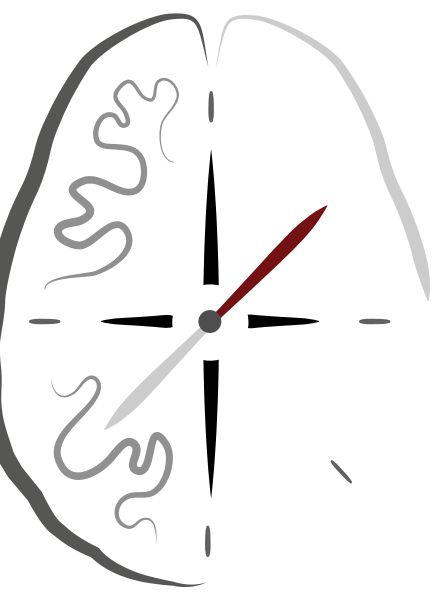


# A rational model of perceived control, negative thinking, and avoidance



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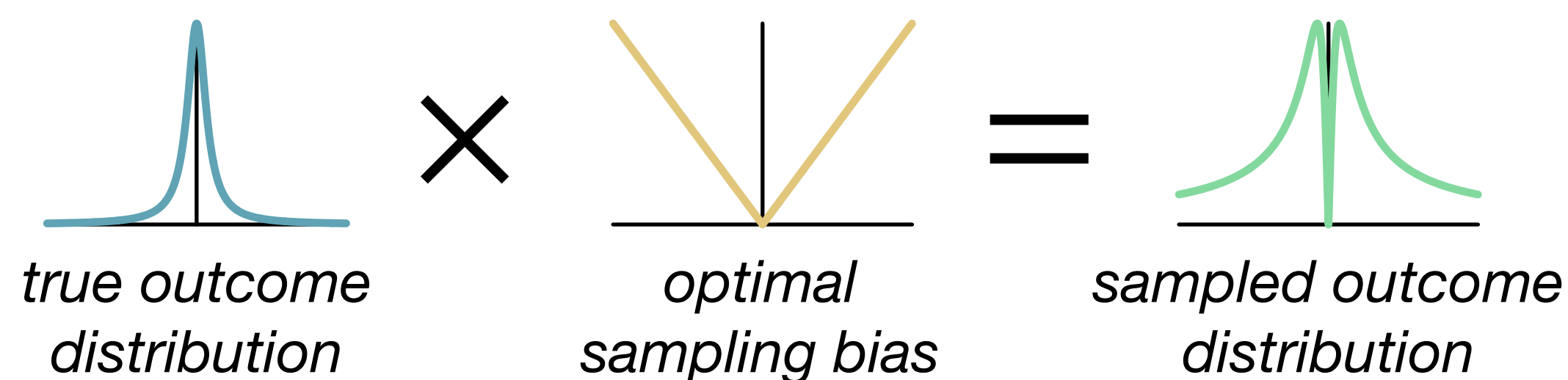
## Background

- Anxiety and depression have been associated with perceived lack of control, negative thoughts, and avoidance.
- A recent model (Zorowitz et al., 2020) connects all three symptoms to a single pessimism bias.
- But it remains unclear *why* people would selectively think about the worst possibilities.

