ANBI 159: Biological and cultural perspectives on intelligence

Lecture 5: Animal learning

http://weber.ucsd.edu/~jmoore/courses/

Chimpanzee Walter rolls heavy log to tree with climbable branch just above shockwire, persistently trying to use it to leap up; abandons effort once, but then some returns with different log & succeeds. Once in tree, teases another chimp by dangling leaves out of reach (& pulling them away at right moment), but eventually throws bunches of leaves down to others.

Where does Occam's Razor slice *this* video?

Family of Chimps 8m 5s

Fur-rubbing by *Cebus*; they recognize leaves of vine *Piper*, seize & frantically rub leaves & stems over themselves. *Piper* has anti-mosquito, antibiotic properties, and *Cebus* use more during wet season when infections & mosquitoes more common. Not all populations do this, apparently 'cultural' in some sense.

Does this *look* "intelligent" ??

Social Climbers 2m 31s

Lots of animals doing things that roughly fit concepts of "intelligent"

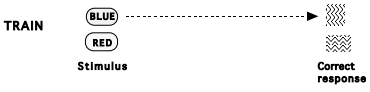
But in sense, back to Romanes' problem. Instead of single individuals (anecdotes), we have "single species" -- what they (can) do is real, but how do we understand it all - put together into a single conceptual framework?

Comparative method offers an approach: look for patterns across species, use patterns to generate predictions that can be tested with new/different data.

Studying animal learning

SO - tools for comparisons...

To study nonhuman learning, first the subject needs to learn how to show you s/he is learning.



Match to sample

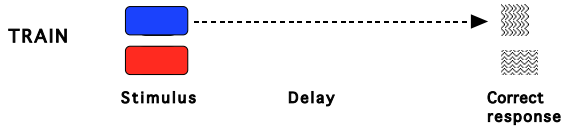
Prospective encoding

Once that done, can study the process of learning and hence what's going on in the mind.

E.g., how is memory (representation) stored?

Test based on assumption based on studies of humans that like interferes with like (color with color, lines with lines). Pigeon learns: when see blue, then offered choice of patterns after a delay, peck the vertical ones and get food. Delay on order of 15 seconds.

Delayed match to sample



Prospective encoding

Then try to mess them up.

Flashing the green right after the blue confuses them, they become unreliable and make lots of errors - as expected.

Prospective encoding

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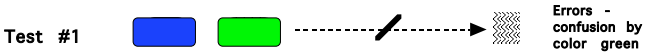
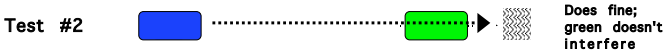


However, if flash the green later in the delay period, they do fine:



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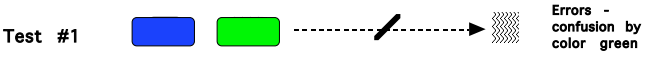

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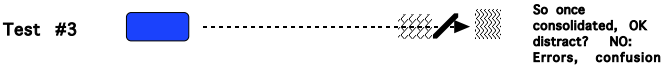
H_1: it takes seconds to consolidate original stimulus, once that done, can't really distract the animal.

BUT: if you flash weird lines *late in the delay period,* you DO confuse: Note: if you flash weird lines near start, no problem.



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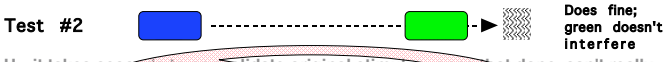

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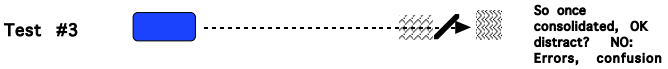
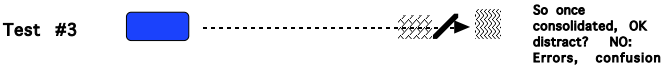


H_2: generate representation, not ONLY of original stimulus ["mere consolidation"] but also of the not-yet-visible "expected" stimulus-- & you stuck with concept of expectation, *and a mind to put it in*. They "prospect" for the expected stimulus. NOT merely like interferes with like.

