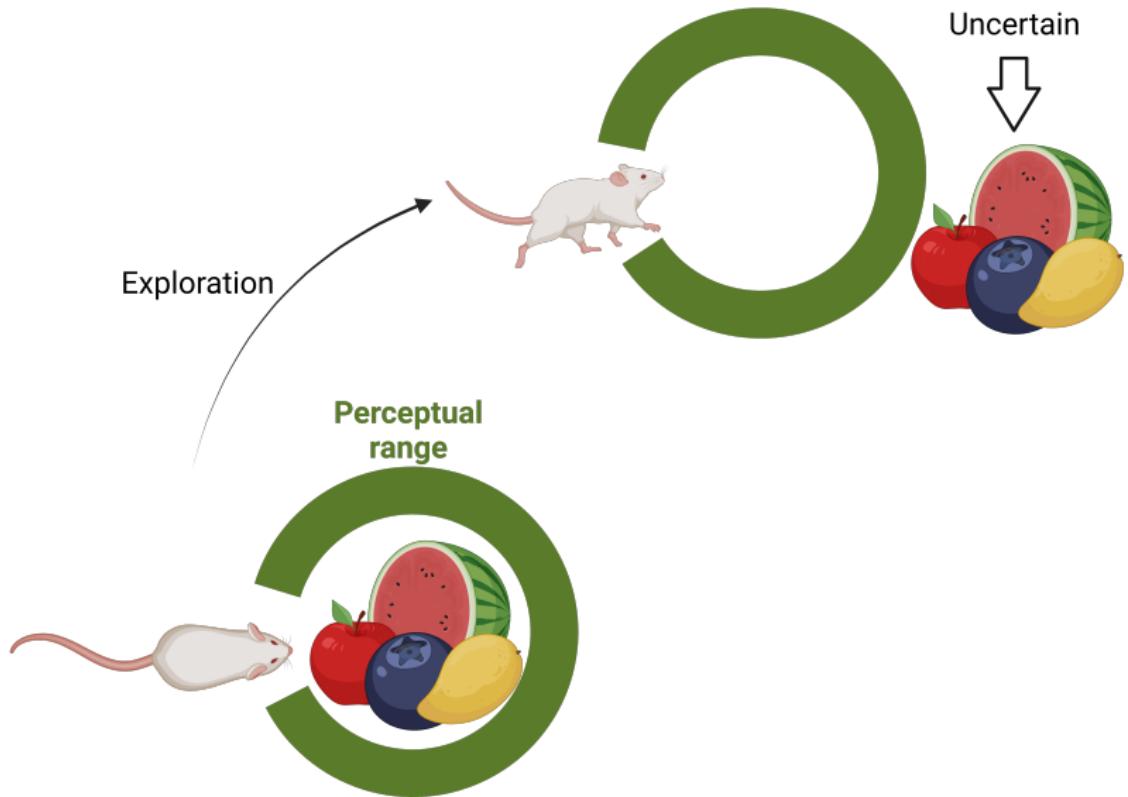
Food-seeking behavior is the coordination of locomotor activity with internal and external cues to procure food



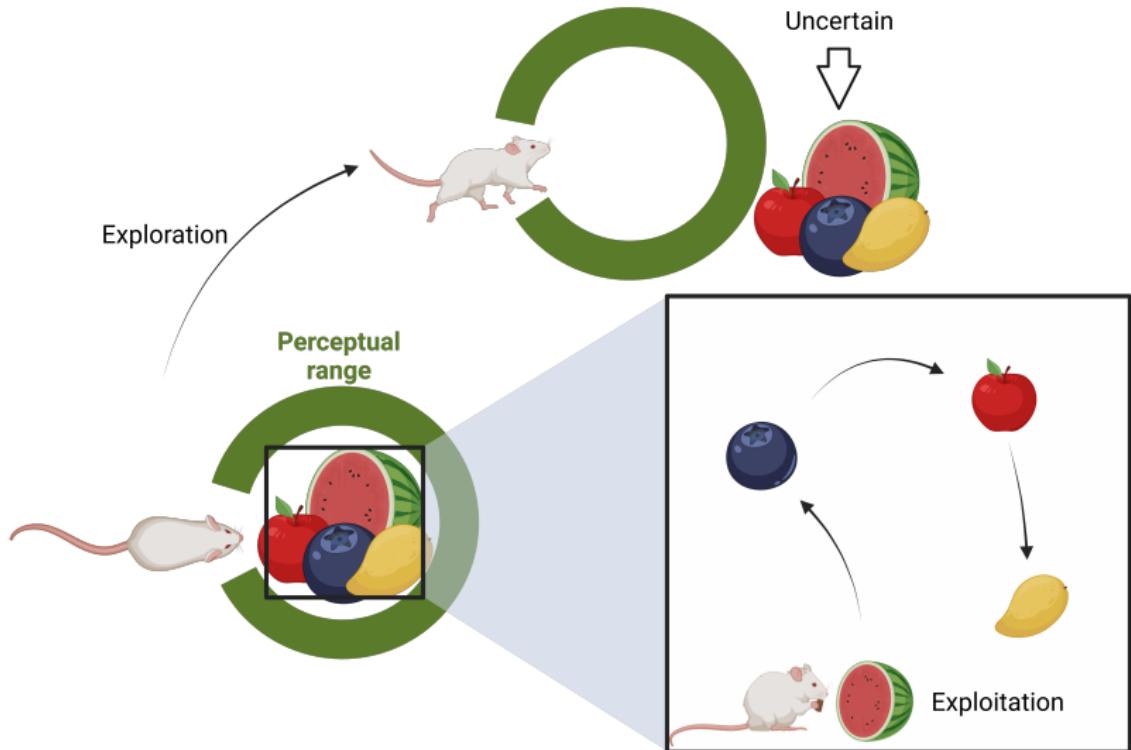
Food-seeking behavior implies a state of partial knowledge



