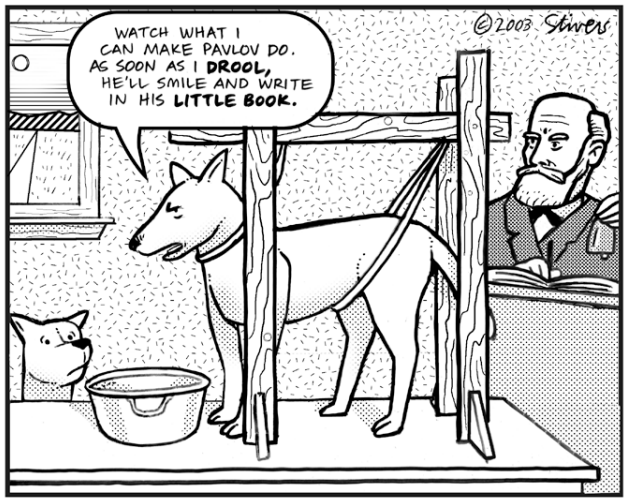
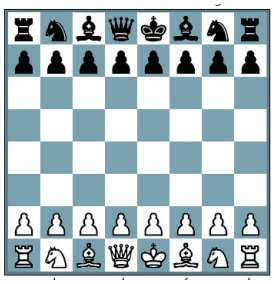
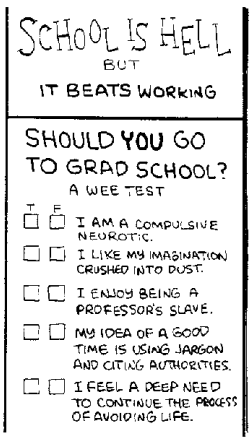
Classical Conditioning I: Prediction learning



PSY/NEU338: Animal learning and decision making: Psychological, computational and neural perspectives

Decision making



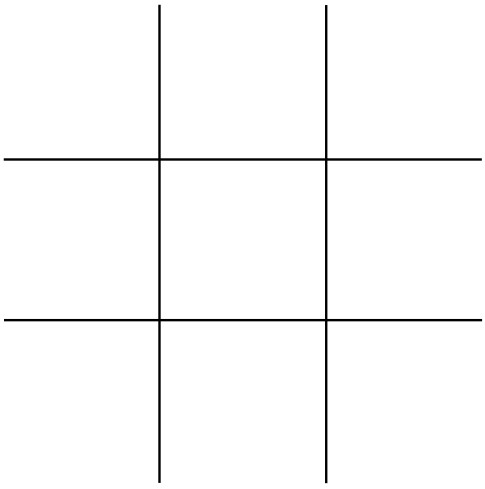


Why is this hard?

- Reward/punishment may be delayed
- Outcomes may depend on a series of actions

⇒ "credit assignment problem" (Sutton, 1978)

another example:



how did *you* solve the credit assignment problem?

What should you learn from interaction with the world?

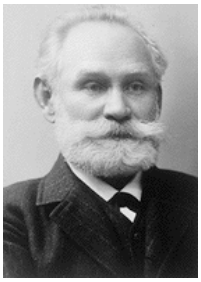
1. what is going to happen (prediction learning)
2. what to do about it (action learning)

outline

PART I - Basics of classical conditioning

PART II - Some challenging results

PART III - A theory (model)

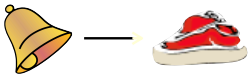


Ivan Pavlov
(Nobel prize portrait)

animals learn predictions

pair stimulus

...with significant event



measure anticipatory behavior

 = Unconditional Stimulus (US)

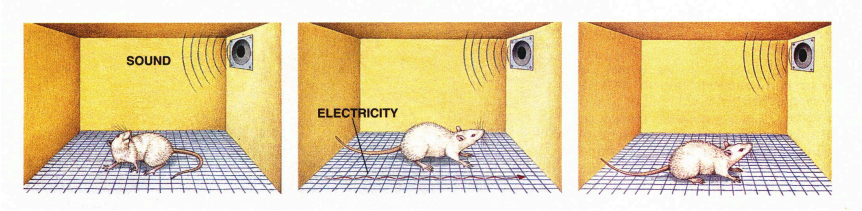
 = Conditional Stimulus (CS)

 = Conditional Response (CR) (here, also Unconditional Response; UR)

Very general form of learning from experience (snails - humans)

example 11: fear conditioning (conditioned suppression)

Habituation (tone) Conditioning (tone+shock) Extinction (tone)



CS: Tone, 30 sec
US: Shock, 0.5 sec
CR: Freezing

(ITI = 4 min)

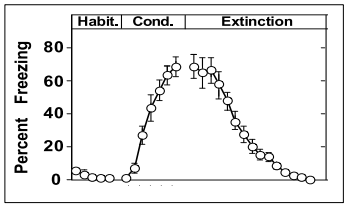
example 11: fear conditioning (conditioned suppression)

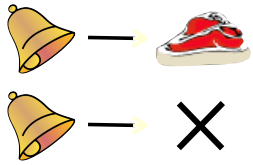
some non-trivial terminology

- Pavlov called the US a "reinforcer"
  What does that mean?

