

Animal Behavior

History to ~1960



Descartes (1596-1650)

- Humans and animals are machines
- Concept of the reflex arc
- ...but humans also have a soul
 - Mind/body dualism



Rembrandt's *The Anatomy Lesson* (1630)

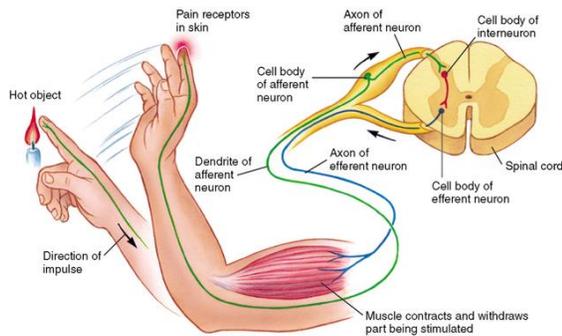


Descartes the concept of the reflex arc



"The fire has the force to move the part of the skin of the foot [at B], and by this means pull the small thread C, which you can see is attached, simultaneously opening the entrance of the pore d, e, where this small thread ends...the entrance of the pore or small passage d, e, being thus opened, the animal spirits in the concavity F enter the thread and are carried by it to the muscles that are used to withdraw the foot from the fire."

Modern conception of the reflex arc

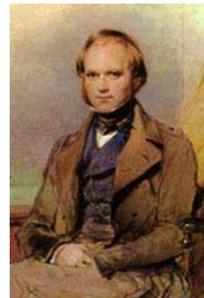


Charles Darwin (1809-1882)



- Life a battle for limited resources
“survival of the fittest”
- Crucial elements of theory:
 - **Adaptation**
 - **Natural selection**
 - **Phylogeny** (evolutionary history) – all species are related (some more closely than others)

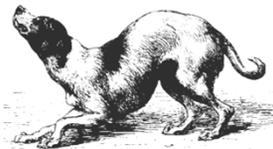
Charles Darwin (1809-1882)



Mental continuity
between humans
and animals.

Descent of Man (1871)
*The Expression of the Emotions in
Man and Animals* (1872)

“Nevertheless the difference in
mind between man and the higher
animals, great as it is, certainly is
one of degree and not of kind.”



Georges Romanes (1848 – 1894)



Applied Darwin’s ideas to
study of animal behavior

Animal Intelligence (1883)

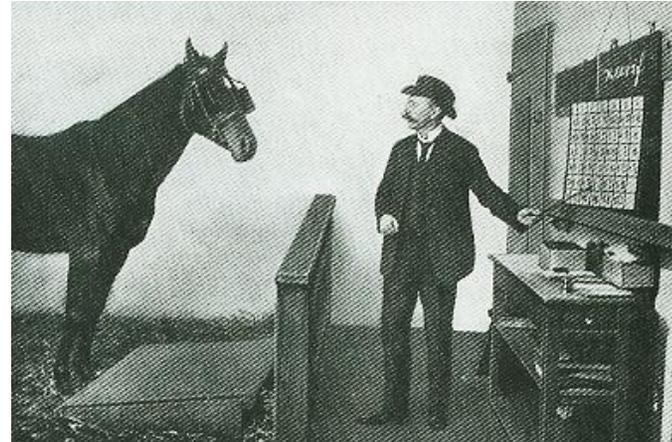
“The external indications of
mental processes which we
observe in animals are trustworthy, so...we
are justified in inferring mental states
from particular bodily actions”.

Romanes used the **anecdotal ‘method’** to
build his views on animal intelligence.