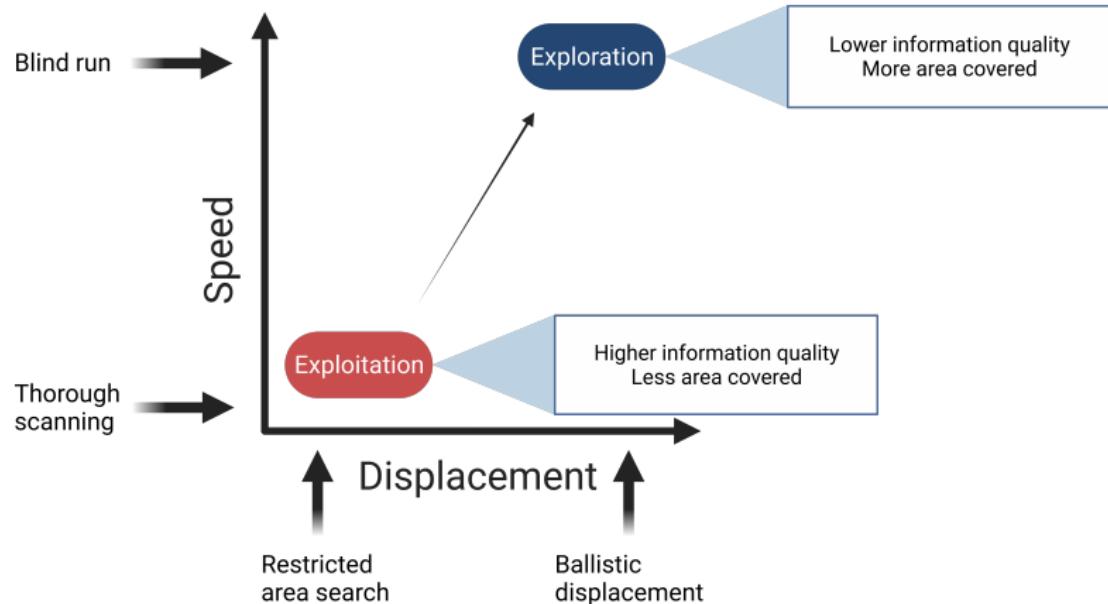
Partial knowledge forces animals to explore for new food sources



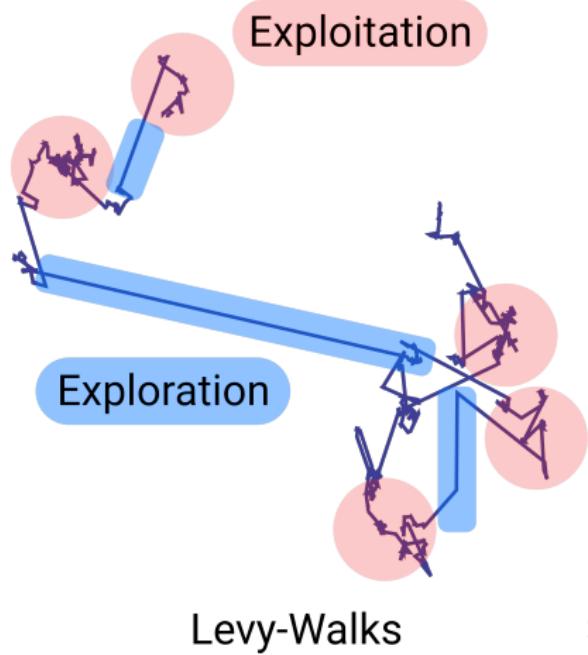
At some point animals need to stop exploring and start exploiting



Uncertainty is inherent to food-seeking behavior



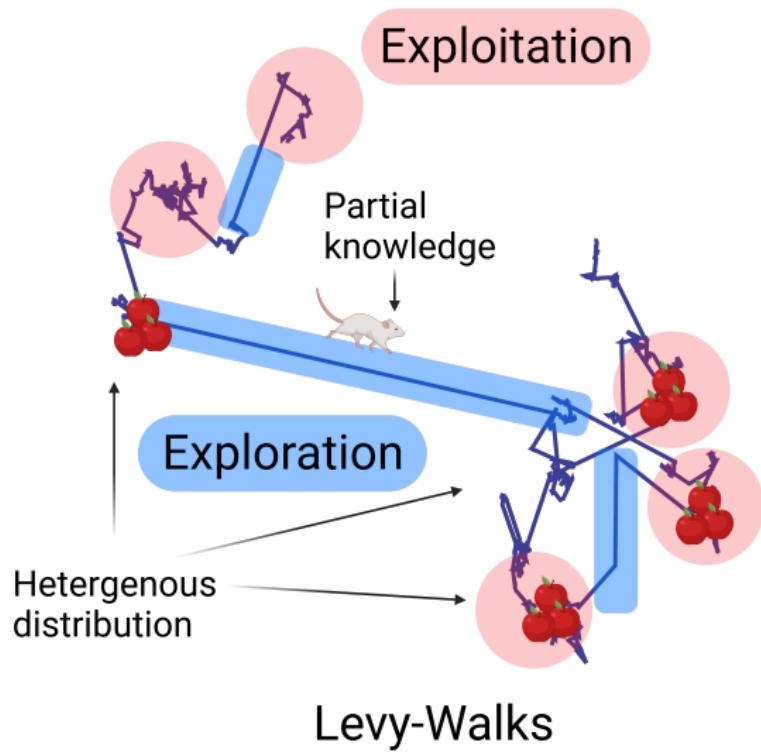
Food-seeking behavior evolved to deal with uncertainty,
balancing between exploration and exploitation