= reinforcer

- Purely operational definition (makes no assumptions regarding affective components)
- Acquisition
- Extinction





- Predictions are: 1) shaped by experience
  2) revealed by behavior

what makes conditioning Pavlovian?

procedurally: Pavlovian/classical conditioning is a learning situation in which the reinforcer *does not depend* on the animal's response

from the animal's point of view: the conditioned response is *unaviodable*, like a *reflex*, not utilitarian or flexible; direct result of a prediction

(e.g., Hershberger (1986) - An approach through the looking glass)

basic procedures

- eye-blink conditioning
- autoshaping
- conditioned taste aversion
- conditioned emotional response (conditioned suppression)
- conditioned place preference
- leg flexion

Pavlovian responses

- most common: approach and withdrawal responses
- in fact: more than one response in every situation (we choose which to measure)
- examples from daily life: bring with you on Thursday (3 examples, each on a separate piece of paper)

CS-US-CR compatibility

- Different USs are more easily conditioned to certain CSs (eg. Garcia and Koelling's "noisy water" experiment, with shock US versus LiCl US)
  - also depends on the animal species: pigeons associate color with illness, rats - flavor
  - evolutionarily adaptive constraint
- The CR is mostly similar to the UR
  - does not have to be similar: freezing versus jumping as a response to shock, salivating versus biting as a response to food

"stimulus substitution"

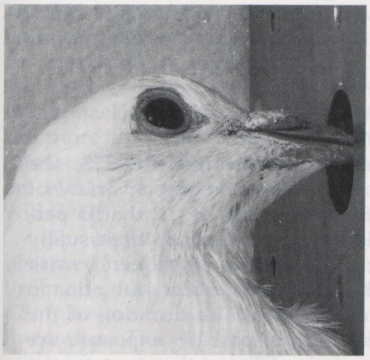


FIGURE 4-3. Photograph showing pigeons pecking keys when receiving water reward (left) or food (right). Pecks to the water-related key included drinking-like movements such as licking. Pecks to the food-related key were made with the beak slightly open, as if to seize a piece of grain.
Photo Courtesy of Bruce Moore

outline

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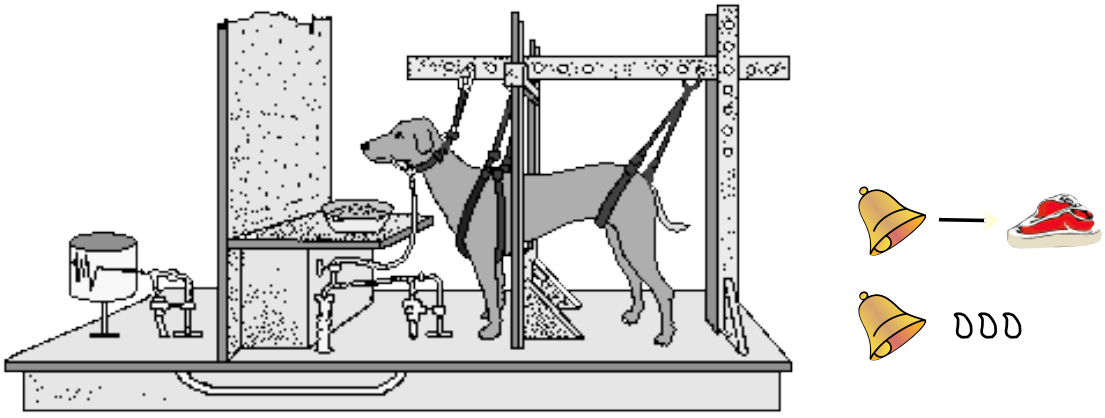
back to basic classical conditioning



What is the proper control experiment?

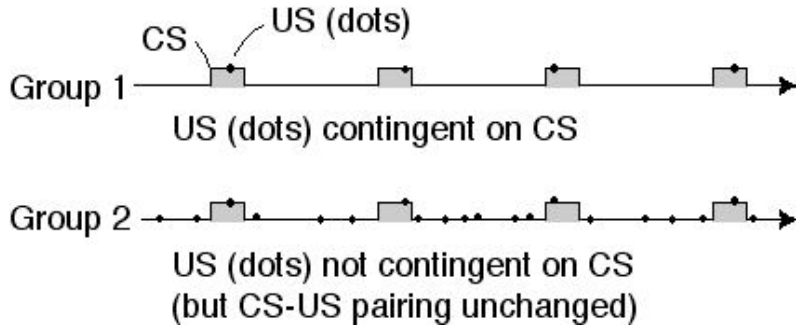
submission to *Nature*

- Exp 1: bell followed by steak for 30 trials→conditioning (CR to bell)
- Exp II: no steak, bell same number of times→no conditioning
- Exp III: no bell, steak same number of times→no conditioning
- Exp IV: bell and steak same number of times, unpaired→no conditioning

Conclusion: pairing of a bell CS and a steak US is necessary and sufficient to get conditioning

would you accept this paper?

But... 1) Rescorla's control condition



will Group 2 show a CR to the tone?