Excerpted from George Romanes' book *Animal Intelligence* (1888)

"One day, watching a small column of these ants (*Eciton hamata*), I placed a little stone on one of them to secure it. The next that approached, as soon as it discovered its situation, ran backwards in an agitated manner, and soon communicated the intelligence to the others. They rushed to the rescue; some bit at the stone and tried to move it, others seized the prisoner by the legs and tugged with such force that I thought the legs would be pulled off, but they persevered until they got the captive free. I next covered one up with a piece of clay, leaving only the ends of its antennae projecting. It was soon discovered by its fellows, which set to work immediately, and by biting off pieces of the clay soon liberated it. Another time ... I confined one of these under a piece of clay ... Several ants passed it, but at last one discovered it and tried to pull it out, but could not. It immediately set off at a great rate ... in a short time about a dozen ants come hurrying up, evidently fully informed of the circumstances of the case, for they made directly for their imprisoned comrade and soon set him free. I do not see how this action could be instinctive. It was sympathetic help, such as man ... shows. The excitement and ardour with which they carried on their unflagging exertions for the rescue of their comrade could not have been greater if they had been human beings". **Anthropomorphizing!** (quote from J. Bret)

Der Kluge Hans (Clever Hans)



Pfungst, O. (1907). Das Pferd des Herrn von Osten (Der Kluge Hans). Ein Beitrag zur experimentellen Tier- und Menschen-Psychologie

- Anthropomorphism
- needless mentalistic explanations
- lack of rigorous observation



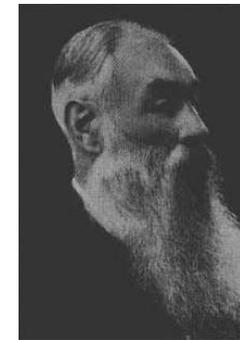
✓ Morgan's Canon

✓ Behaviorism

Romanes' method of supporting his claims with anecdotal evidence rather than empirical tests prompted **Lloyd Morgan's Canon** (similar to much older Ockham's "Razor" or to "law of parsimony")

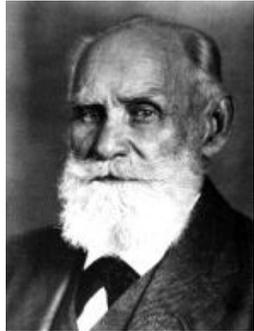
Morgan's Canon of Parsimony

"In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale." (Morgan 1903)

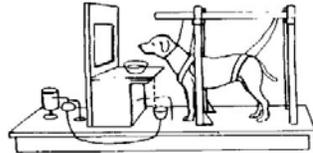


C. Lloyd Morgan
(1852 – 1936)

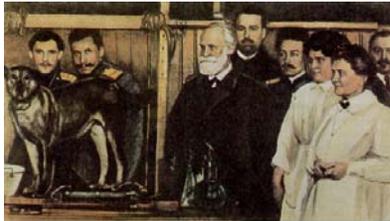
In studying the digestive system, Pavlov discovered classical conditioning.



Ivan Petrovich Pavlov
(1849 - 1936)



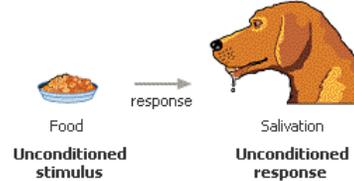
Pavlov received Nobel Prize in 1904



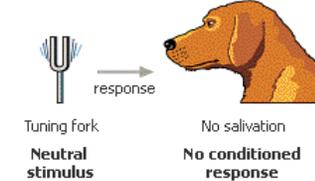
Pavlov (center) shown demonstrating classical conditioning to students at the Military Academy in Russia. © The Granger Collection

Classical Conditioning

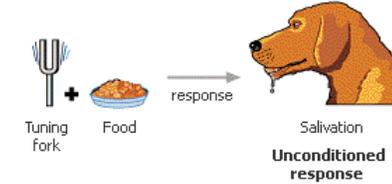
1. Before conditioning



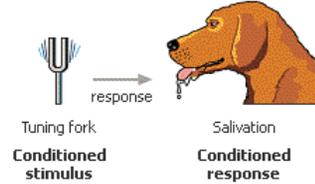
2. Before conditioning



3. During conditioning



4. After conditioning



Edward Thorndike (1874-1949)

Criticized Romanes' views as unscientific.