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

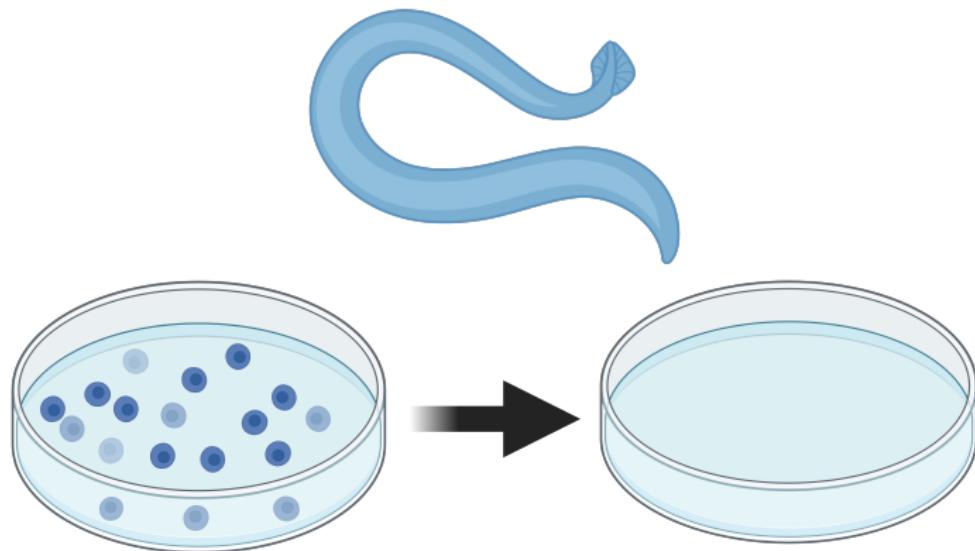
Food-seeking behavior evolved to deal with uncertainty, balancing between exploration and exploitation



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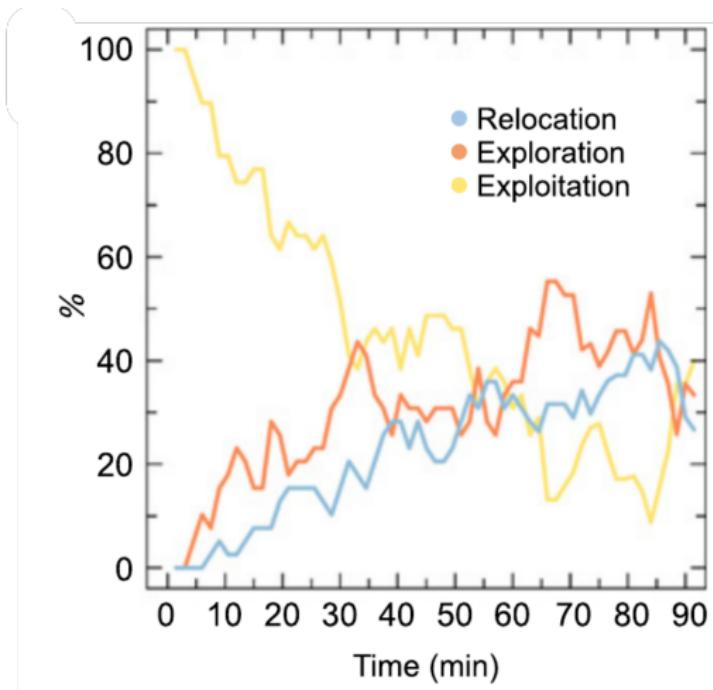
³Sims et al. (2014); Raichlen et al. (2014); Wosniack et al. (2017)

Dealing with uncertainty is inherent to food-seeking behavior



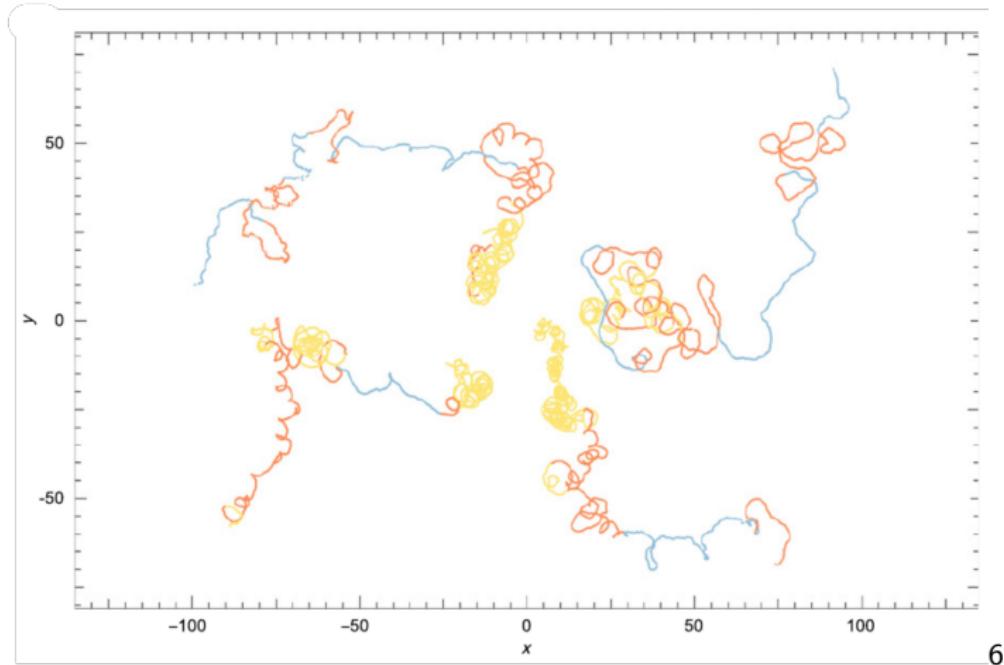
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Dealing with uncertainty is inherent to food-seeking behavior