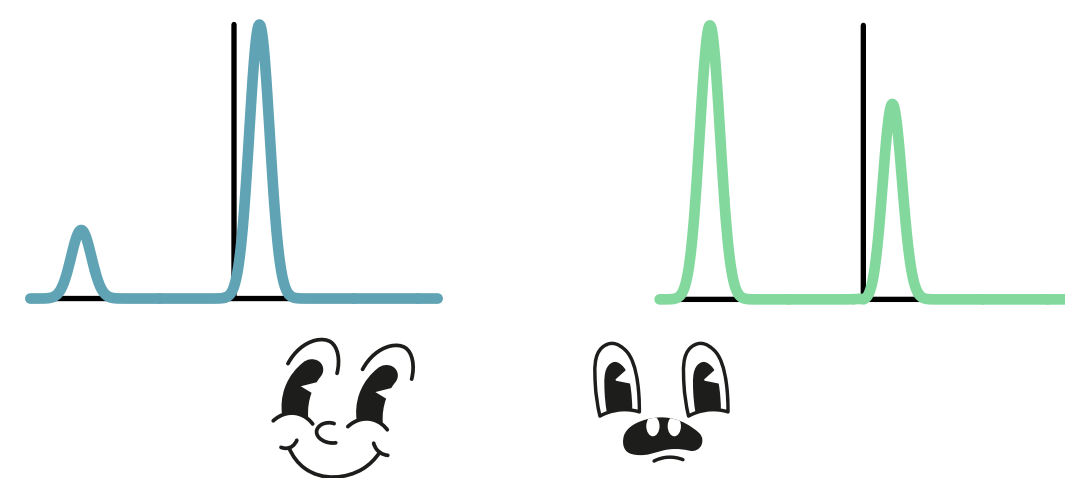
*Why does low perceived control lead to negative thinking and avoidance?*

## 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!



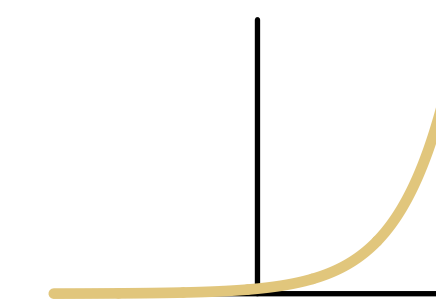
## References

- Zorowitz, S., Momennejad, I., & Daw, N. D. (2020). Anxiety, Avoidance, and Sequential Evaluation. *Computational Psychiatry*.
- Lieder, F., Griffiths, T. L., & Hsu, M. (2018). Overrepresentation of extreme events in decision making reflects rational use of cognitive resources. *Psychological Review*.
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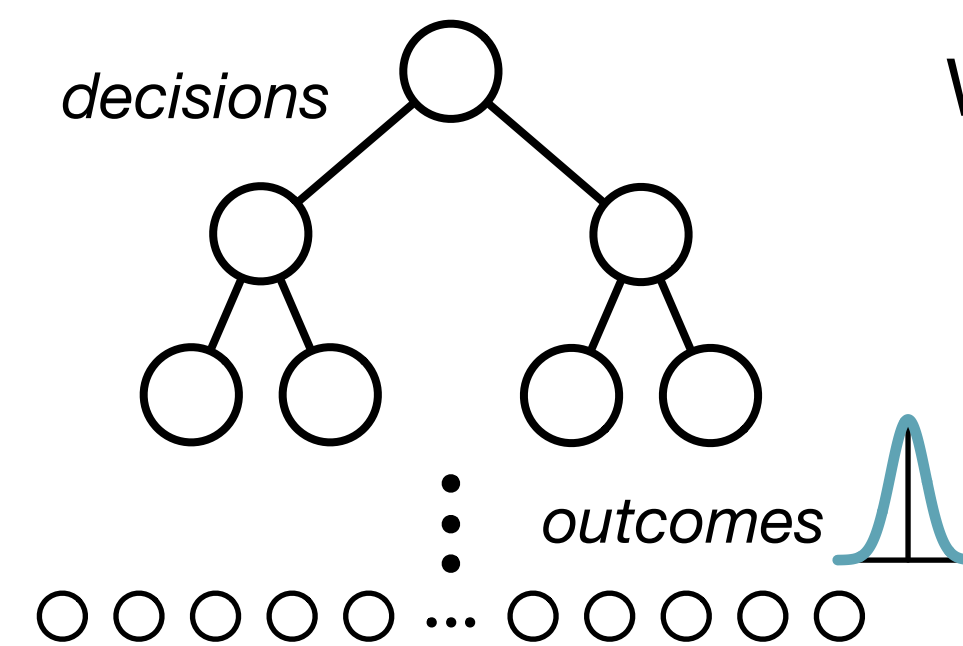
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## Why is negativity specific to anxiety?

