Cognition: Methods and Models

PSYC 2040

L5: Behaviorism

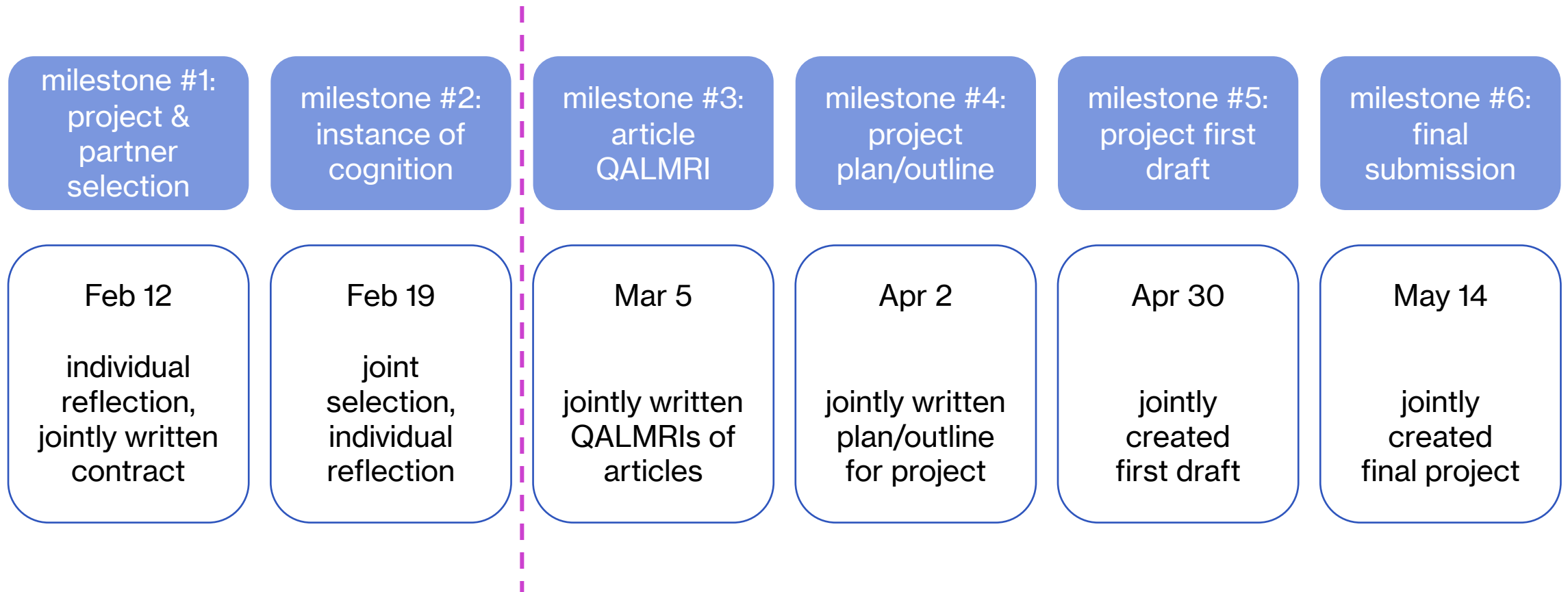Part 1

logistics: class survey (February: 1 point)

- https://forms.gle/8KSgcRyE7o2h4VLU8
  - link also on Canvas (under class surveys)
- due Feb 26 (Sunday, so we can talk about it in class on Feb 28)
- 1 point that counts towards your final points/grade
  - submit on Canvas (it's an "assignment" on Canvas)
- I value your feedback
- anonymous survey! please be honest and reflective
- you will get a code at the end of the survey (on the thank you screen)
  - copy-paste this code on Canvas to get credit

project **milestones** overview

milestone #1: project & partner selection	milestone #2: instance of cognition	milestone #3: article QALMRI	milestone #4: project plan/outline	milestone #5: project first draft	milestone #6: final submission
Feb 12 individual reflection, jointly written contract	Feb 19 joint selection, individual reflection	Mar 5 jointly written QALMRIs of articles	Apr 2 jointly written plan/outline for project	Apr 30 jointly created first draft	May 14 jointly created final project

logistics: final project

- milestone #2: instance
  - grades/feedback will be sent latest by Thursday morning

- milestone #3: QALMRI (due Mar 5)
  - finding 3 research articles + jointly written QALMRIs
  - use your review article to guide your search
  - might need to read ~10 abstracts to find the best 3 papers
  - QALMRIs should be detailed enough for an outsider to know what the paper was about (independent/dependent variables, key results, etc.)
  - show it to a friend/classmate and ask them what they learned
  - Thursday: Beth Hoppe revisits!

logistics: assessment 1

- when/where: March 9 (Thursday), in-class

- content covered: L0 (Getting Started) – L6 (Information Processing)
  - textbook + class lecture + quiz content is all fair game
  - idea: you could use the quizzes as a practice aid!