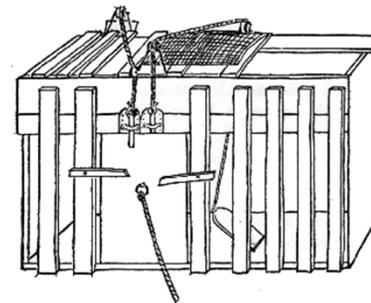
Problems with anecdotes:

1. Only a single case is studied – Does it apply to whole species?
2. Observations are often not repeated or repeatable.
3. Conditions under which observations are made are not controlled.
4. Do not know history of the animal.

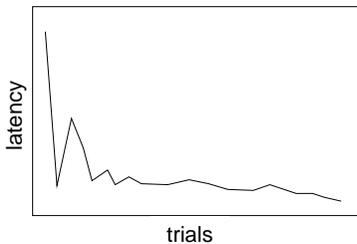


Edward Thorndike (1874-1949)

Animal Intelligence (1911)



The Puzzle Box



Edward Thorndike (1874-1949)

Law of Effect

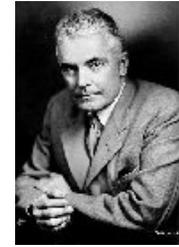
- There is a random element in behavior (**trial & error**)
- Behaviors with pleasurable consequences are “stamped in” (**reward**)
- Those that have noxious consequences are weakened (**punishment**)
- **Instrumental conditioning**



John Watson (1878-1958)

Founder of Behaviorism

- *Behaviorism* (1911)
- *Psychology from the Standpoint of a Behaviorist* (1919)
- Psychology “has failed signally...to establish itself as a natural science”
- Psychology should be “a purely objective experimental branch of natural science”
- “Psychology must discard all reference to consciousness”



John Watson (1878-1958)

Founder of Behaviorism

- *Behaviorism* (1911)
- *Psychology from the Standpoint of a Behaviorist* (1919)
- “Behavior, not consciousness, [should be] the objective point of our attack.”
- **Inferring internal states is redundant and unnecessary.**
- Pavlovian and instrumental conditioning can explain much, if not all, behavior.



Watson’s famous quote:

Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I’ll guarantee to take any one at random and train him to become any type of specialist I might select -- doctor, lawyer, artist, merchant-chief and, yes, even beggarman and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors. (Watson, 1930, p. 104)

Concept of Tabula Rasa (Blank Slate)

The Age of Behaviorism and Learning Theory (~1920 - 1970)

- Watson a methodological behaviorist **and** an extreme environmentalist.
- Behaviorism – goal to rid the world of (1) mentalistic explanations, (2) instinct.

Universal rules of learning became the Holy Grail

- Hull – a theoretical behaviorist – learning theorist
- Tolman – a very different kind of learning theorist
- Guthrie – an atheoretical learning theorist
- Skinner – an atheoretical, radical behaviorist

Clark Hull – a theoretical behaviorist

$$sEr = V \times D \times K \times J \times sHr - slr - lr - sOr - sLr$$

where sEr = excitatory potential (likelihood that animal will produce response r to stimulus s)

sHr = habit strength (derived from previous conditioning trials),

D = drive strength (determined by, e.g., hours of deprivation of food, water, etc.)

V is the stimulus intensity

K is incentive motivation (size or quality of the reinforcer),

J is the incentive based on the delay of reinforcement,

lr is reactive inhibition (i.e., fatigue) slr is conditioned inhibition (due to previous non-reinforcement of r),

sLr is the reaction threshold (smallest reinforcement that will produce learning), and

sOr is momentary behavioral oscillation (error).



(1884 - 1952)

Clark Hull – a theoretical behaviorist

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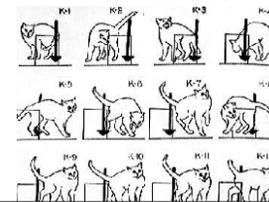
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(1884 - 1952)

“Universal rules of learning became the Holy Grail”

Edwin Guthrie – an atheoretical behaviorist



One word that could describe Edwin Guthrie is “simple”.