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Dealing with uncertainty is inherent to food-seeking behavior

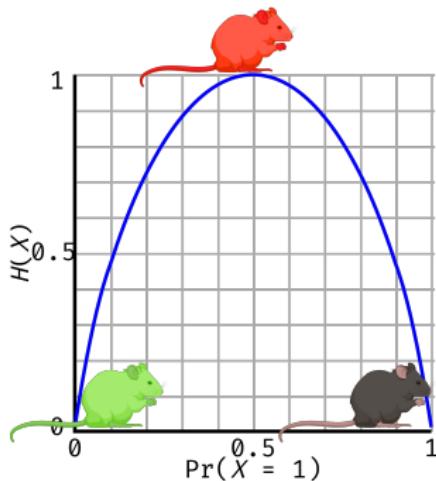


⁶Bartumeus et al. (2014)

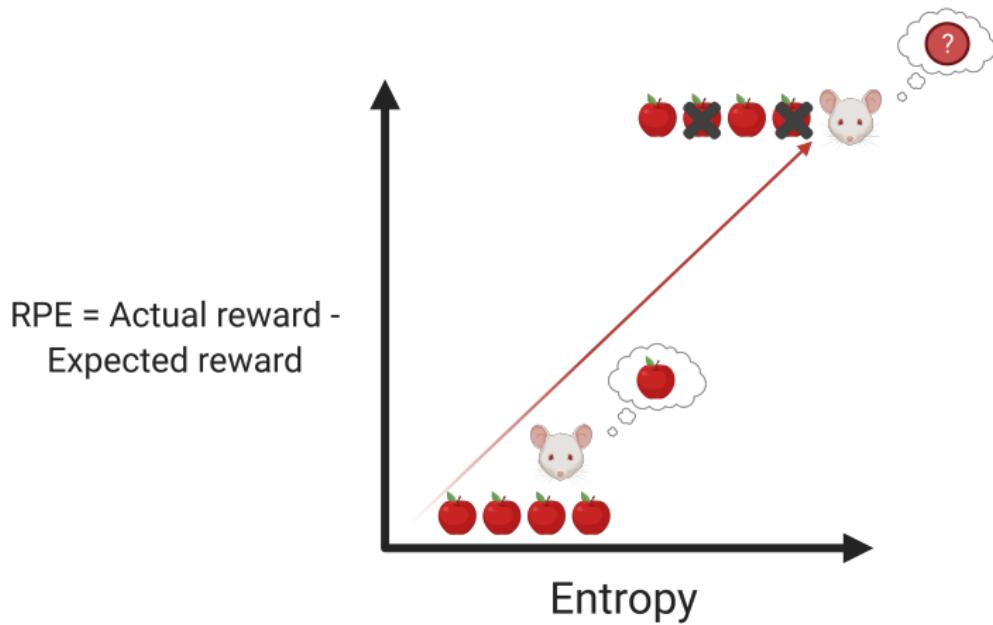
Key points

- 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

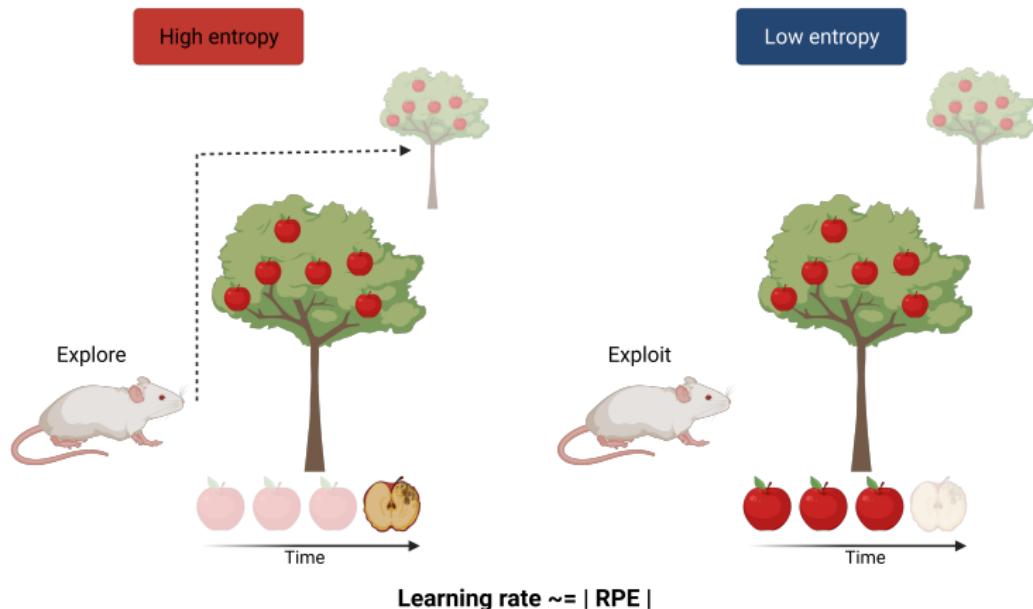
Uncertainty and behavior: entropy relates the probability of obtaining food with uncertainty