- format: 30 multiple-choice, 10 short answer

- what's coming up:
  - a practice assessment (Feb 27) + answers (Mar 3)
  - review session on March 6 and 8 (7-8 pm)

- use our office hours for questions about the content!!

recap: Feb 14/16, 2023

- what we covered:
  - associations: Cattell and Thorndike
  - Pavlov's classical conditioning
  - Rescorla-Wagner model

- your to-dos were:
  - *fill out*: class survey
  - *schedule*: group project meeting with Abhilasha
  - *submit:* project milestone #2
  - *finish:* L4 quiz + writing assignments
 - *start:* L5 (behaviorism) chapter

lion   tiger

lion   tiger

lion   tiger
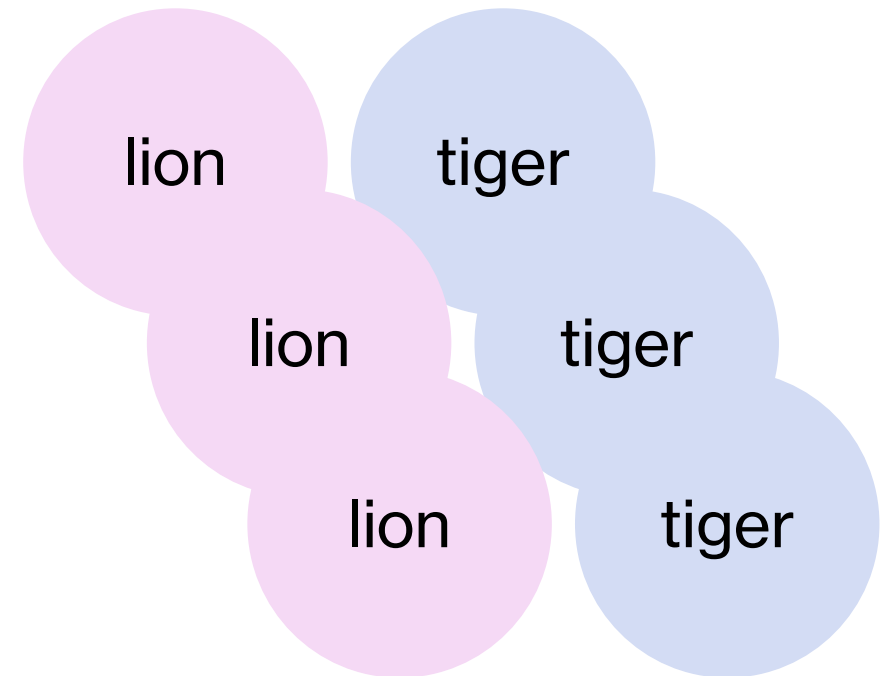
today's agenda

- the backdrop for behaviorism
- the many forms of behaviorism
  - Today: Watson and Tolman
  - Thursday: Hull and Skinner

WILL PRESS LEVER FOR FOOD

the backdrop: mentalists vs. physicalists

- mentalists wanted to study the mental processes contributing to behavior
  - examples?
- physicalists wanted to explain behavior through the physiological processes occurring in the body/brain
  - examples?
- limitations and criticisms to both approaches:
  - mentalists lacked objective measures
  - physicalists were too reductive

mental ⇄ physical
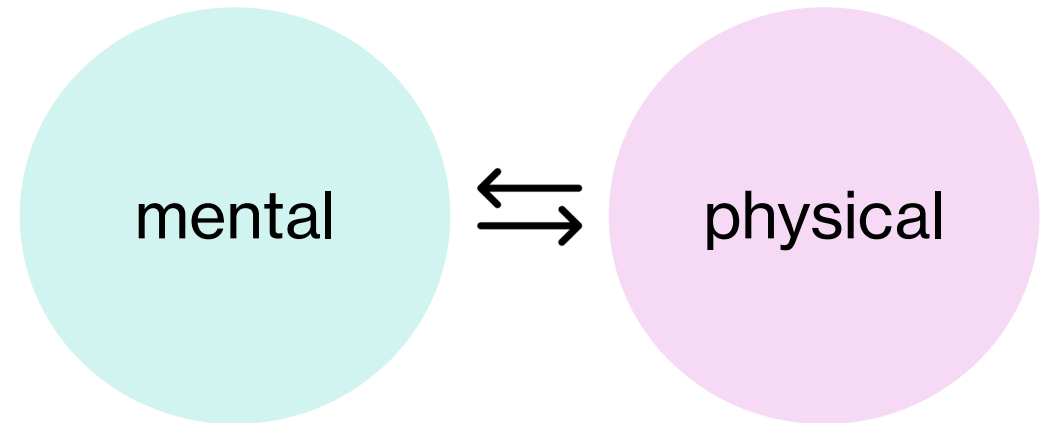
the backdrop: positivism & utopianism

- August Comte

- early example of the philosophy of science
  - "a branch of philosophy concerned with the foundations, methods, and implications of science"

- positivism: argued that science develops through three stages: theological, metaphysical, positive

- Comte's ideas about positivism were expanded to utopianism

- eugenics was also inspired by utopianism and led to devastating global, far-reaching consequences

the backdrop: associationism and conditioning

- we learned about how the study of cognition began through associationism

- Pavlov's work on classical conditioning directly inspired behaviorism as a movement, perhaps due to feeling "more scientific"

- this also coincided with psychology trying to establish itself as a real science

- behaviorism had many flavors but all of them agreed on the fact that behavior was all about stimulus-response interactions

WILL PRESS LEVER FOR FOOD

Watson's behaviorism: origins
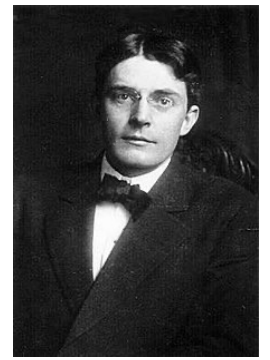
- John B. Watson, the "arch-prophet"

- listed as a researcher in Eugenical News

- believed that prior methods (introspectionist) of studying behavior were biased and unreliable

PSYCHOLOGY AS THE BEHAVIORIST VIEWS IT

BY JOHN B. WATSON

The Johns Hopkins University

Psychology as the behaviorist views it is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness. The behaviorist, in his efforts to get a unitary scheme of animal response, recognizes no dividing line between man and brute. The behavior of man, with all of its refinement and complexity, forms only a part of the behaviorist's total scheme of investigation.

