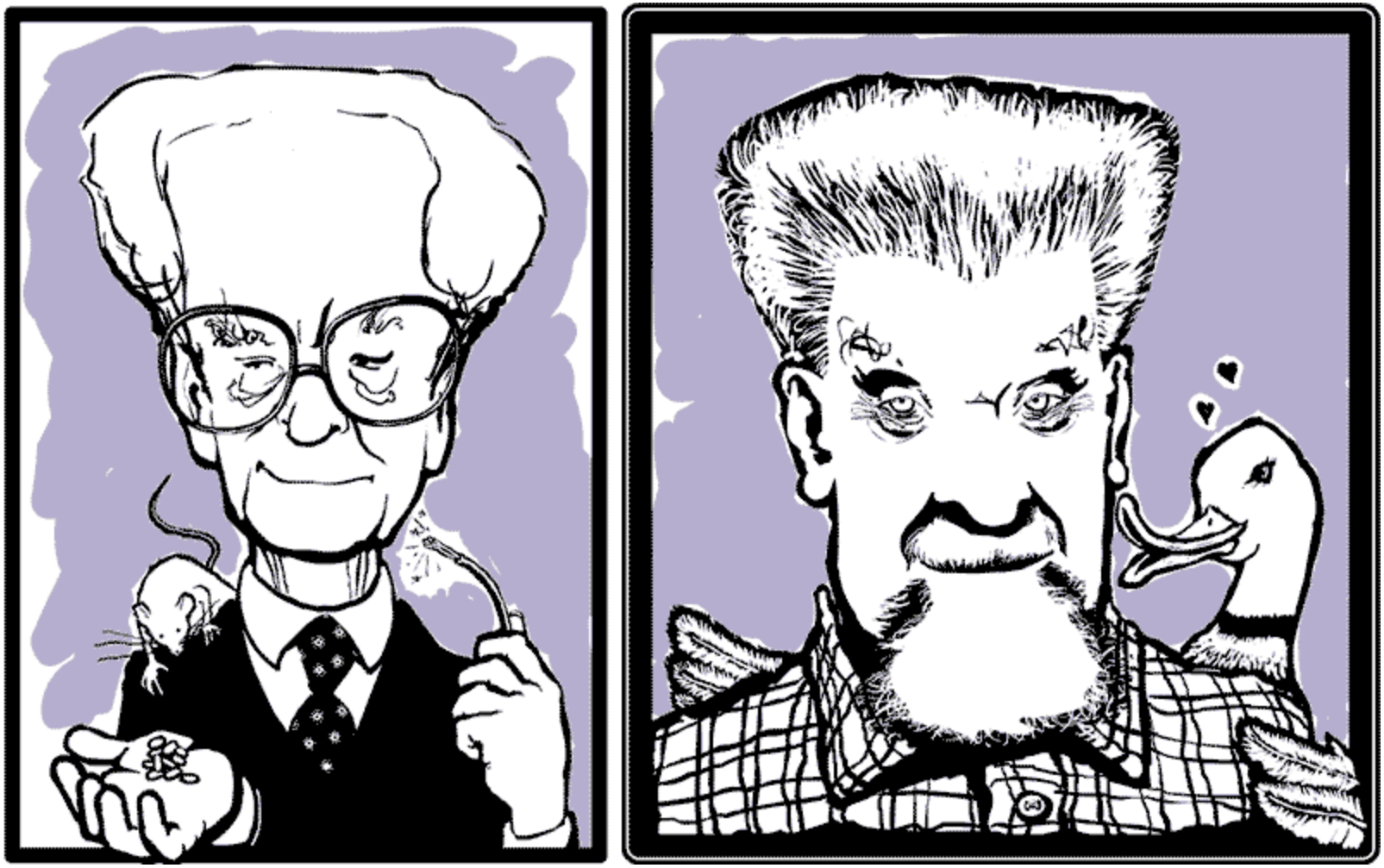
Approaches to studying animal behavior



Foundations of modern study of behavior

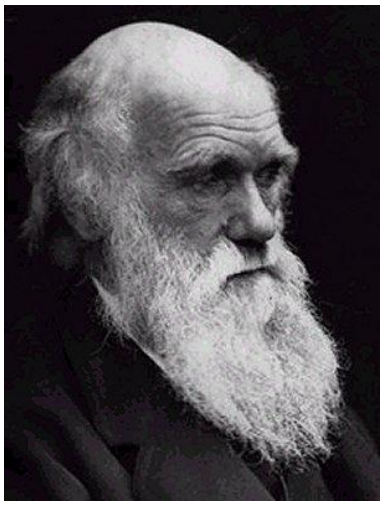
1. Evolution by natural selection

2. Genetics and inheritance

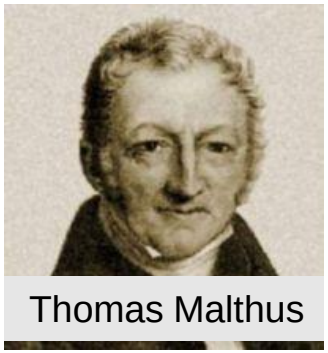
3. Comparative method

Evolution by natural selection

Alfred Russell Wallace (1823-1913)
Contributions to the Theory of Natural Selection, 1870