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

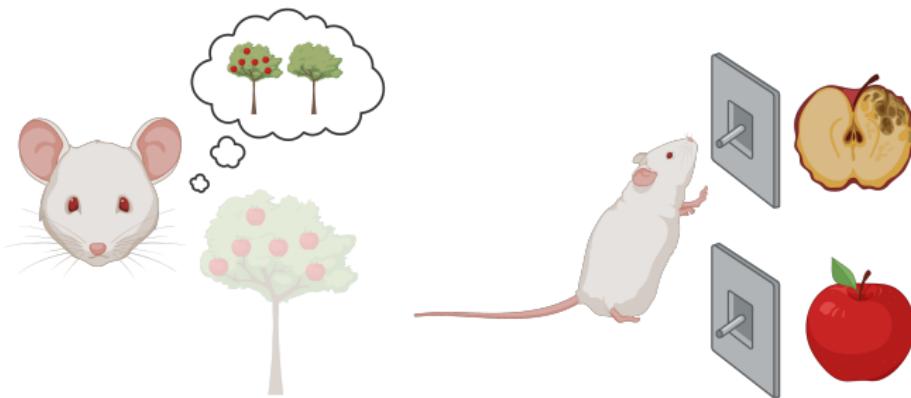
Food-seeking behavior modeling starts by expected value computation



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

Expected value $\sim=$ Action | State

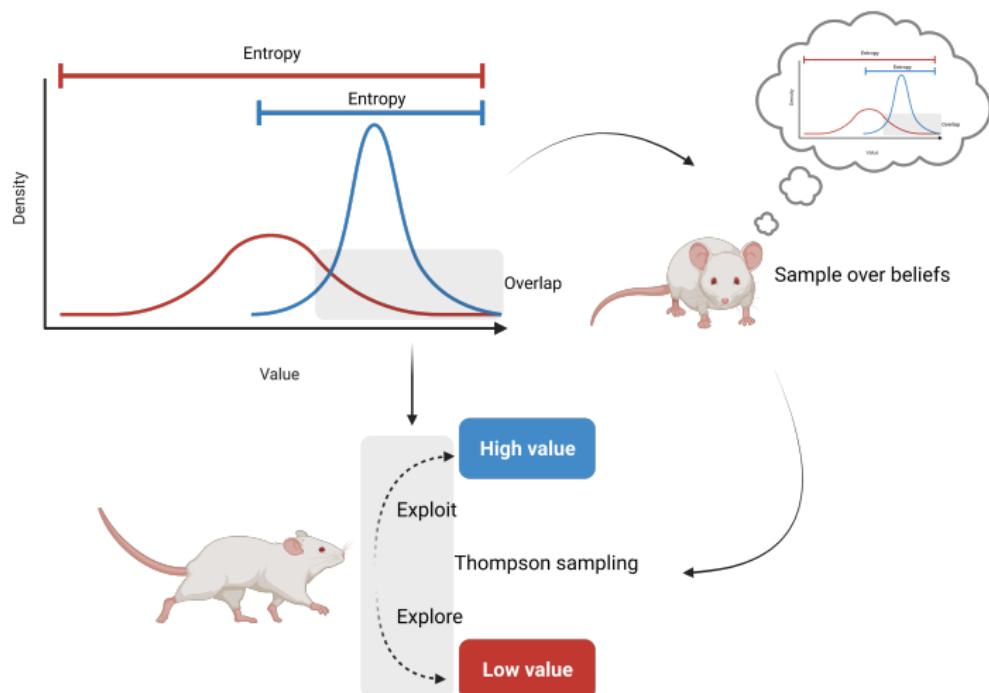
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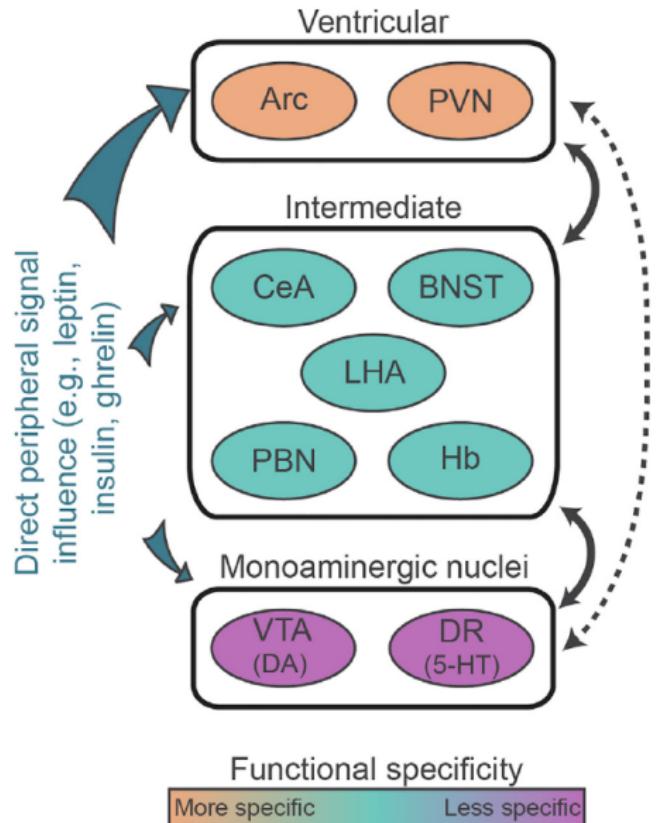


