inhibitory conditioning, opponent processes and introduction to instrumental conditioning

PSY/NEU338: from animal learning to changing people's minds

Plan for today

- Inhibitory conditioning
- Opponent appetitive and aversive processes
- Instrumental conditioning(!!)

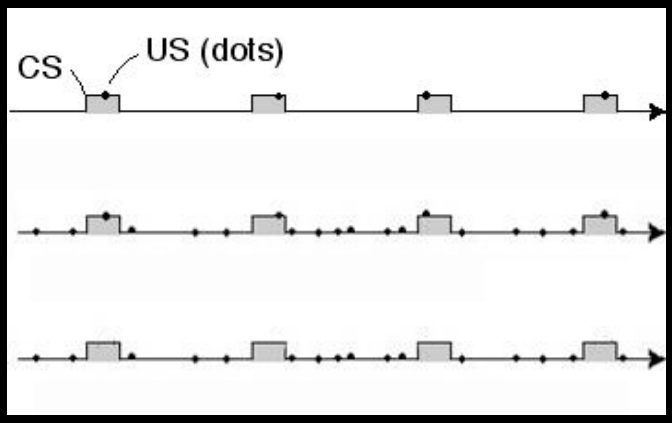
Part 1: Inhibitory conditioning

excitatory vs. inhibitory conditioning

excitatory conditioning

background conditioning

inhibitory conditioning



how can we measure an inhibitory stimulus?

1. directly: CER, withdrawal,
   (only possible for some CRs, of course)
2. summation test
   (with another classically or instrumentally conditioned stimulus)
3. retardation test
   (must be with a US of the same motivational "class")

common requirement: pass both "tests" (2+3)

how can we create an inhibitory stimulus?

1. tone → food
   tone+light → no food
   (e.g. 'closed' sign on cafe door)
2. food
   light → no food
   (also: backward conditioning)
3. A+ ; B- alternating
   (differential inhibition)

which of these can RW/TD explain?

how can we create an inhibitory stimulus?

1. tone → food
   tone+light → no food
   (e.g. 'closed' sign on cafe door)

A. can be explained by RW and TD
B. can be explained by RW but not TD
C. can be explained by TD but not RW
D. can't be explained by the models we know so far

how can we create an inhibitory stimulus?

2. food
   light → no food

A. can be explained by RW and TD
B. can be explained by RW but not TD
C. can be explained by TD but not RW
D. can't be explained by the models we know so far

how can we create an inhibitory stimulus?

3. A+ ; B- randomly mixed
   (differential inhibition)

A. can be explained by RW and TD
B. can be explained by RW but not TD
C. can be explained by TD but not RW
D. can't be explained by the models we know so far

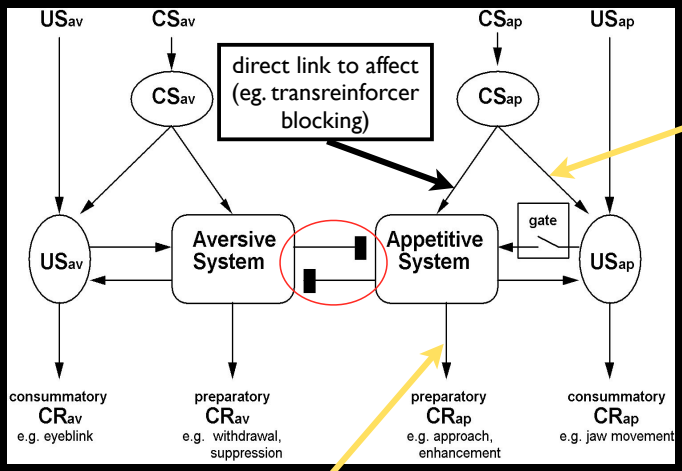
Part 2: aversive vs appetitive conditioning

appetitive vs. aversive conditioning

- Pavlov: consummatory reflexes versus defense reflexes
- more general: appetitive USs (food, water) vs aversive (acid, shock) USs
- another (intuitive) distinction: satisfiers versus annoyers

Theory: two opponent motivational systems

Konorski: opponent (antagonistic) motivational systems



CS-US associations
(eg. sensory preconditioning,
stimulus substitution)

CS-CR association
(eg. 2nd order cond)