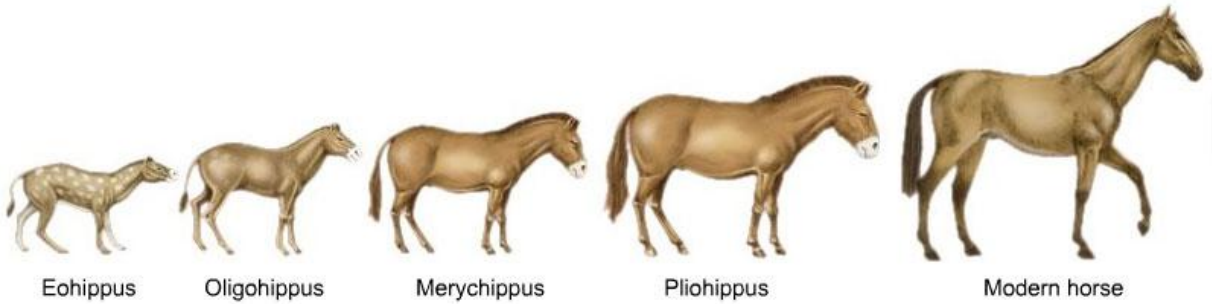


Charles Darwin (1809-1882)
Origin of Species, 1859
Descent of Man, 1871

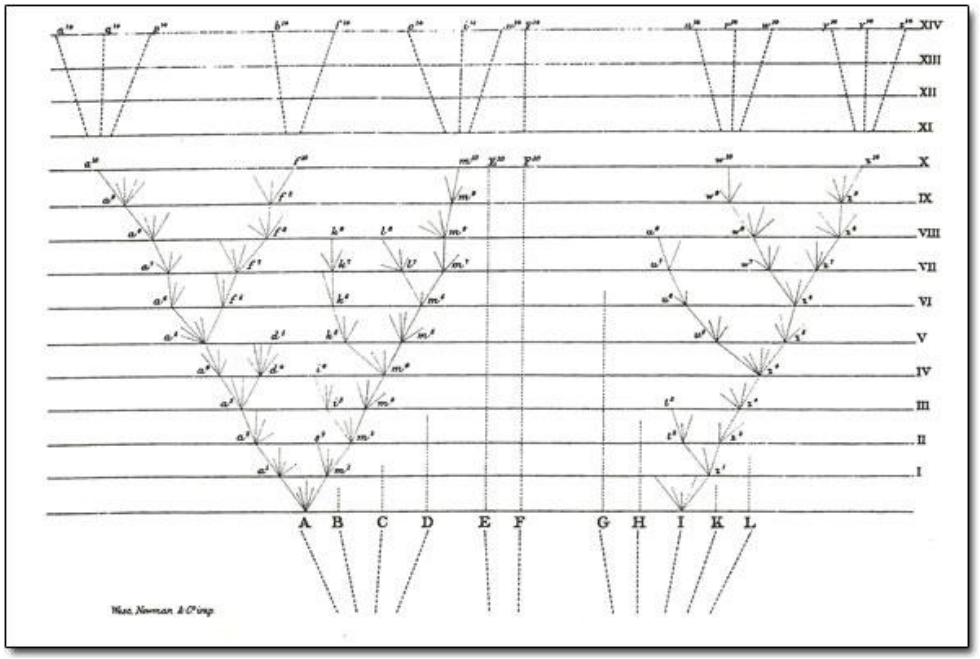


Thomas Malthus

Evolution by natural selection



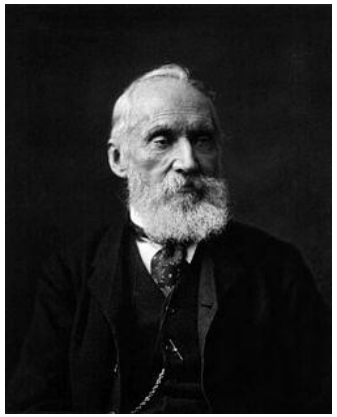
Species are not immutable



Descent from a common ancestor

Evolution by natural selection

Reasons why Darwin's (and Wallace's) ideas weren't widely accepted:

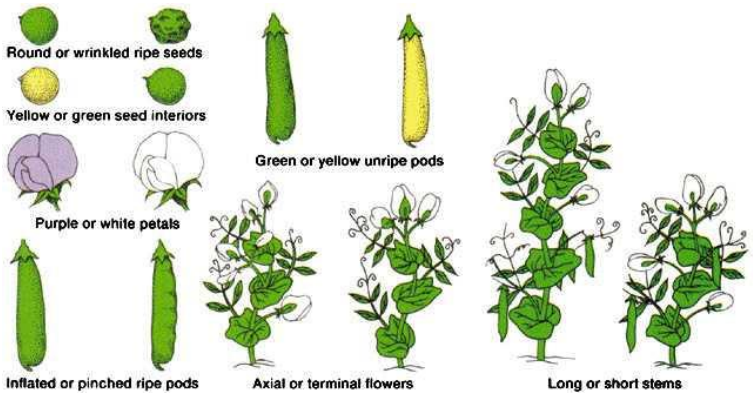


Lord Kelvin: Earth is only
15-20 million years old

Darwin had no idea where
genetic variability came from

Thomas Hunt Morgan

Gregor Mendel



Darwin didn't
understand inheritance

Comparative method

Comparative method: comparing traits and environments across taxa in search of correlations that test hypotheses about adaptation

George Romanes
(1848-1894)

Ethology

Scientific study of animal behavior

Douglas Spalding (1841-1877) tests the concept of instinct

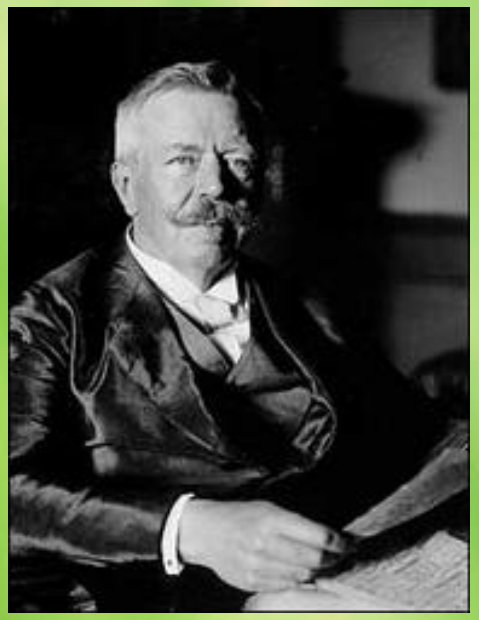
Ethology

Oskar Heinroth (1871-1945)

Charles Otis Whitman (1842-1910)

Wallace Craig (1876-1954)

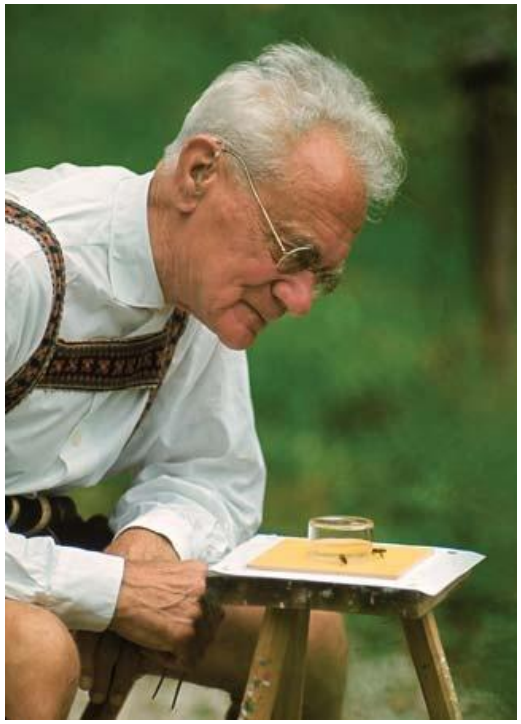
- Appetitive behavior
- Consummatory behavior



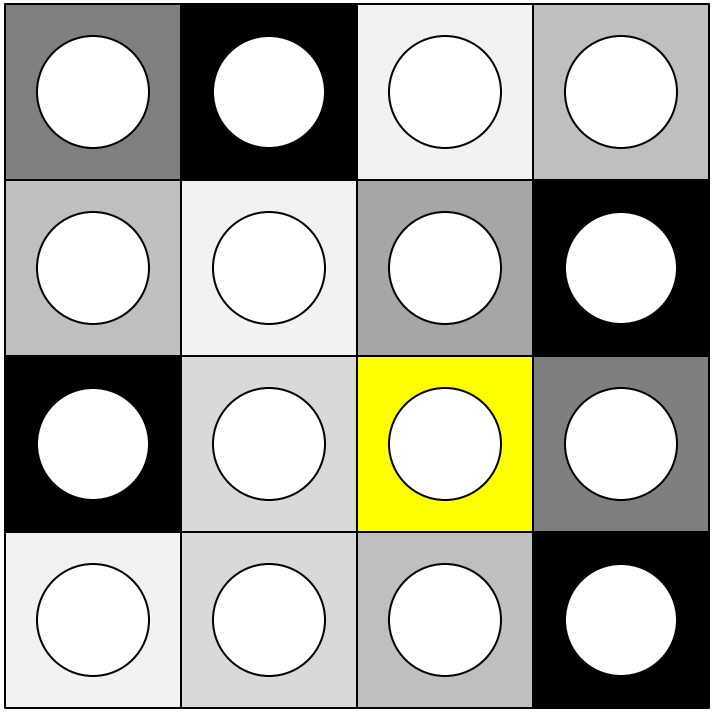
Jakob von Uexküll
(1864-1944)