Watson's behaviorism: Little Albert

- Watson wanted to generalize Pavlov's classical conditioning methods to humans

- the key idea was to train an infant to produce fear-related responses to different kinds of stimuli (part 1) and then eventually de-sensitize the infant via extinction (part 2: incomplete)

- Little Albert was exposed to different stimuli (rats, masks, etc.) and sounds that led to traumatic experiences/reactions

- extremely unethical and before ethical standards had been established for human subjects research

Watson's behaviorism: S-R positivism

- "*it is the business of behavioristic psychology to be able to predict and to control human activity. To do this it must gather scientific data by experimental methods. Only then can the trained behaviorist predict, given the stimulus, what reaction will take place; or, given the reaction, state what the situation or stimulus is that has caused the reaction*"

- behavior = relationship between stimulus (S) and response (R)

- Pavlovian conditioning could be used to generate new S-R associations

S..R
Given   ?(to be determined)

S..R
?(to be determined)   given

Your problem reaches its explanation always when:

S..R
has been determined   has been determined

Substitution of Response

Can we substitute or condition responses? Experiment teaches us that the process of response substitution or conditioning does take place in all animals throughout life. Yesterday his puppy called out from a two-year-old child—fondling, pet words, play and laughter:

S..R
Sight of dog   Manipulation, laughter, etc.

Today the dog calls out:

S..R
Sight of dog   Screaming,
                                    withdrawal of body,

Something happened. Late yesterday the dog bit him too hard in play—broke the skin and caused bleeding. We know that

S..R
Cutting, burning of skin   withdrawal of body, etc.
                                    screaming, etc.

In other words while the visual stimulus *dog* has remained substantially the same, the reaction belonging to another unconditioned stimulus (cutting, pricking skin) has made its appearance.[1]

Watson's behaviorism: **speculations**

- much of Watson's ideas were theoretical and did not have analytical or mathematical grounding that would specify how S might come to produce R

- he believed the S-R framework could be used for broader human/society engineering

Stimuli given	Reaction—outcome—too complicated for prediction
S	R
Overthrow of monarchy; formation of Soviet government	?
War	?
Prohibition	?
Easy divorce	?
No marriage	?
Children brought up in ignorance of their parents	?
Substitution of physiological ethics for religion	?
Equalization of wealth	?
Elimination of hereditary wealth, etc.	?

| S	R
?	Marriage under modern financial pressure
?	Continence in great cities where social control is difficult
?	Joining the church
?	Truthfulness
?	Rapid acquisition of skill in a special line
?	Correct deportment etc.

Tolman's behaviorism

- Watson argued that psychology should only be concerned with describing how different stimuli produced different responses

- Tolman thought that this approach was too reductive (similar to the physicalists), i.e., *molecular*

- Tolman argued for a molar version of behaviorism, where the behavior itself could be studied, without trying to understand the molecular units of stimulus and response

- was trying to tread the line between being a mentalist (that had previously invoked God-like concepts) vs. a positivist (that cared about a descriptive system without relying on theological and metaphysical stages)

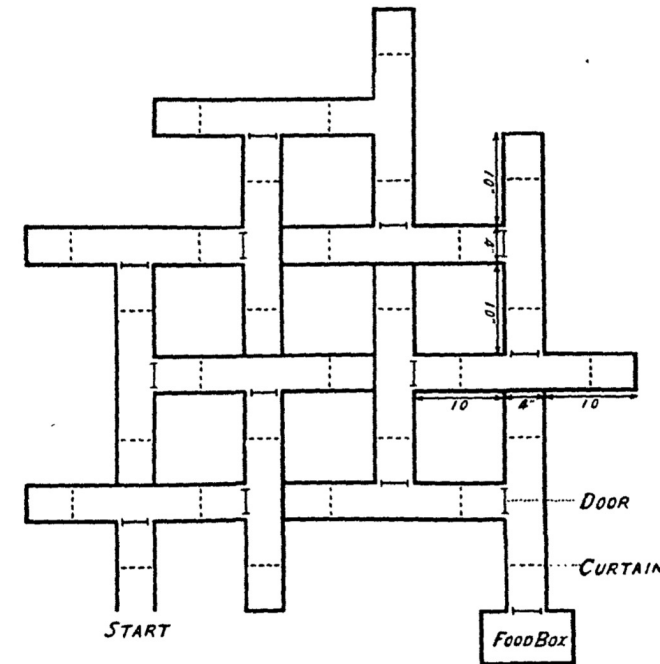# Tolman's behaviorism: purposes and cognitions

- Tolman thought that describing behavior from the lens of purposes and cognitions would be useful and informative

- BUT he maintained that these purposes and cognitions only had a descriptive function, it did not mean that purposes and cognitions were truly mental processes