Idea:
USs have sensory properties
(determine type of CRs)
and affective properties
(determine reinforcing ability).
The latter are only of two
possible (antagonistic) types

Konorski (1976), Balleine+Dickinson (2002)

opponent (antagonistic) motivational systems: support

1. difficult to "activate" both systems simultaneously
   - counter conditioning is hard: CS→food, then CS→shock
   - aversive and appetitive USs "cancel" each other:
     CS(shock)→food
     UR to the shock disappears as food CR acquired and shock's aversiveness is reduced
     (tested through suppression)
2. CSs associated with one motivational system will increase behaviors dependent on this system, and suppress those dependent on the other
   (tested thru PIT, also transreinforcer blocking)

the big picture

	excitatory (+1)	inhibitory (-1)
appetitive (+1)	**+1 Hope**	**-1 Frustration**
aversive (-1)	**-1 Fear**	**+1 Relief**

appetitive motivation/affect system
aversive motivation/affect system

to know what CR a stimulus will cause, you must know what type of conditioning it received, and with what type of US

Summary: Pavlovian conditioning

1. Animals can learn predictions.
   This makes sense as predictions are important for optimal decision making.
2. We can measure prediction learning through (compulsory) Pavlovian responses
3. Learning happens when predictions are violated ("surprise"; blocking)
4. Error correcting learning rules: R-W, TD
5. In the brain: Dopamine conveys prediction errors; can also be seen in target area (ventral striatum) using fMRI

How is this related to real life

- Advertising: tying products to things that make you feel good (wholesome photos) creates a positive emotional response to the product. Spot these.
- Going to throw up? You can get conditioned taste aversion. Eat something that you don't mind getting an aversion to, to "tie" the learning to it.
- Conditioned immunosuppression in Lupus/rheumatoid arthritis: we can use conditioning to our advantage
- Conditioned inhibitors don't extinguish easily… can cause avoidance behavior (instrumental), excess rituals

Clinical Trial > FASEB J. 2002 Dec;16(14):1869-73. doi: 10.1096/fj.02-0389com.

Behavioral conditioning of immunosuppression is possible in humans

Marion U Goebel [1], Almuth E Trebst, Jan Steiner, Yu F Xie, Michael S Exton, Stilla Frede, Ali E Canbay, Martin C Michel, Uwe Heemann, Manfred Schedlowski

Affiliations + expand

PMID: 12468450 DOI: 10.1096/fj.02-0389com

Abstract

Behavioral conditioned immunosuppression has been described in rodents as the most impressive demonstration of brain-to-immune system interaction. To analyze whether behavioral conditioned immunosuppression is possible in humans, healthy subjects in this double-blind, placebo-controlled study were conditioned in four sessions over 3 consecutive days, receiving the immunosuppressive drug cyclosporin A as an unconditioned stimulus paired with a distinctively flavored drink (conditioned stimulus) each 12 h. In the next week, re-exposure to the conditioned stimulus (drink), but now paired with placebo capsules, induced a suppression of immune functions as analyzed by the IL-2 and IFN-gamma mRNA expression, intracellular production, and in vitro release of IL-2 and IFN-gamma, as well as lymphocyte proliferation. These data demonstrate for the first time that immunosuppression can be behaviorally conditioned in humans.

3 minute break

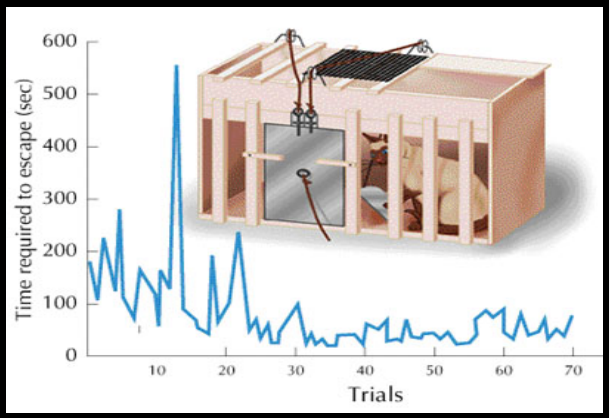
Part 3: instrumental conditioning

predictions are for control

If we can predict what situations are associated with rewards
we can try to bring those about through our actions