von Uexküll’s tick and the Umwelt

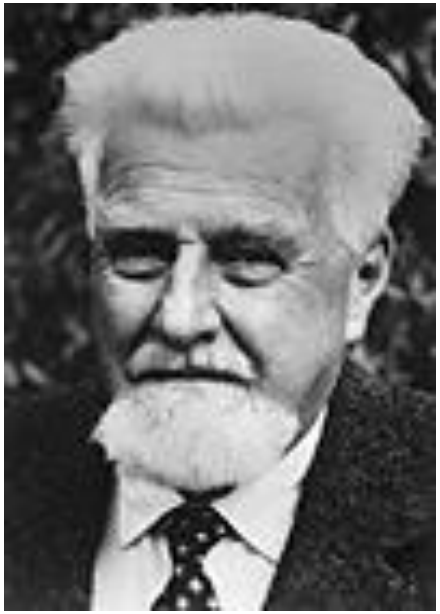
Experimental ethology



Karl von Frisch
(1886-1982)



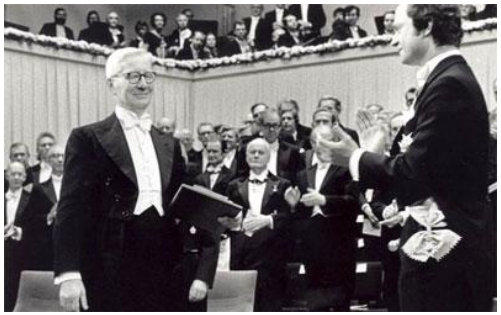
Ethology's triumvirate



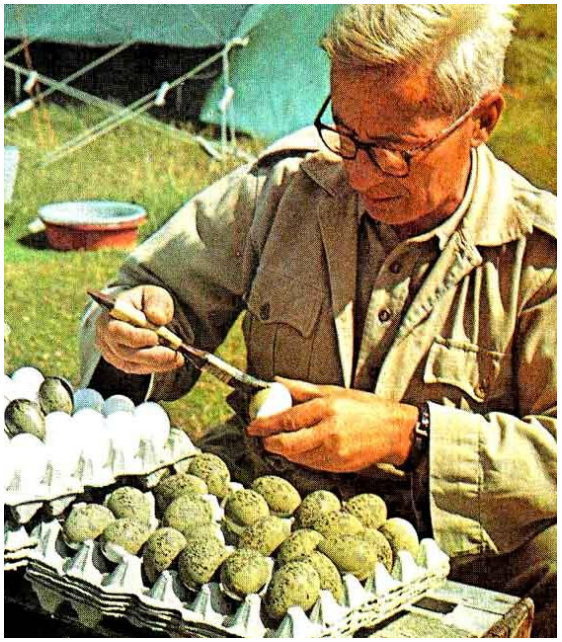
Konrad Lorenz
(1903-1989)

Niko Tinbergen
(1907-1988)

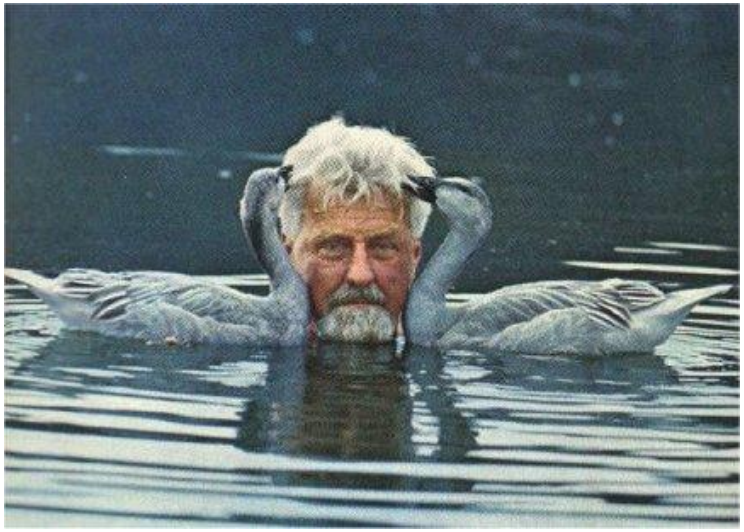
Karl von Frisch
(1886-1982)