- these ideas are again reminiscent of Marr's "levels of explanation"

purposes ⇄ cognitions
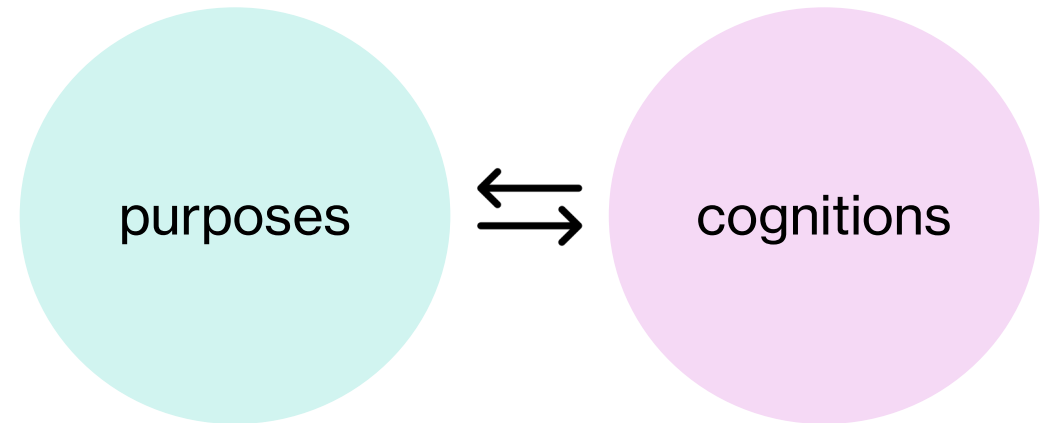
Tolman's behaviorism: maze running

- Tolman's theories were based on his experiments of maze-running behavior with rats, similar to Thorndike's puzzle boxes

- he manipulated different aspects in his experiments, such as hunger, the design of the maze, etc., and studied the errors made as well as the route chosen by the rats
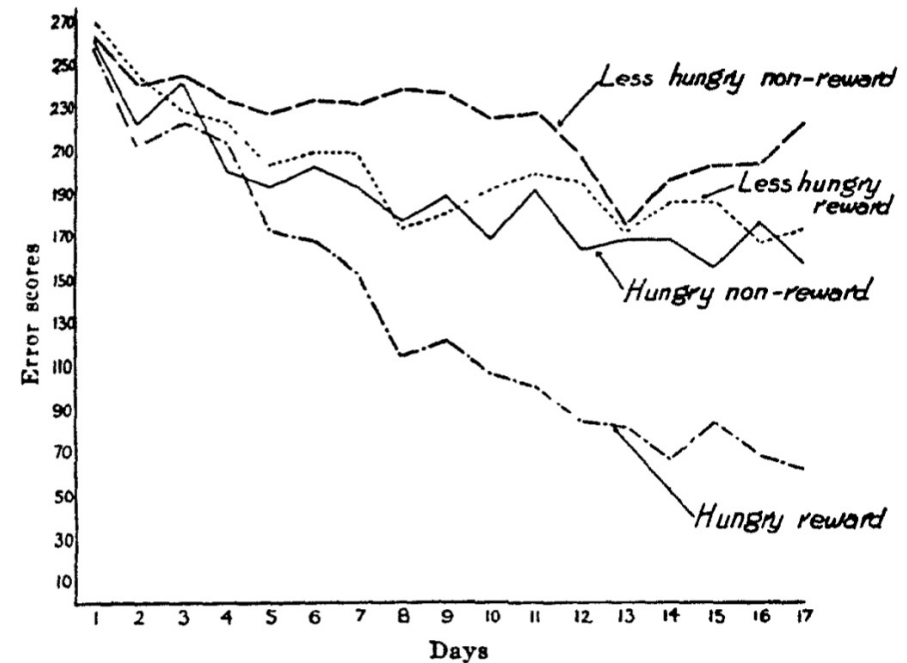
Plan of maze
14-Unit T-Alley Maze
FIG. 1
(From M. H. Elliott, The effect of change of reward on the maze performance of rats. *Univ. Calif. Publ. Psychol.*, 1928, 4, p. 20.)

Tolman's behaviorism: **purpose**

- activity: gleaning basic design from the figure

- in groups of 2, investigate the figure and note down:
  - independent variable
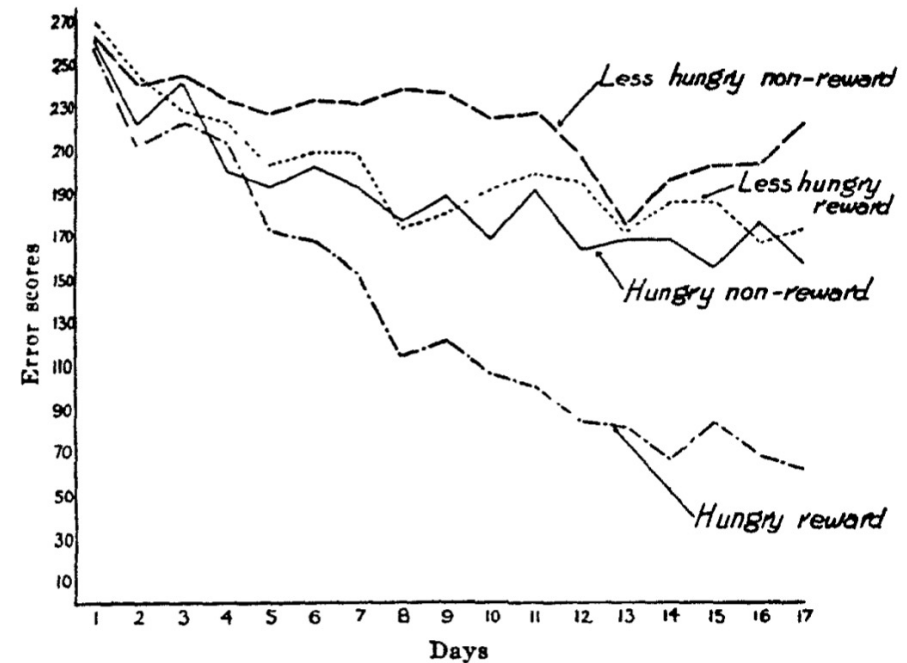 - dependent variable
  - key question

Error curves for four groups, 36 rats.