In the general population, people show a tendency to think specifically about *good* things. Bear et al. (2020) model this as an **exponential sampling bias**. We propose that this captures **perceived control**.

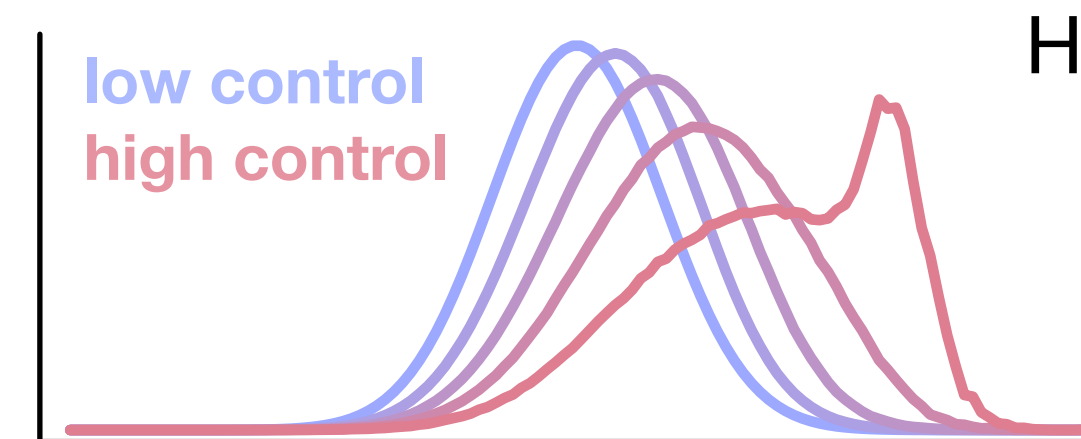
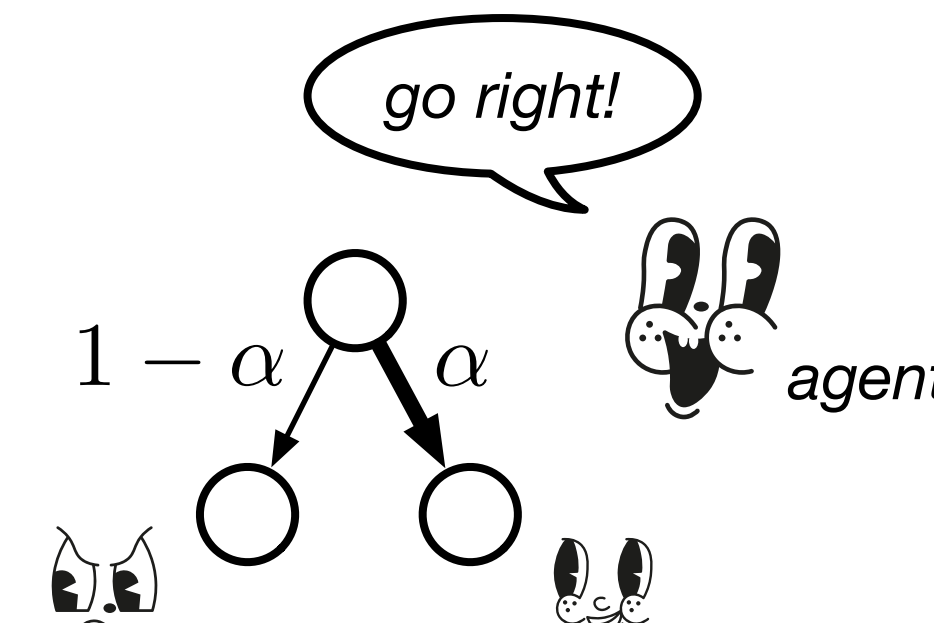