Ethology's triumvirate

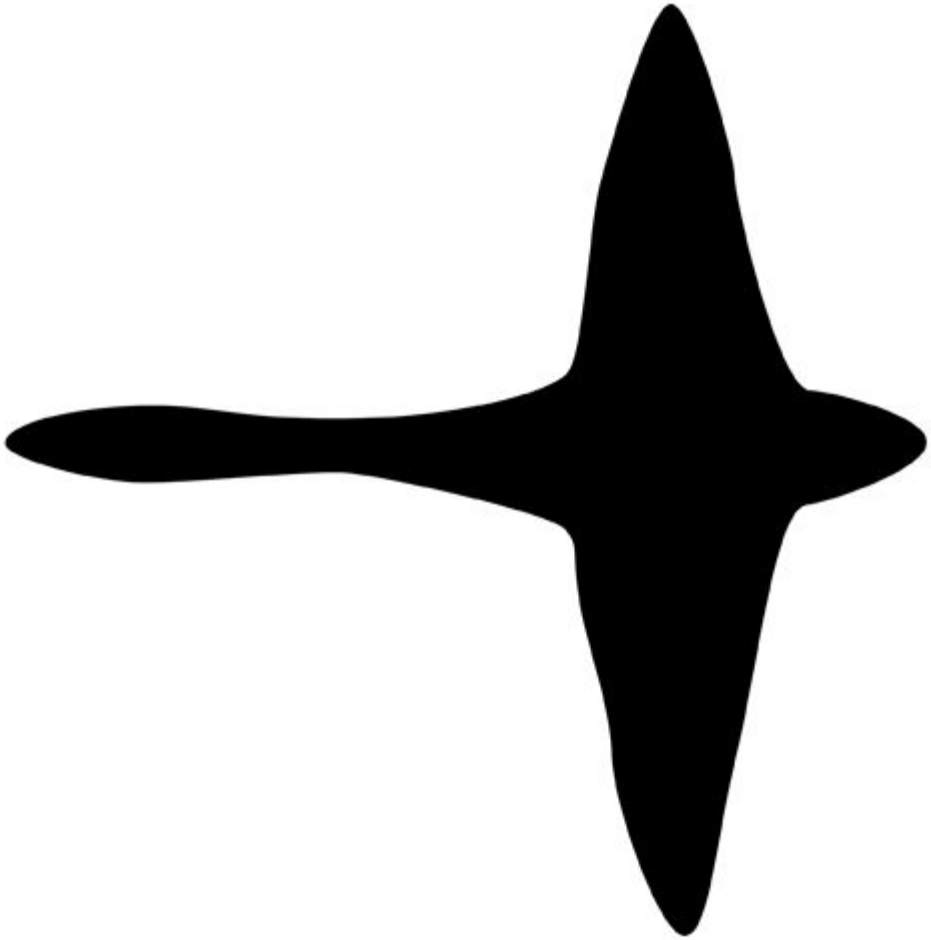


Sign stimuli

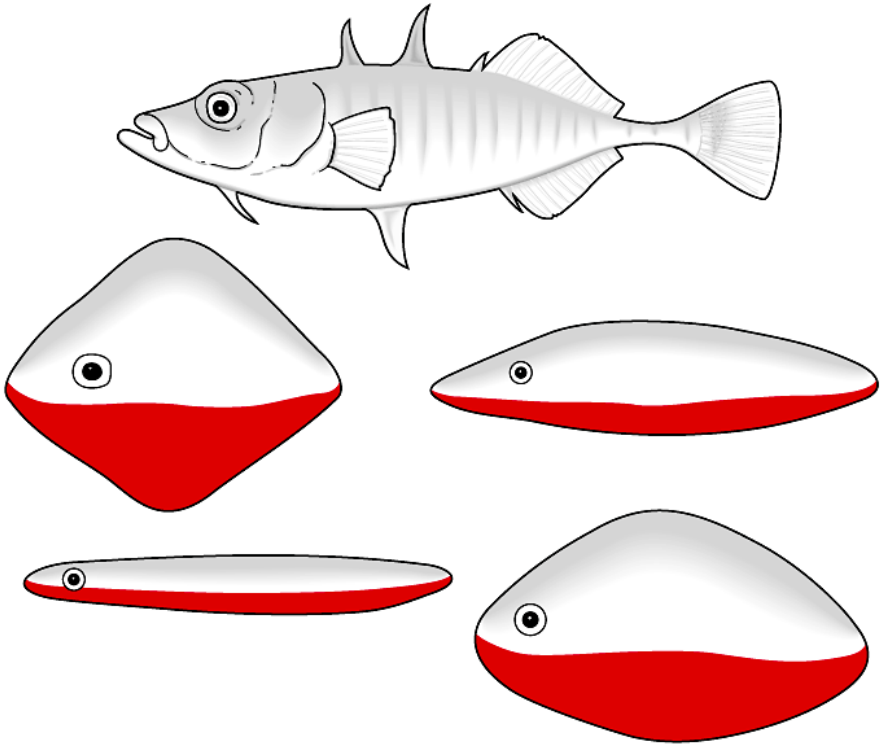


Lorenz's accidental discovery of sign stimuli or releasers

Sign stimuli



Experimental ethology



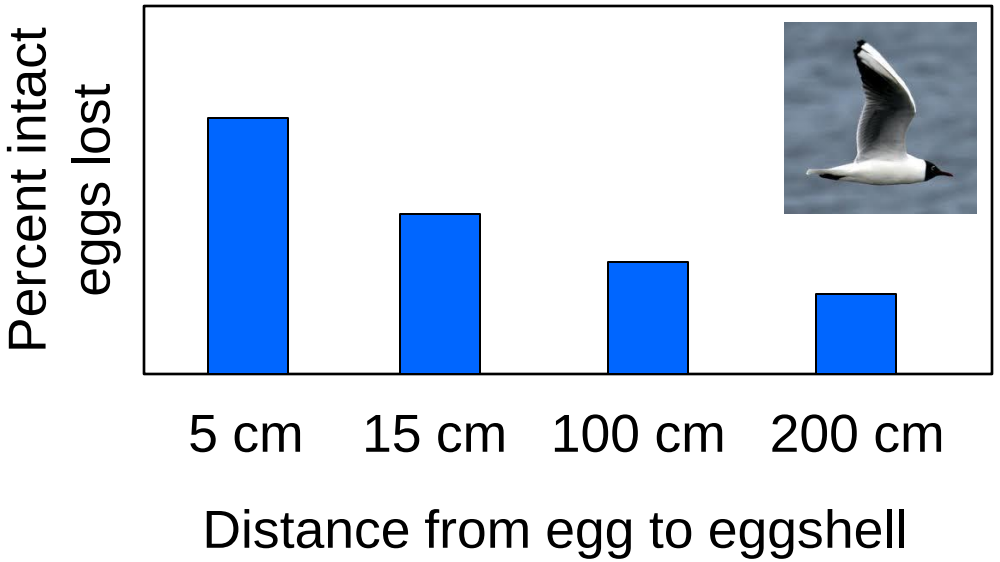
Tinbergen's experiments on three-spined sticklebacks