FIG. 3

(From E. C. Tolman and C. H. Honzik, Degrees of hunger, reward and non-reward, and maze learning in rats. *Univ. Calif. Publ. Psychol.,* 1930, 4, No. 16, p. 246. A maze identical with the alley maze shown in Fig. 1 was used.)

Tolman's behaviorism: purpose

- independent variable:
  - hunger (hungry, less hungry)
  - reward (reward, non–reward)
- dependent variable:
  - errors made by rats in the maze
- key question:
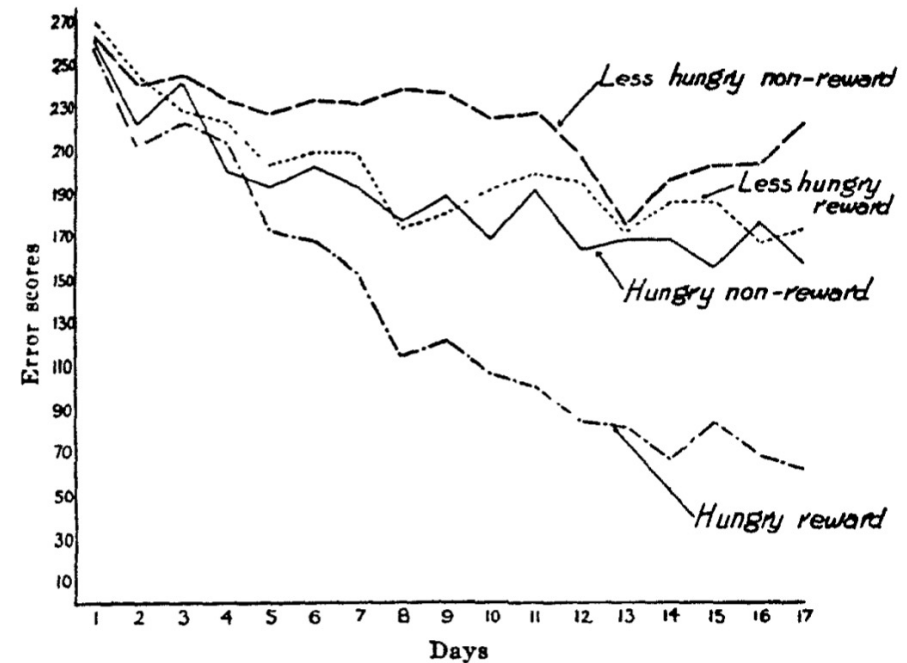 - do rats make fewer errors when they are hungry and presented with rewards?

Error curves for four groups, 36 rats.

FIG. 3

(From E. C. Tolman and C. H. Honzik, Degrees of hunger, reward and non-reward, and maze learning in rats. *Univ. Calif. Publ. Psychol.*, 1930, 4, No. 16, p. 246. A maze identical with the alley maze shown in Fig. 1 was used.)

Tolman's behaviorism: purpose

- two key findings

- all rats made fewer errors over time
  - all lines have a negative slope (trending downward)

- rats who were hungry and were rewarded made the fewest errors
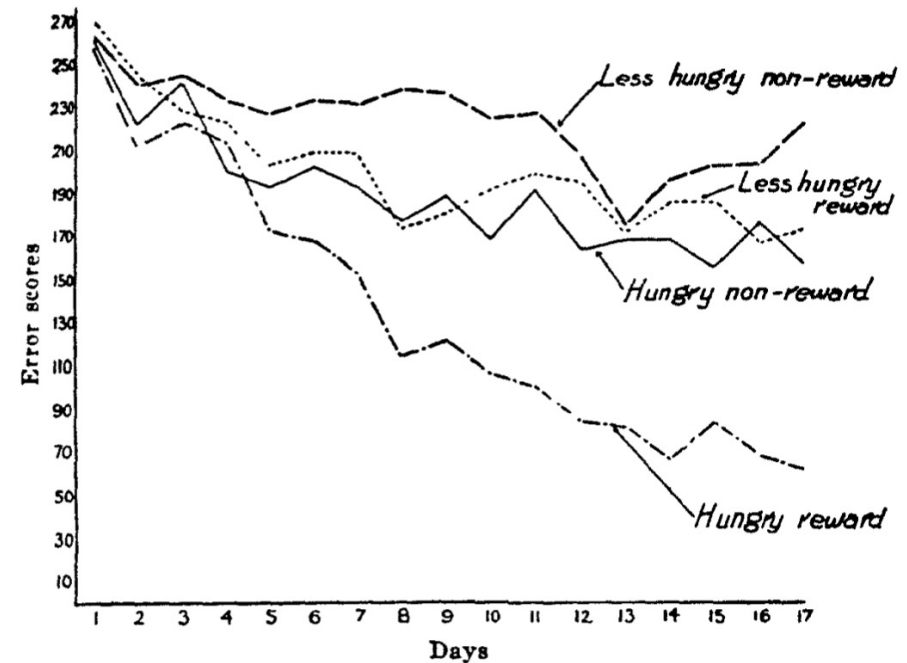 - the line has the sharpest drop-off

Error curves for four groups, 36 rats.

