

## 19. Gopnik 2020, The explore-exploit tradeoff

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**The explore-exploit tradeoff:** In many situations, agents face a tradeoff between exploring the environment (to learn how to better make use of it), and exploiting what they already know about it.

Examples: restaurant choice; hobbies; friendships.

Schematic example: *two-armed bandit*.

- $L_1$  has a known 50% chance of a payout (of \$1) on any given pull, independently of the others.
- $L_2$  has an unknown chance—either 60% or 40%—of a payout on any given pull (again, independently).
- Suppose you're going to be allowed to pull it twice. What's the best strategy? Why?

No gambler's fallacy!

If  $G$ , it's 60%; if  $\neg G$ , it's 40%.  
 $cr(G) = cr(\neg G) = 0.5$

This is an instance of a very common type of situation.

Can you think of other examples of explore-exploit tradeoffs?

Exactly how to "solve" (do best in expectation) in a given explore-exploit tradeoff is a very hard ("computationally intractable") problem.

E.g. suppose 10 chances at lever. How long pull  $L_2$  before switch to  $L_1$  if it's not going well?

### Kids

Children are often thought of as paragons of irrationality: unable to stick to plans or exhibit self-control (marshmallow experiment), prone to day-dreaming and fantasy, and generally less competent than adults.

Evolutionary puzzle. Why spend so many resources on unproductive childhood?

Extension of childhood coincides with the rapid changes that led to modern humans: increased brain size and longevity, better causal reasoning, language, social and cultural cognition.

Gopnik's answer: the explore-exploit tradeoff!

Children are much smarter than you think; rate of learning is meteoric.

- One-shot learning.
- Motor control.
- Language.
- Social cognition.

At some points, may be learning dozens of words per day. (Must learn 50,000 between one and mid teens—only  $\approx 5000$  days!.)

"Explore" picture fits with children's plasticity and flexibility, tendency to play and fantasize/imagine, etc.

**Q1:** Suppose Gopnik's hypothesis is right. Would that mean that children are rational?

**Q2:** Are there other domains where this type of explore-exploit tradeoff might make sense of apparently irrational behavior?