Experimental ethology

Broken egg stimulates removal behavior

Experimental ethology

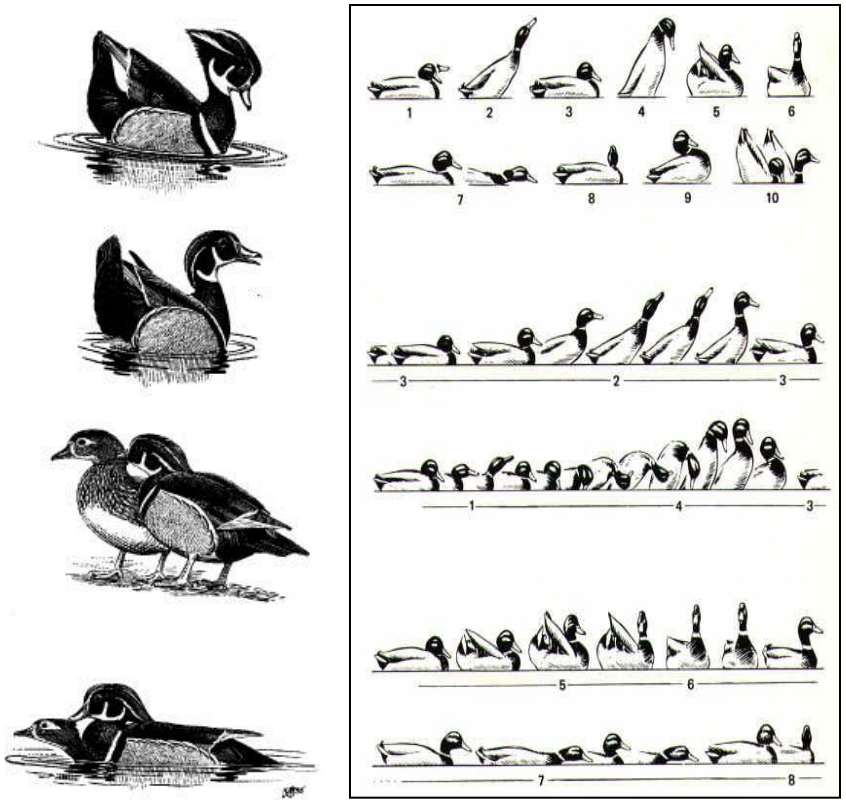
Experimental ethology



Fixed action patterns

Lorenz and Tinbergen devised concept of fixed action pattern

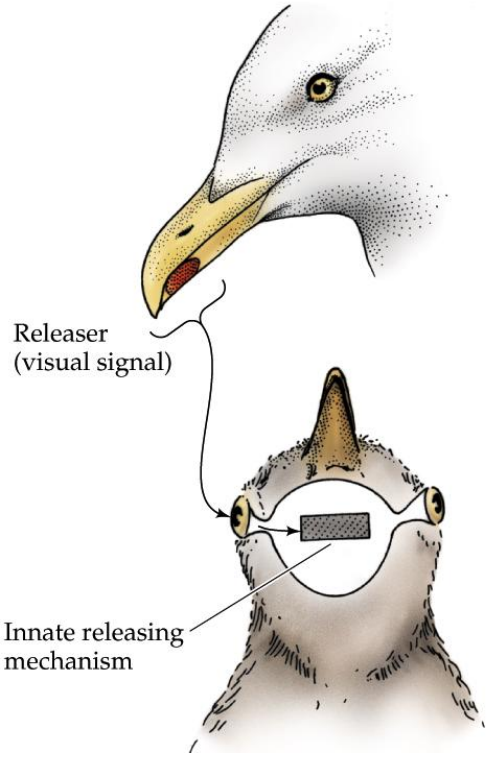
Example of FAP: egg rolling in greylag goose