FIG. 3

(From E. C. Tolman and C. H. Honzik, Degrees of hunger, reward and non-reward, and maze learning in rats. *Univ. Calif. Publ. Psychol.*, 1930, 4, No. 16, p. 246. A maze identical with the alley maze shown in Fig. 1 was used.)

Tolman's behaviorism: purpose

- inferences:
- hungry-reward rats were more driven by hunger and motivated by the reward to correctly navigate the maze
- if drive and motivation did not matter, then all rats should have performed identically, but that was not the case


Error curves for four groups, 36 rats.

FIG. 3

(From E. C. Tolman and C. H. Honzik, Degrees of hunger, reward and non-reward, and maze learning in rats. *Univ. Calif. Publ. Psychol.*, 1930, 4, No. 16, p. 246. A maze identical with the alley maze shown in Fig. 1 was used.)

Tolman's behaviorism: cognition

- De Camp's (1920) experiment with a circular maze

- rats entered at the bottom (S) and food could be present in one of the two rooms on the left and right

- left/right room contained food, rats showed preference for shorter route

- inferences:
  - rats were weighing their options and chose the shortest way that would help them achieve the goal
  - if "stimulus" (food/maze) and "response" (wayfinding) were all that mattered, why would rats choose the shorter way, why not do it randomly?

FIGURE 30²
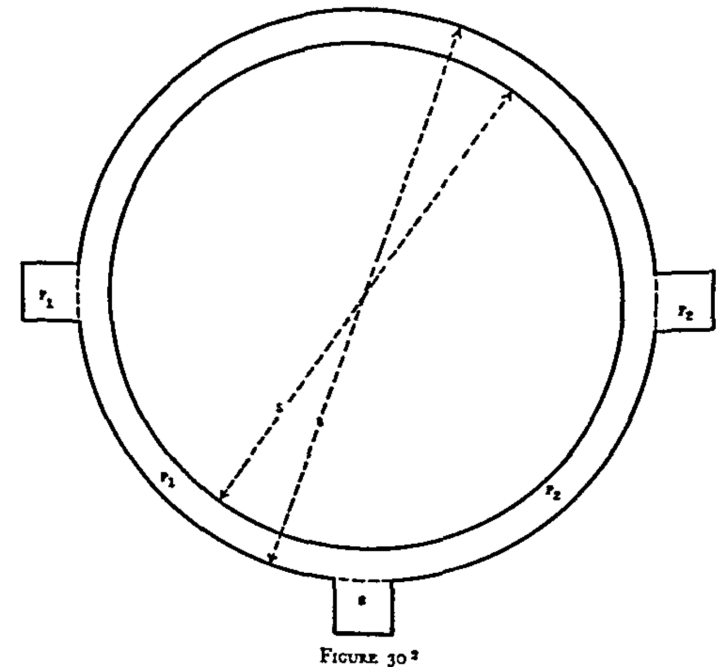
Tolman's behaviorism: cognition

- Gengerelli's (1930) experiment with a "bean machine"

- rats entered at the "start" and could navigate the maze in several ways to get to the food at the end

- over time, rats took the shortest path

- inferences:
  - rats are able to assess the pros and cons of different options to optimize their behavior
  - if "stimulus" (food/maze) and "response" (wayfinding) were all that mattered, why would rats choose the shorter way, why not do it randomly?
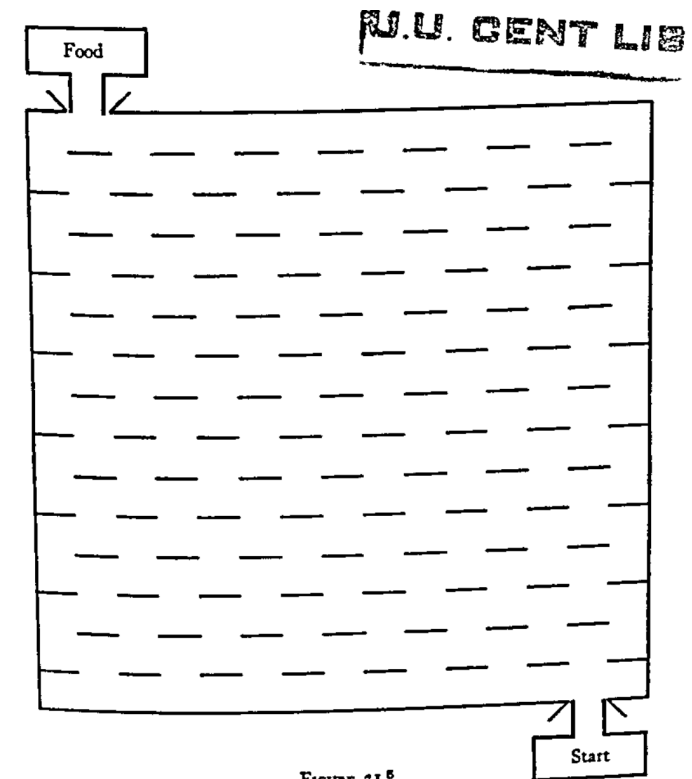
FIGURE 31 ⁵

⁴ J A Gengerelli, The principle of maxima and minima in animal learning, J Comp Psychol, 1930, 11, 193 236