[Wikipedia](#)



(1886 - 1959)



Edward Tolman – a cognitive behaviorist

"Cognitive maps in rats and men" (1948)

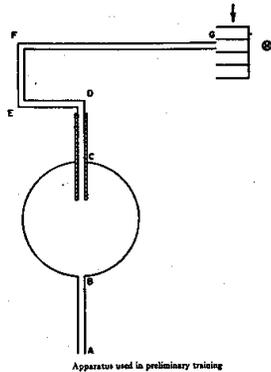


FIG. 15

(From E. C. Tolman, B. F. Ritchie and D. Kalish, *Studies in spatial learning. I. Orientation and the short-cut. J. exp. Psychol.*, 1946, 36, p. 16.)



(1886 - 1959)

Do rats use a mental map to navigate?

First the rats learn to follow the tunnel that leads to the reward.

squeak!

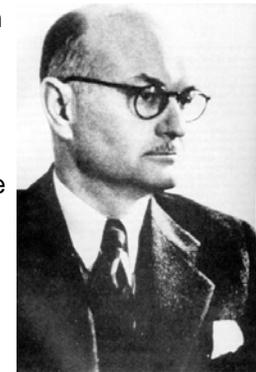
Do rats use a mental map to navigate?

When the tunnel to the reward is blocked the rats follow their mental map and choose the tunnel that leads in the direction where they know the reward to be.

grrrr!

Edward Tolman – a cognitive behaviorist

“When in the last quarter of the twentieth century animal psychologists took a cue from the success of human cognitive psychology, and began to renew the study of animal cognition, many of them turned to Tolman’s ideas and to his maze techniques. Of the three great figures of animal psychology of the middle twentieth century, Tolman, Hull and Skinner, it can reasonably be claimed that it is Tolman’s legacy that is currently the liveliest, certainly in terms of academic research.” [Wikipedia](#)



(1886 - 1959)

B. F. Skinner – a radical behaviorist

(or a strict operational behaviorist, S.O.B.)

1938: *The Behavior of Organisms: An Experimental Analysis*

1939: The alliteration in Shakespeare's sonnets: a study in literary behavior

1948: *Walden Two*

1950: Are theories of learning necessary? *Psych Review*

1950: *Verbal behavior* (revised 1957)



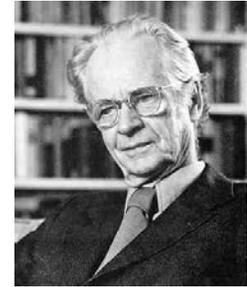
B. F. Skinner – a radical behaviorist

Operant conditioning: behavior is voluntary and goal directed ('operates on the environment').

It is 'shaped' by its **consequences** – strengthened if rewarded, weakened if punished.

Positive reinforcement – **Good**

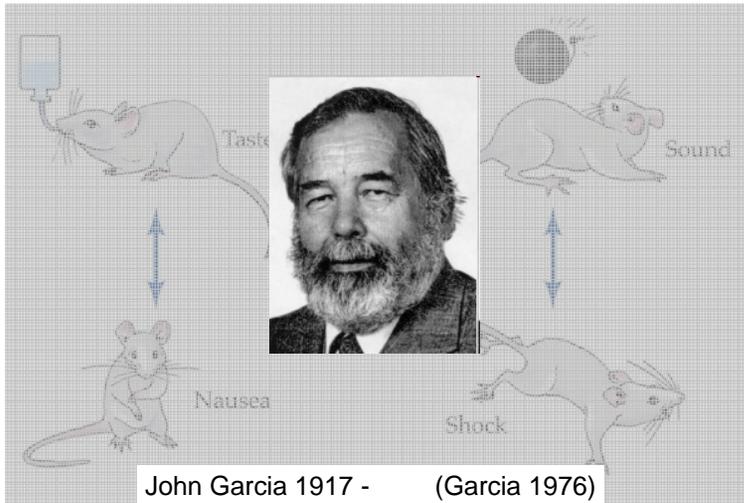
Punishment – **Bad**



What can be an operant? **Practically anything!**

- rate of response
- timing
- posture
- pushes and pulls
- study habits
- bad habits
- athletic performance
- arts and crafts
- creativity
- behavioral disorders
- language (NOT!)