*Is an exponential sampling bias a good way to capture one's degree of control?*



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

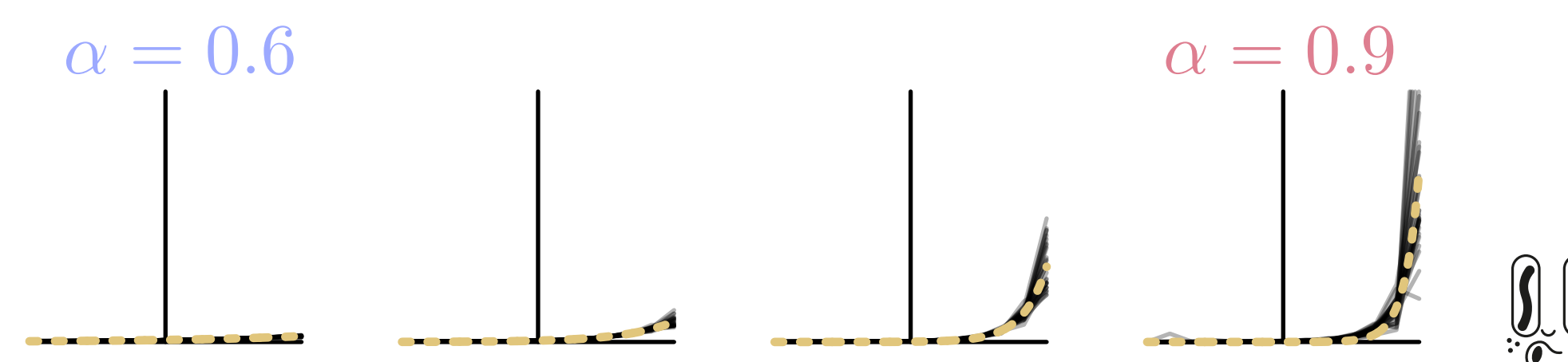
We model **control** as the probability of transitioning to the intended state.



Higher control yields better outcome distributions.



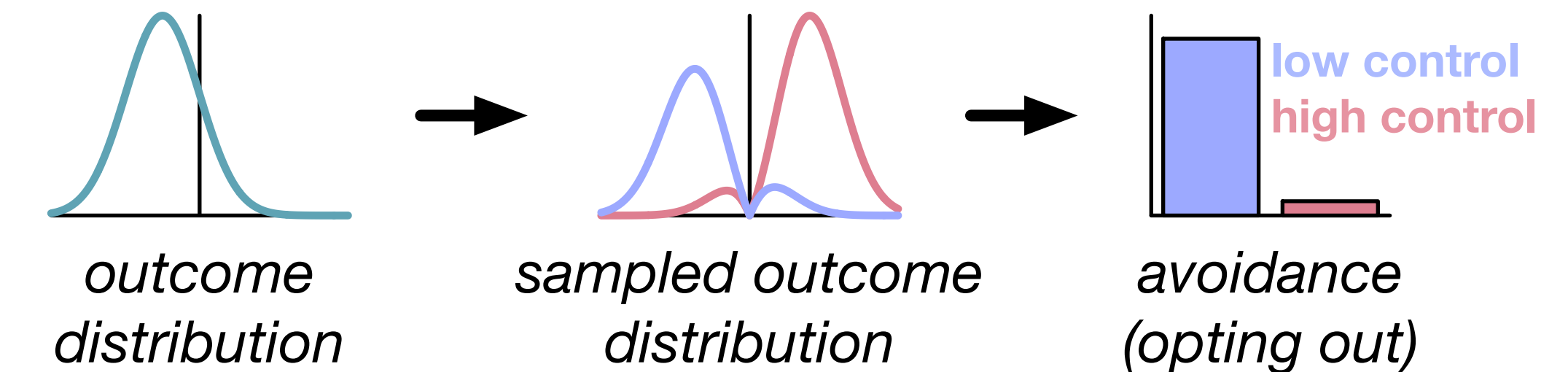
We quantify the effect of control by dividing the controlled outcome distribution by the baseline distribution (no control).