Tolman's behaviorism: cognition

- Sams and Tolman's (1925) experiment
- rats started at the entrance (E) and navigated to the food (F), but were detained for different amounts of time in the left/right rooms
- over time, rats took the route that had the shorter detention
- inferences:
  - rats can perform temporal discrimination
  - there are a number of intervening operations between a stimulus and a response
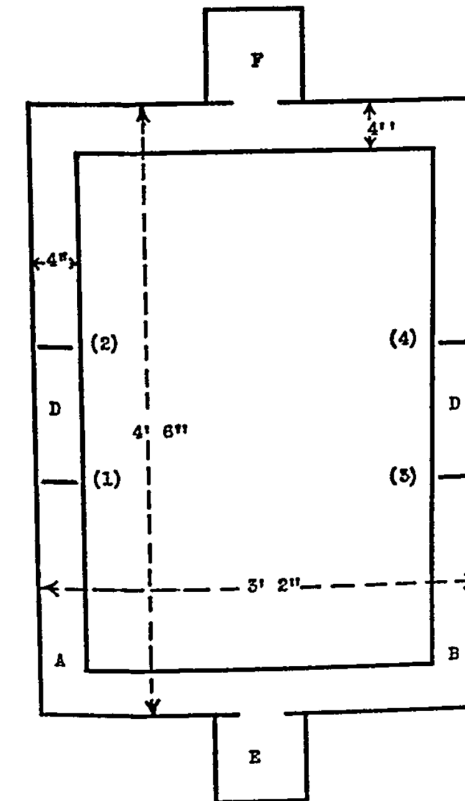

FIGURE 33 [10]

* E. C. Tolman and C. F. Sams, Time discrimination in white rats, *J. Comp. Psychol.*, 1925, 5, 255-263.

Tolman's behaviorism: latent learning

- Blodgett's (1929) latent learning experiment

- independent variable: when reward was provided
  - group 1: always rewarded
  - group 2: rewarded on day 3
  - group 3: rewarded on day 7

- dependent variable: error score
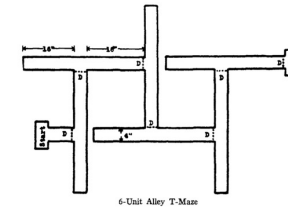
- activity: in pairs, interpret the figure/pattern

6-Unit Alley T-Maze

Fig. 4

(From H. C. Blodgett, The effect of the introduction of reward upon the maze performance of rats. *Univ. Calif. Publ. Psychol.*, 1929, 4, No. 8, p. 117.)

Group I
Group II
Group III

Fig. 5

(From H. C. Blodgett, The effect of the introduction of reward upon the maze performance of rats. *Univ. Calif. Publ. Psychol.*, 1929, 4, No. 8, p. 120.)

Tolman's behaviorism: latent learning

- key finding:
  - groups 2 and 3 did not show much learning until they were provided with food as the reward, after which they learned very quickly

- inferences:
  - rats were learning even when there was no reward, otherwise, there wouldn't be such a sharp drop when they were motivated by food

6-Unit Alley T-Maze
Fig. 4
(From H. C. Blodgett, The effect of the introduction of reward upon the maze performance of rats. *Univ. Calif. Publ. Psychol.*, 1929, 4, No. 8, p. 117.)
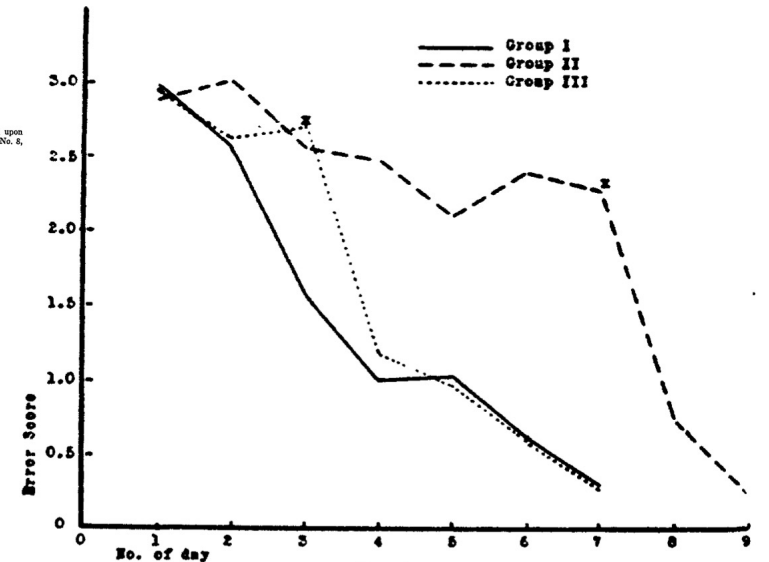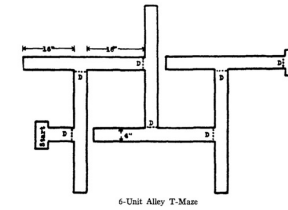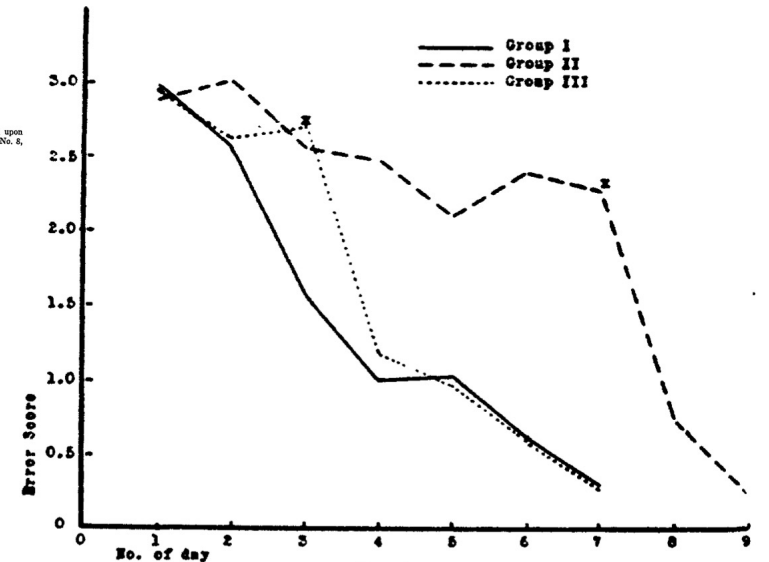
Fig. 5
(From H. C. Blodgett, The effect of the introduction of reward upon the maze performance of rats. *Univ. Calif. Publ. Psychol.*, 1929, 4, No. 8, p. 120.)