Key points

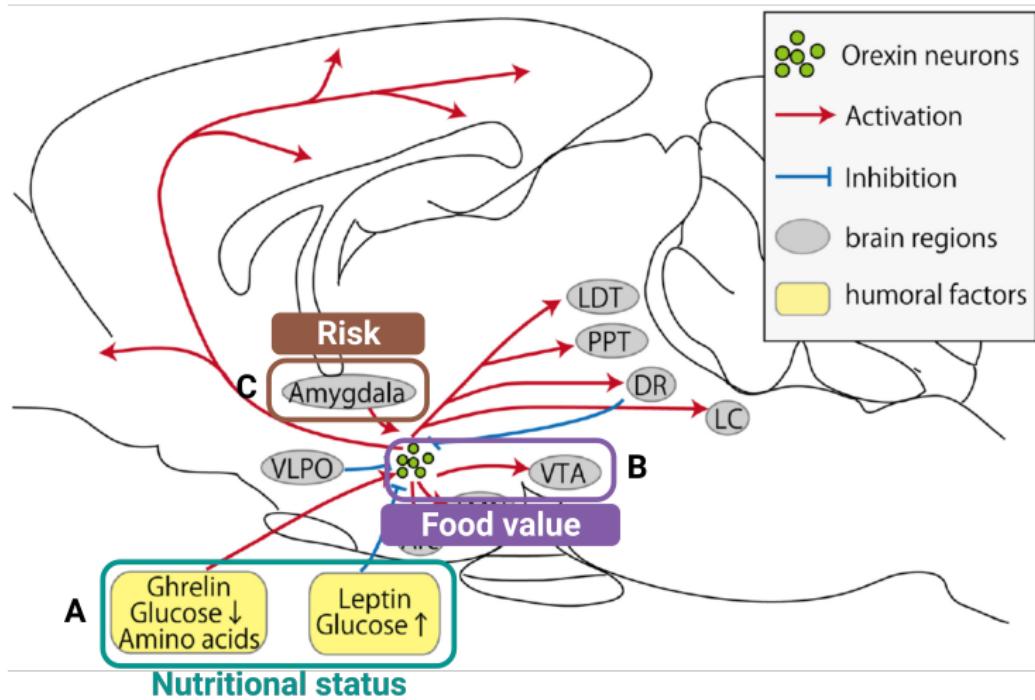
- 1 Uncertainty is inherent to food-seeking behavior and forces the animal to balance between exploration and exploitation
- 2 Uncertainty can be sensed indirectly through direct experience
- 3 The main aspects of food-seeking behavior can be modeled with RPE, learning rate and thompson sampling

Neural basis of uncertainty-driven food-seeking behavior

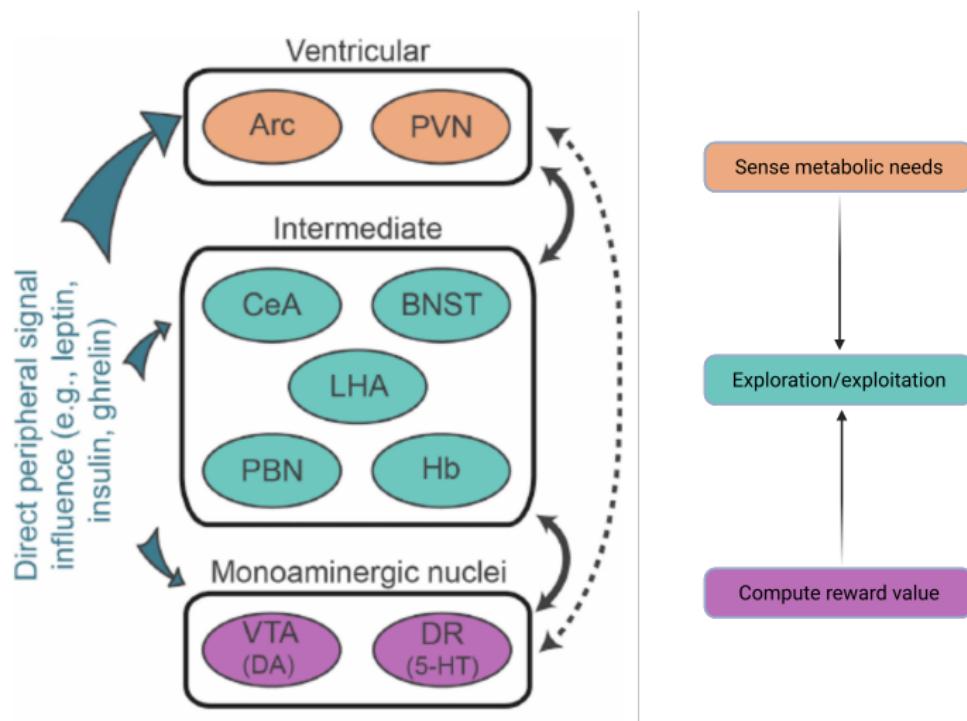
Reward and feeding centers connectivity permits procuring rewarding food to meet metabolic demands



