A rational model of perceived control, negative thinking, and avoidance

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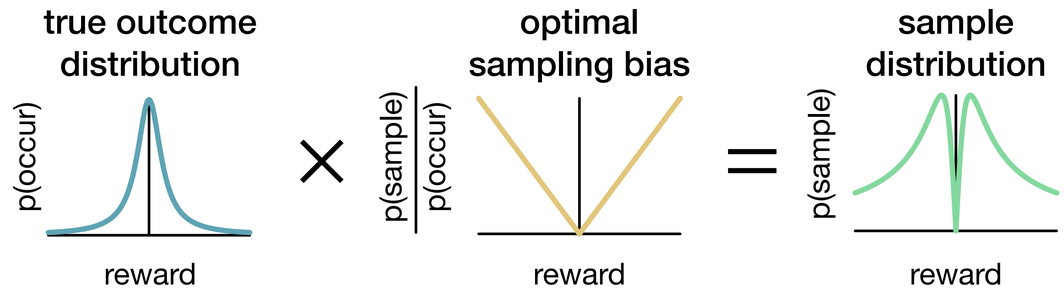
1 Background

- Anxiety and depression are associated with low perceived control, negative thoughts, and avoidance.
- Zorowitz et al. (2020) model low perceived control as pessimistic value estimation, showing that that this can produce excessively cautious behavior (avoidance).
- However it remains unclear **how** pessimistic value estimation relates to negative thinking, and **why** it is produced by low perceived control.

How and why does low perceived control lead to negative thinking and avoidance?

2 Why think about bad things?

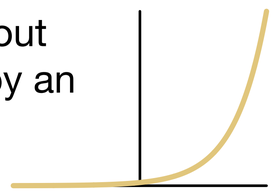
Intuitively, thinking about bad things prevents you from taking on too much risk. Lieder et al. (2018) show that an optimal agent is biased to consider **extreme** outcomes.



When the worst outcomes are more extreme than the best (*negative skew*), there is a **negativity bias**.

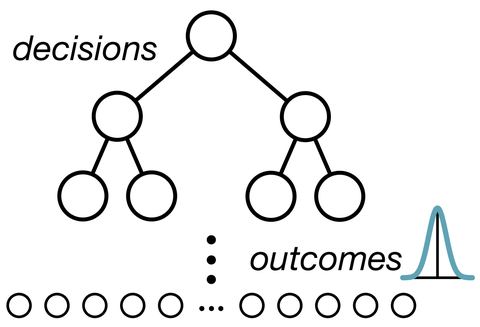
3 Why is negativity specific to anxiety?

In the general population, people tend to think about good things. Empirically, this tendency is well-fit by an **exponential sampling bias** (Bear et al 2020). We propose that this captures **perceived control.**

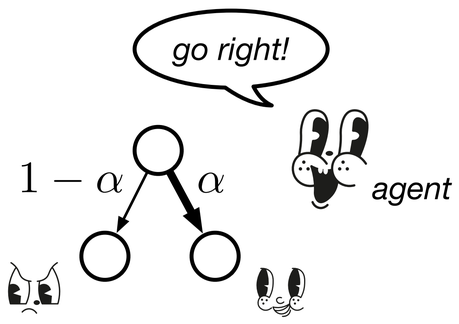


Is an exponential sampling bias a good way to capture one's degree of control?

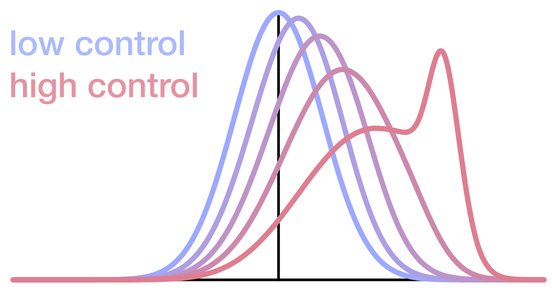
We model the **environment** as a deep binary decision tree with outcomes at the leaves.



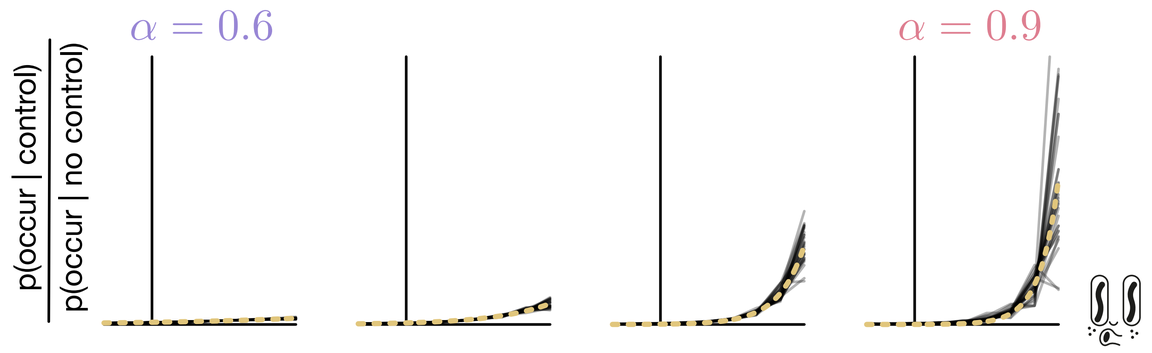
We model **control** as the probability of transitioning to the intended state.



Agents with control achieve better outcome distributions.