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

## From anxiety to avoidance

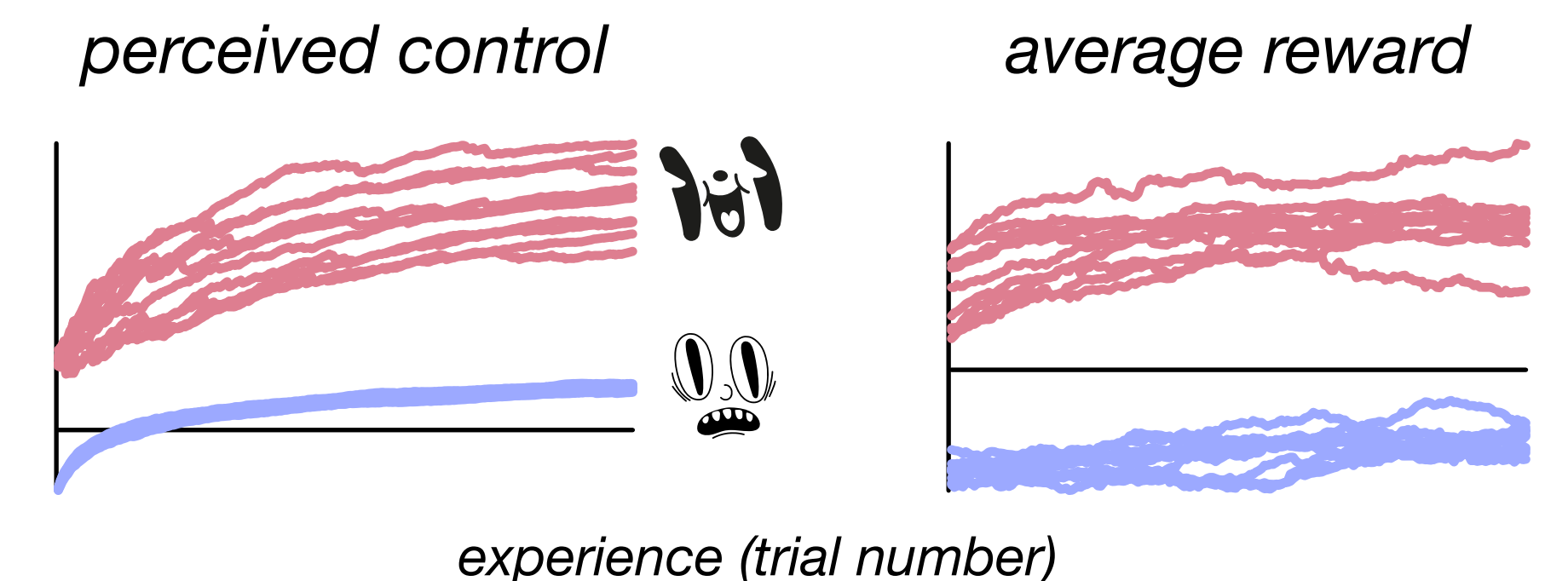
Agents with diminished perceived control over-sample bad outcomes and avoid risky but beneficial opportunities.



## Why do people underestimate control?

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

We model this by allowing an agent to **learn** their degree of control based on the outcomes they receive, with early outcomes fixed to be **positive** or **negative**.



When the outcomes are negatively skewed, agents who start with a few bad experiences avoid valuable, but risky, opportunities. This reinforces their false belief that they have low control, creating a **learning trap**.

## Takeaways

- Thinking about bad things is a rational response to environments with extreme possible outcomes.
- This tendency is ameliorated if you believe you have control, and can prevent those outcomes.
- Early life adversity can create a learning trap, yielding a persistent underestimation of control.