Flies in the Ointment: Constraints on Learning



John Garcia 1917 - (Garcia 1976)

Flies in the Ointment: Constraints on Learning

Keller Breland & Marian Breland (1961) *The Misbehavior of organisms*. *American Psychologist*, 16, 681-684.

THE MISBEHAVIOR OF ORGANISMS

KELLER BRELAND AND MARIAN BRELAND
Animal Behavior Enterprises, Hot Springs, Arkansas

THERE seems to be a continuing realization by psychologists that perhaps the white rat cannot reveal everything there is to know about behavior. Among the voices raised on this topic, Beach (1950) has emphasized the necessity of widening the range of species subjected to experimental techniques and conditions. However, psychologists as a whole do not seem to be heeding these admonitions, as Whalen (1961) has pointed out.

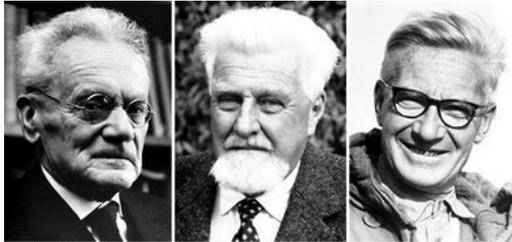
under nonlaboratory conditions throughout a considerable segment of the phylogenetic scale.

When we began this work, it was our aim to see if the science would work beyond the laboratory, to determine if animal psychology could stand on its own feet as an engineering discipline. These aims have been realized. We have controlled a wide range of animal behavior and have made use of the great popular appeal of animals to make it an economically feasible project. Conditioned be-

Ethology (Heyday ~ 1930-1960)

- Originated in Biology Departments in Europe.
- Focused on species-specific behavior, studied in the field (or close laboratory analogs).
- Focused on instinct rather than learning.

On one and only one point did the ethologists agree with the behaviorists: they wanted an objective science of behavior and rejected mentalism and anthropomorphism outright.

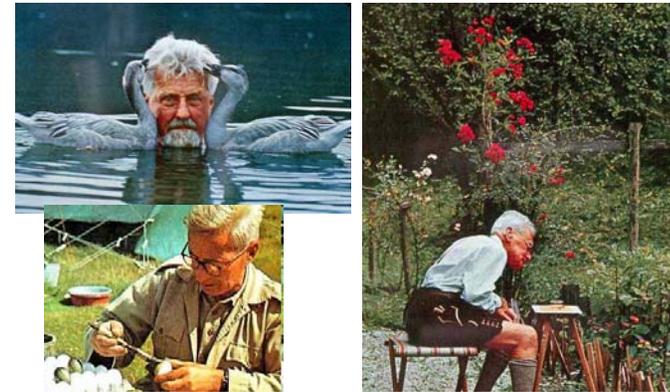


Karl von Frisch
(1886 - 1982)

Konrad Lorenz
(1903 - 1989)

Nikolaas Tinbergen
(1907 - 1988)

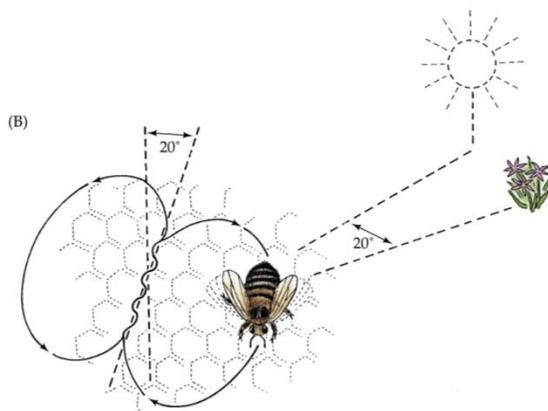
Ethology (Heyday ~ 1930-1960)