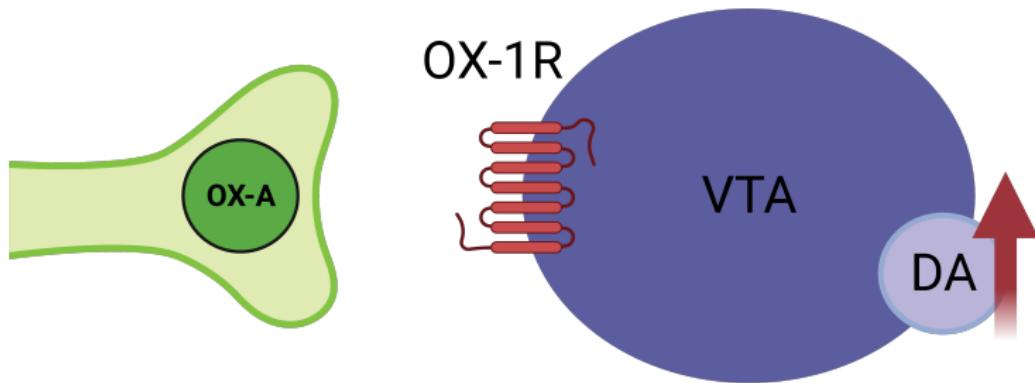
Orexin could modulate exploration/exploitation through VTA DA activity



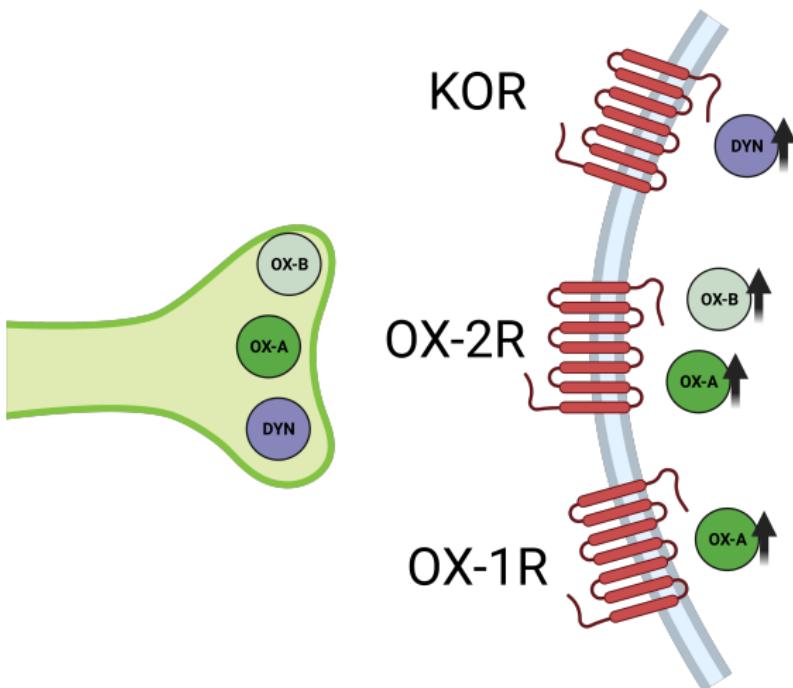
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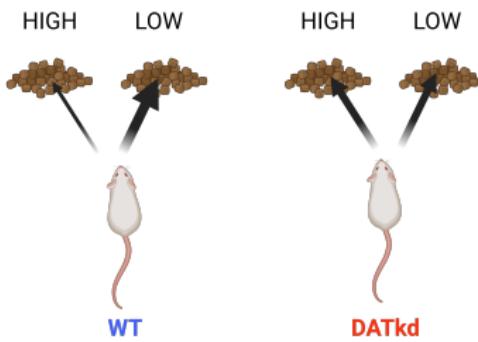
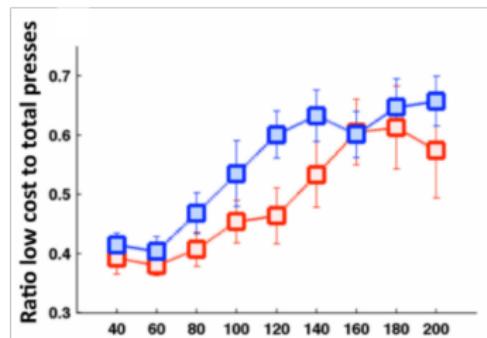