Mental representations in the wild



Pigeons prospectively encode in the lab. Does that have 'ecological validity' - i.e., anything like that going on in "reality"?

Search image: e.g., jays tend to eat one type of insect at a time, regardless of abundance. Or *you*, looking for familiar vs. unfamiliar item in a new store.

That search image is an *expectation*, evidence of mind.

Mental representations in the wild

Cognitive maps:

Give rat A 10 trials to find food, and rat B simply allowed to explore until 'bored' for 10 trials.

On 11th, both get food (so B knows reason to go to particular place).

On 12th trial, both rats *equally efficient* at finding food -- B learned maze *just as well* by exploring *without* a specific goal.

Maps and minds

Cognitive maps: Both can find food from any starting place, must have overall concept of "*I'm here, food is at X, shortest distance is ...*" -- i.e., a map. Map has to *be* someplace - mind (and this lots more complex than those expectations... right?)

So, *minds exist*

Behaviorism / Descarte can claim minds do not exist in nonhumans, or that whether do or not, it is impossible and therefore improper to study them.

But controlled experiments & natural observations provide evidence that *minds of some kind exist in nonhumans*. Formally demonstrated our intuition from lecture 1.

MODULE II: What's it for?

Making predictions based on detecting and remembering reliable, relevant event *correlations*.

So that's what learning mechanisms should be designed for.

Classical conditioning: Pavlov's dog

Ring bell then give (drool-producing) food; eventually dog salivates at bell.

Dog learns that bell 'predicts' food, and salivation is evidence of 'expectation' based on this prediction.

That 'expectation' could be some sort of mental representation of an E1 - E2 correlation (event 1 = bell, event 2 = food).

Classical conditioning: natural example

Bird makes positive connection between rain and worms coming out, so pays to hunt after rain. Might also represent correlation between sunshine and no worms, not waste time hunting then.

Classical conditioning: test?

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How demonstrate this really represents learned expectation, rather than not detecting correlation in first place, *or* FAP?

Classical conditioning: test *in nature?*

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How demonstrate this really represents learned expectation, rather than not detecting correlation in first place, *or* FAP?

Correlation ≠ causation - so seeing forage only in rain doesn't prove that the reason involves expectation about worms.

Classical conditioning: test *in lab*

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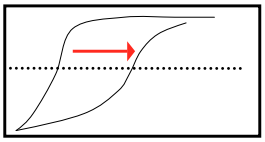
How demonstrate this really represents learned expectation, rather than not detecting correlation in first place, *or* FAP?

Lab: Create positive correlation between sun and worms. IF had prior negative association, should take *longer to learn* than if had no association at all.

Classical conditioning: learning rates

Lab: Create positive correlation between sun and worms. IF had prior negative association, should take longer to learn this than if had no association at all.

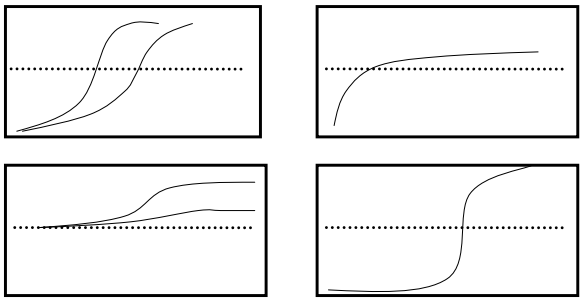


This is why rate of learning in different paradigms is important for learning mechanisms

In statistics, correlation can go equally either way.

In real world, want to learn causal mechanisms (who cares if food --> bell). Hence conditioning usually more effective if **conditioned stimulus** (bell) presented before **unconditioned stimulus** (food), rather than after. **E1** (aka **CS**) precede **E2** (aka **UCS**), with little or no delay. This sort of learning nearly universal, insects etc.

Learning curves



What is on the X axis??

Individual trials, or blocks of trials?

What does each of these show?