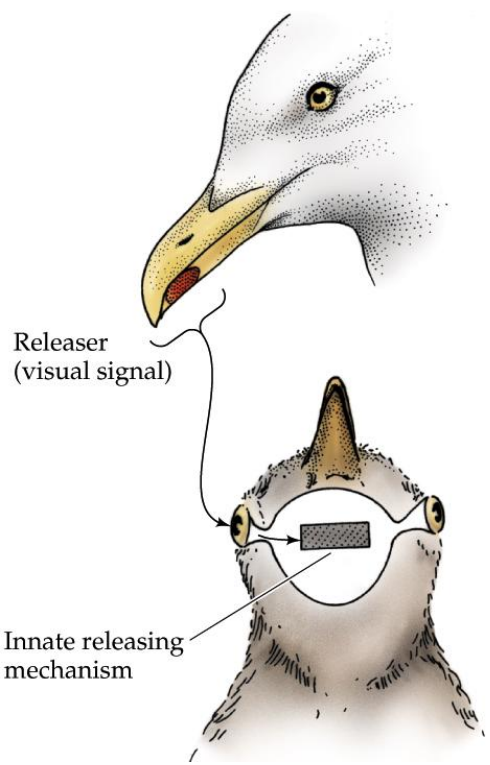
Wood duck (left) and mallard (right) courtship

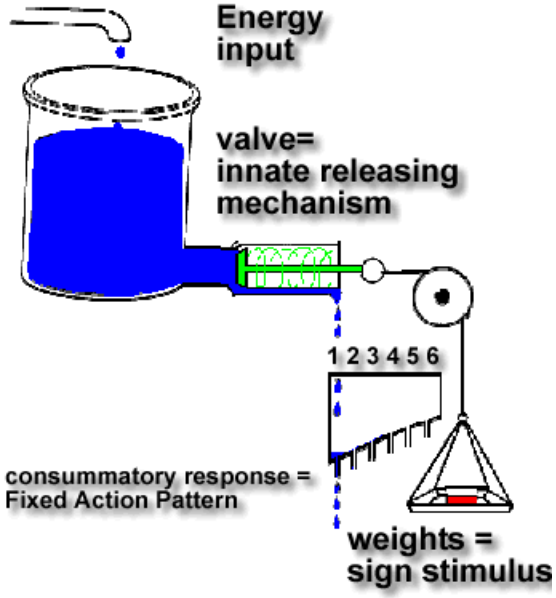
Fixed action patterns

Sign stimulus (releaser) → **Innate releasing mechanism (IRM) (filter + trigger)** → **Fixed action pattern (FAP)**