Tolman's behaviorism: in 1948

- Tolman's views changed over time

- earlier, he discussed purposes and cognitions as mere descriptors of behavior

- over time, he came to argue more strongly for "cognitive" aspects of learning

- Tolman argued that rats learn cognitive maps of the mazes, i.e., they internally represent the maze and use it to navigate the maze in the future

COGNITIVE MAPS IN RATS AND MEN [1]

BY EDWARD C. TOLMAN

University of California

I shall devote the body of this paper to a description of experiments with rats. But I shall also attempt in a few words at the close to indicate the significance of these findings on rats for the clinical behavior of men. Most of the rat investigations, which I shall report, were carried out in the Berkeley laboratory. But I shall also include, occasionally, accounts of the behavior of non-Berkeley rats who obviously have misspent their lives in out-of-State laboratories. Furthermore, in reporting our Berkeley experiments I shall have to omit a very great many. The ones I *shall* talk about were carried out by graduate students (or underpaid research assistants) who, supposedly, got some of their ideas from me. And a few, though a very few, were even carried out by me myself.

Let me begin by presenting diagrams for a couple of typical mazes, an alley maze and an elevated maze. In the typical experiment a hungry rat is put at the entrance of the maze (alley or elevated), and wanders about through the various true path segments and blind alleys until he finally comes to the food box and eats. This is repeated (again in the typical experiment) one trial every 24 hours and the animal tends to make fewer and fewer errors (that is, blind-alley entrances) and to take less and less time between start and goal-box until finally he is entering no blinds at all and running in a very few seconds from start to goal. The results are usually presented in the form of average curves of blind-entrances, or of seconds from start to finish, for groups of rats.

All students agree as to the facts. They disagree, however, on theory and explanation.

(1) First, there is a school of animal psychologists which believes that the maze behavior of rats is a matter of mere simple stimulus-response connections. Learning, according to them, consists in the strengthening of some of these connections and in the weakening of others. According to this 'stimulus-response' school the rat in progressing down the maze is helplessly responding to a succession of external stimuli—sights, sounds, smells, pressures, etc. impinging upon his external sense organs—plus internal stimuli coming from the viscera and from the skeletal muscles. These external and internal stimuli call out the walkings, runnings, turnings, retracings, smellings, rearings, and the like which appear. The rat's central

[1] 34th Annual Faculty Research Lecture, delivered at the University of California, Berkeley, March 17, 1947. Presented also on March 26, 1947 as one in a series of lectures in Dynamic Psychology sponsored by the division of psychology of Western Reserve University, Cleveland, Ohio.

Tolman's behaviorism: selective breeding

- Tolman and his student Tryon studied individual differences in rats using the maze-running paradigm

- they used selective breeding to produce "better" / "more intelligent" rats over 2 generations: first generation showed better performance but not the second generation

- clear connections to eugenics but Tolman (1948) provided "softer" outcomes/implications for society

THE INHERITANCE OF MAZE-LEARNING ABILITY IN RATS[1]

EDWARD CHACE TOLMAN
University of California

What in the name of Heaven and Psychology can we do about it? My only answer is to preach again the virtues of reason—of, that is, broad cognitive maps. And to suggest that the child-trainers and the world-planners of the future can only, if at all, bring about the presence of the required rationality (*i.e.,* comprehensive maps) if they see to it that nobody's children are too over-motivated or too frustrated. Only then can these children learn to look before and after, learn to see that there are often round-about and safer paths to their quite proper goals—learn, that is, to realize that the well-beings of White and of Negro, of Catholic and of Protestant, of Christian and of Jew, of American and of Russian (and even of males and females) are mutually interdependent.

big takeaways

- there were several schools of psychology before behaviorism occupied centerstage, such as positivism, utopianism, associationism and conditioning

- behaviorism had many flavors / versions
  - Watson propagated the idea that psychology should focus on stimulus (S) – response (R) relationships and abandon questions about internal processes
  - Tolman brought back the idea of purposes and cognitions, first as descriptors of behavior, and then as critical intervening operations/components of behavior

behaviorism around us!

- internet algorithms
  - NYT Rabbit Hole podcast
  - this week's writing assignment
- advertising and marketing
- rewards and punishments (more next time on this)

next class

- **before** class:
  - *finish:* L5 (behaviorism) chapter
  - *fill out*: class survey
    - https://forms.gle/8KSgcRyE7o2h4VLU8
  - *start finding*: project research articles (milestone #3)
  - *explore:* L5 quiz and/or writing assignment

- **during** class:
  - more flavors of behaviorism (Hull and Skinner)
  - project milestone #3 discussion (QALMRI)
    - Beth Hoppe revisits!