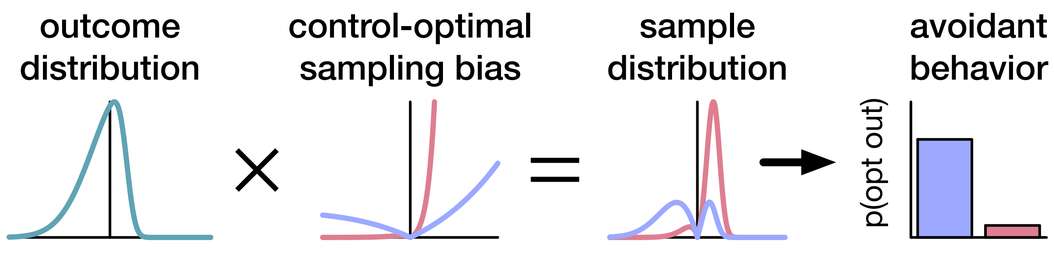
We quantify the effect of control by dividing the controlled outcome distribution by the baseline distribution (no control).



It's well fit by an exponential! This suggests an exponential sampling bias is a good way to approximate one's control.

4 From anxiety to avoidance

We model avoidance by allowing the agent to *opt out*, receiving a fixed reward of zero. The decision is made based on one sample from the control-optimal sample distribution.

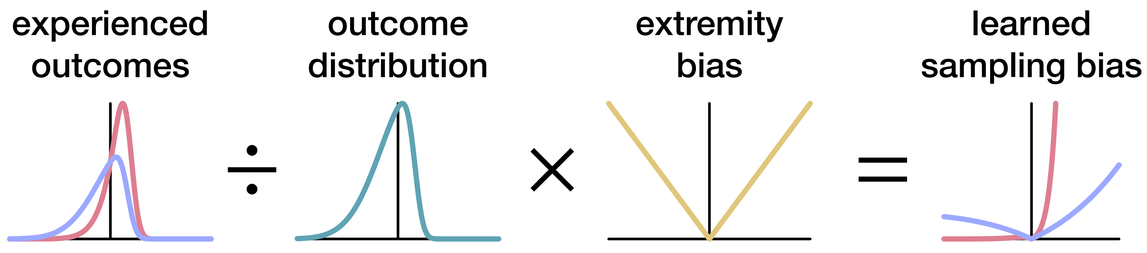


Agents with diminished perceived control over-sample bad outcomes and avoid risky but beneficial opportunities, especially when the outcomes have **negative skew.**

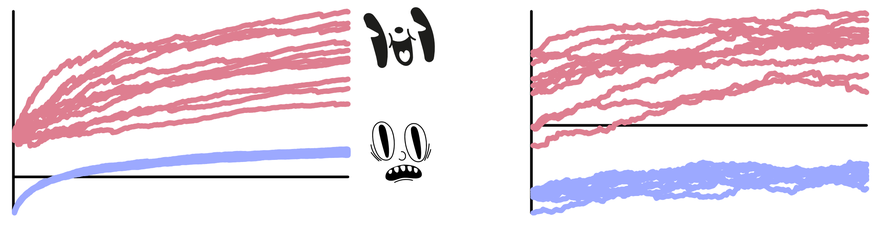
5 Why would you underestimate control?

Anxiety has been associated with early life adversity. Why don't people update when their control increases?

We allow an agent to learn the slope of their exponential bias to match the outcomes they receive in a binary tree.



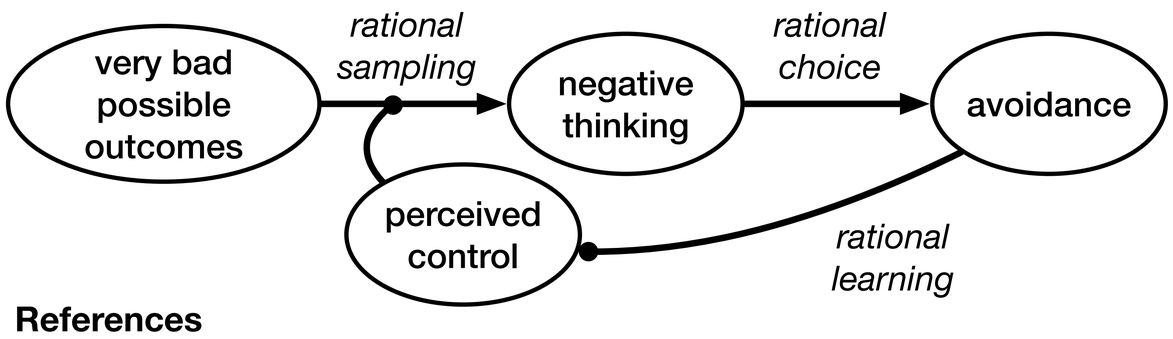
All agents have high control and the same (skewed) outcome distribution, but early outcomes are fixed to be good or bad.



An initial low control estimate leads the agent to avoid valuable, but risky, opportunities. This reinforces their false belief that they have low control, creating a **learning trap**.

6 Summary

A rational agent with low perceived control will focus on extreme negative outcomes and avoid risky situations, reinforcing an underestimate of control.



References

Zorowitz, Momennejad & Daw (2020). Anxiety, avoidance, and sequential evaluation. *Computational Psychiatry.*
Lieder, Griffiths & Hsu (2018). Overrepresentation of extreme events… *Psychological Review*.
Bear, Bensinger, Jara-Ettinger, Knobe & Cushman. (2020). What comes to mind? *Cognition*.