The Nobel Prize in Physiology or Medicine 1973

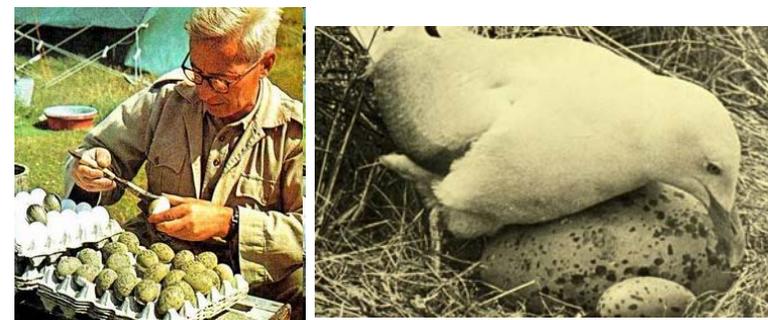
"for their discoveries concerning organization and elicitation of individual and social behaviour patterns"

Ethology's Fundamental Point: Behavior is Adaptive



Von Frisch: Honeybee Dance 'Language'

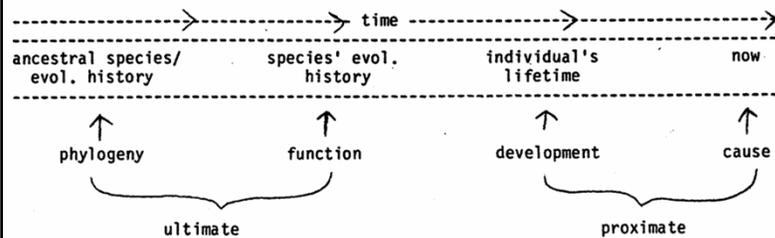
Ethology (Heyday ~ 1930-1960)



(1951) *The study of instinct.*

(1963) 'On the aims and methods of ethology'
[In honor of Konrad Lorenz's 60th birthday]

Different levels of analysis (different perspectives)



Historically, in study of behavior, there has been **confusion** between explanations at different levels (esp. between proximate & ultimate).
 But explanations at different levels are almost always **complementary, not alternative**.
Integrative explanations involve several levels.

Tinbergen's "four questions" (perspectives)

1. Cause or mechanism
 - a. environmental factors (stimuli)
 - b. inferred mechanisms *psychological*
 - c. genetic mechanisms
 - d. neuro-physiological mechanisms
2. Development
3. Function (how is it adaptive?)
4. Phylogeny (evolutionary history)

Proximate

Ultimate

Proximate and ultimate explanations are considered to be *different levels of explanation*

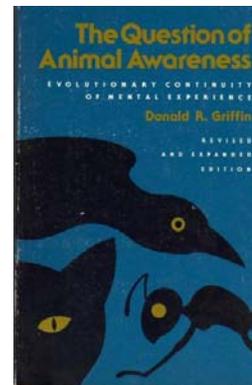
1960s: The rise of **behavioral ecology** (aka sociobiology) and **human cognitive psychology** and the decline of behaviorism and ethology

- W. D. Hamilton (1964) papers on inclusive fitness
- George Williams (1966) *Adaptation and Natural Selection*
- Robert Trivers (1970-1976) series of classic papers
- E. O. Wilson (1975): *Sociobiology*
- Noam Chomsky (1959) review of Skinner's *Verbal Behavior*
- Ulric Neisser (1967): *Cognitive Psychology*

Donald Griffin (1976): "The Question of Animal Awareness: Evolutionary continuity of mental experiences."



"A thin but deeply subversive volume"
 (Gould)



"For more than 60 years (1915 - 2003) this topic had been off limits, and most of us had forgotten that there even was such a question"

Griffin considered his book an attack on behaviorists **and** ethologists (who banned minds) **and** behavioral ecologists (who ignored minds) **and** cognitive psychologists (who preferred computer analogies).