Edward Thorndike (1874-1949)

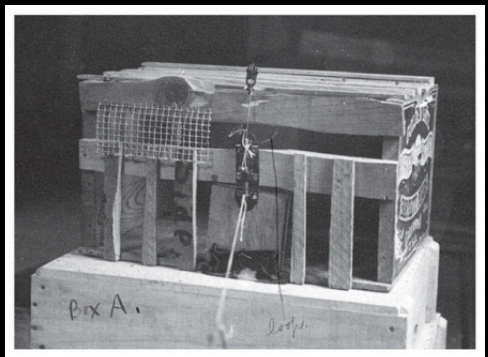
- Background: Darwin, attempts to show that animals are intelligent
- Thorndike was the first to show this systematically (not just anecdotes)
- PhD thesis on "Animal intelligence: an experimental study of the associative processes in animals"
- Tested hungry cats (also chicks, dogs) in "puzzle boxes"
- operational definition for learning: time to escape
- gradual learning curves, did not look like 'insight' but rather trial & error

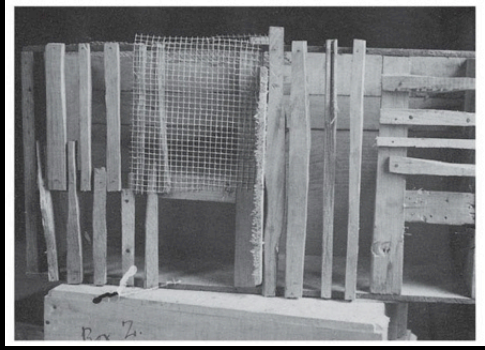


THORNDIKE'S PUZZLE BOXES AND THE ORIGINS OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR - Paul Chance, JEAB (1999)

There were 15 of these boxes, and they were constructed mainly of wooden slats and hardware cloth. Each box contained a door that the cat could open by manipulating some device. Cats opened the door to Box I by pressing a lever (The cat that first escaped from Box I may well deserve a place in history for being the first in a long line of lever-pressing animals.) Box K, the only box depicted graphically in the dissertation, required the performance of three distinct responses: The cat had to depress a treadle, pull on a string, and push a bar up or down before the door would finally fall open.

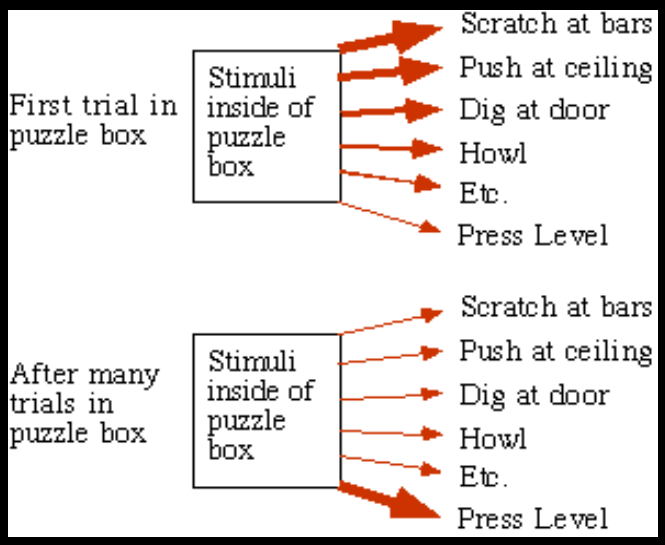
At first the cat's behavior appeared to be almost random, one might even say chaotic. Gradually, however, it became more orderly, more deliberate, more efficient. "The cat that is clawing all over the box in her impulsive struggle will probably claw the string or loop or button so as to open the door. And gradually . . . After many trials, the cat will, when put in the box, immediately claw the button or loop in a definite way".





Thorndike: The Law of Effect

Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur; those which are accompanied or closely followed by discomfort to the animal will, other things being equal, have their connections with that situation weakened, so that, when it recurs, they will be less likely to occur. The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond.



what is the role of the reinforcer?

- the reinforcer "stamps in" the association between the situation and some actions
- not needed after training: behavior becomes habitual
- automatic process once there is a goal (motivation)
- no need to assume more intelligence (imitation etc.) or causal learning/insight
- also: generalization, discrimination ("I must feed those cats")