Orexin could modulate exploration/exploitation through VTA DA activity

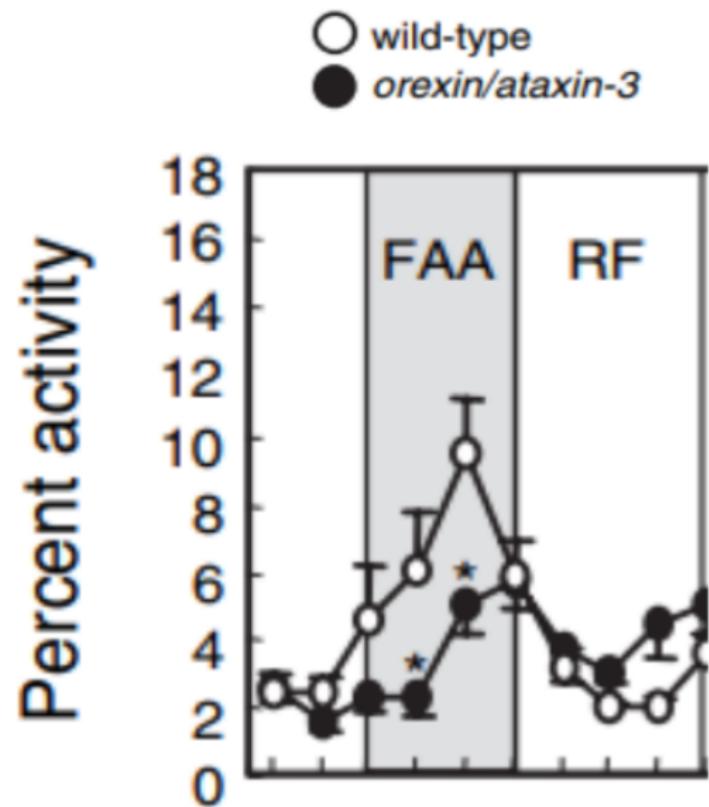


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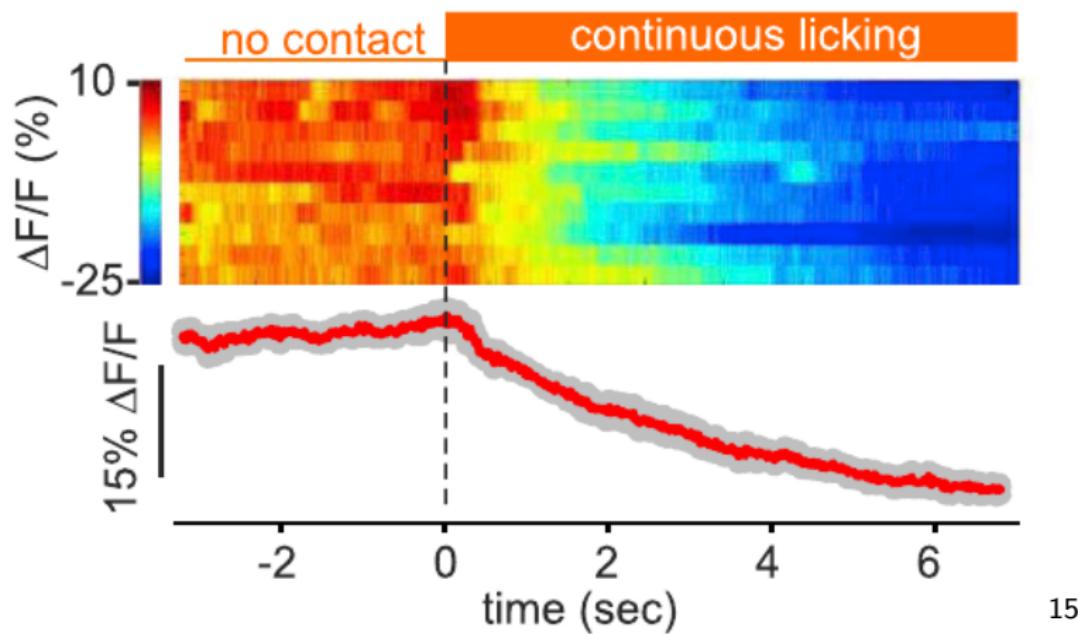
LHA orexin activity is specific to food-seeking behavior



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VTA DA tonic activity encodes entropy

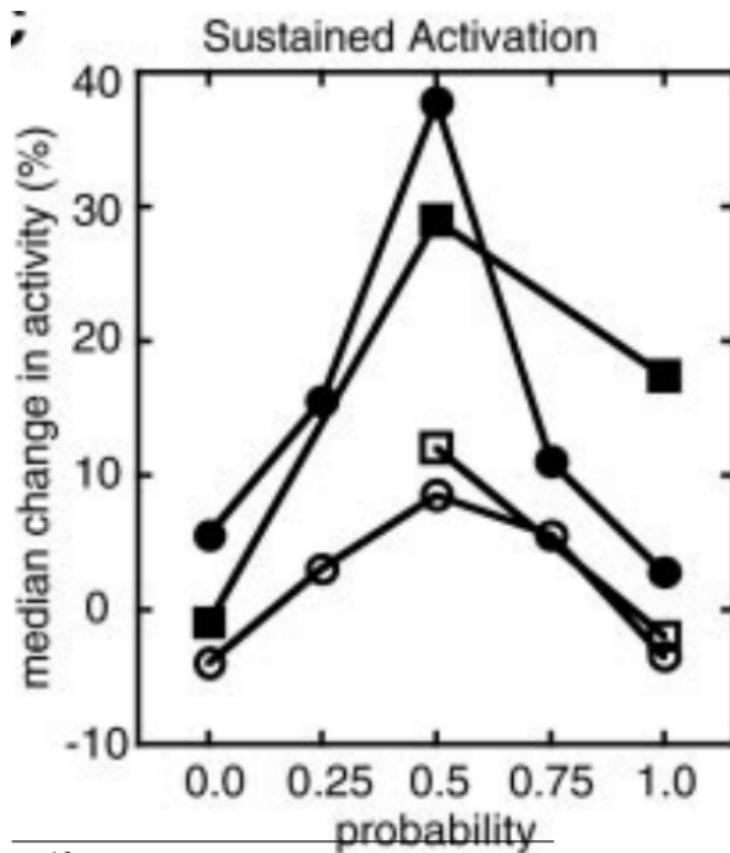


Key points

- 1 Orexin coordinates locomotor activity towards procuring food
- 2 VTA DA tonic activity encodes entropy
- 3 Orexin functional connectivity with VTA, allows modulation of exploration/exploitation in food-seeking behavior

Food-seeking in modern obesogenic environments

High calorie food items are of easy access



References

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