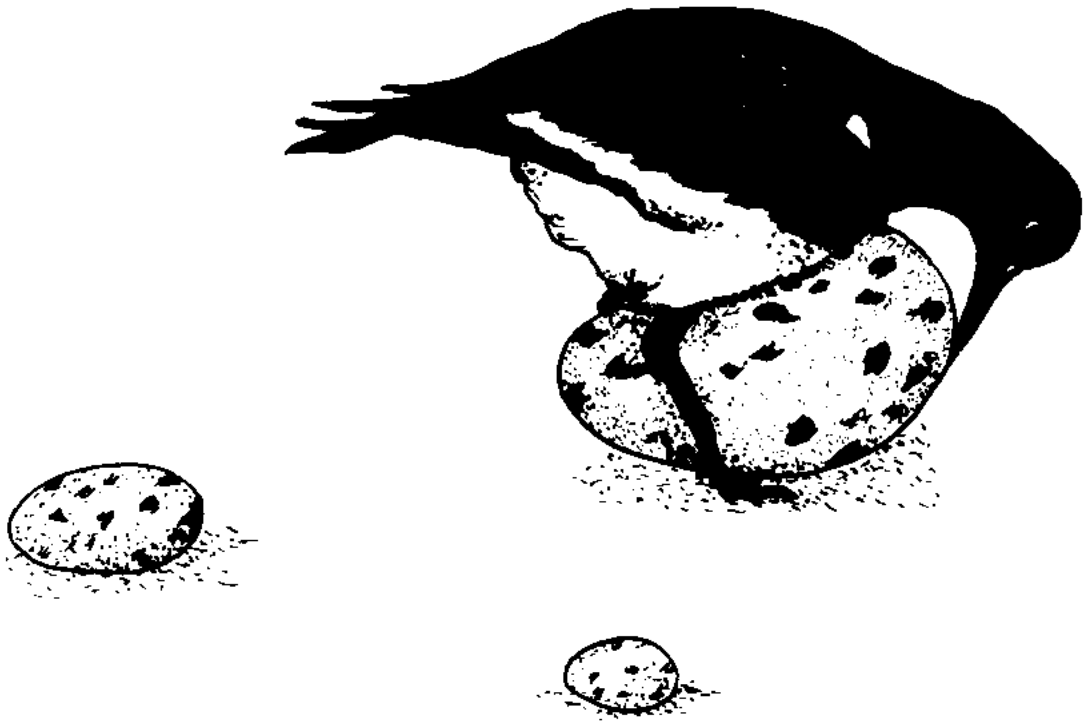


Lorenz's hydraulic model

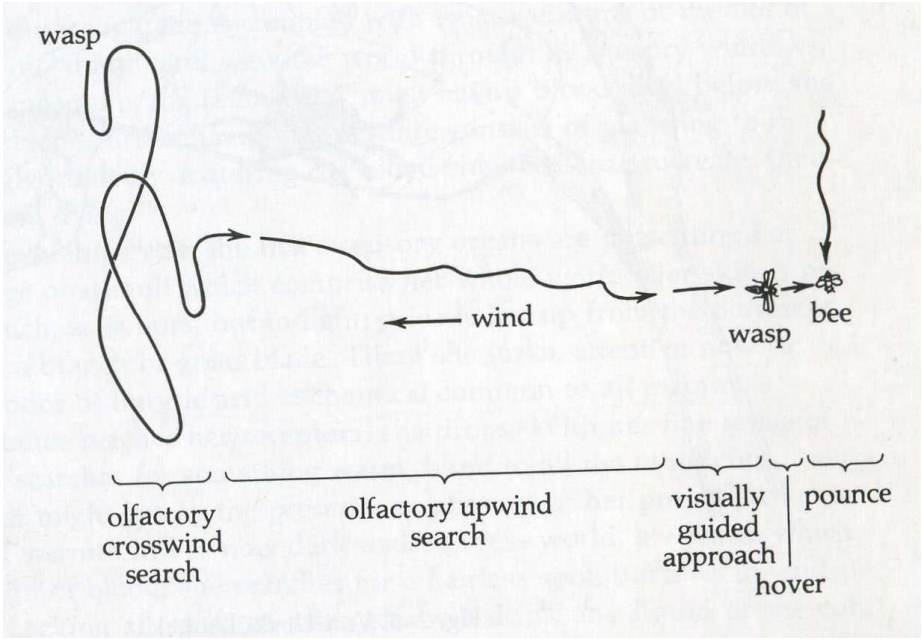




Supernormal stimuli

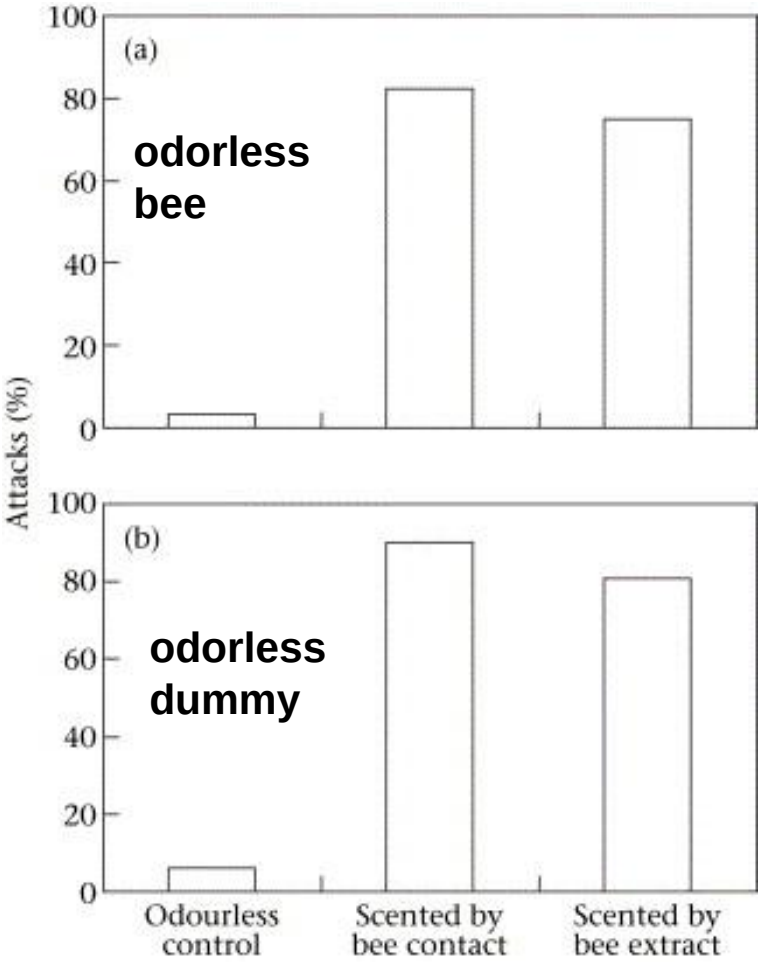


What about more complex behavior?

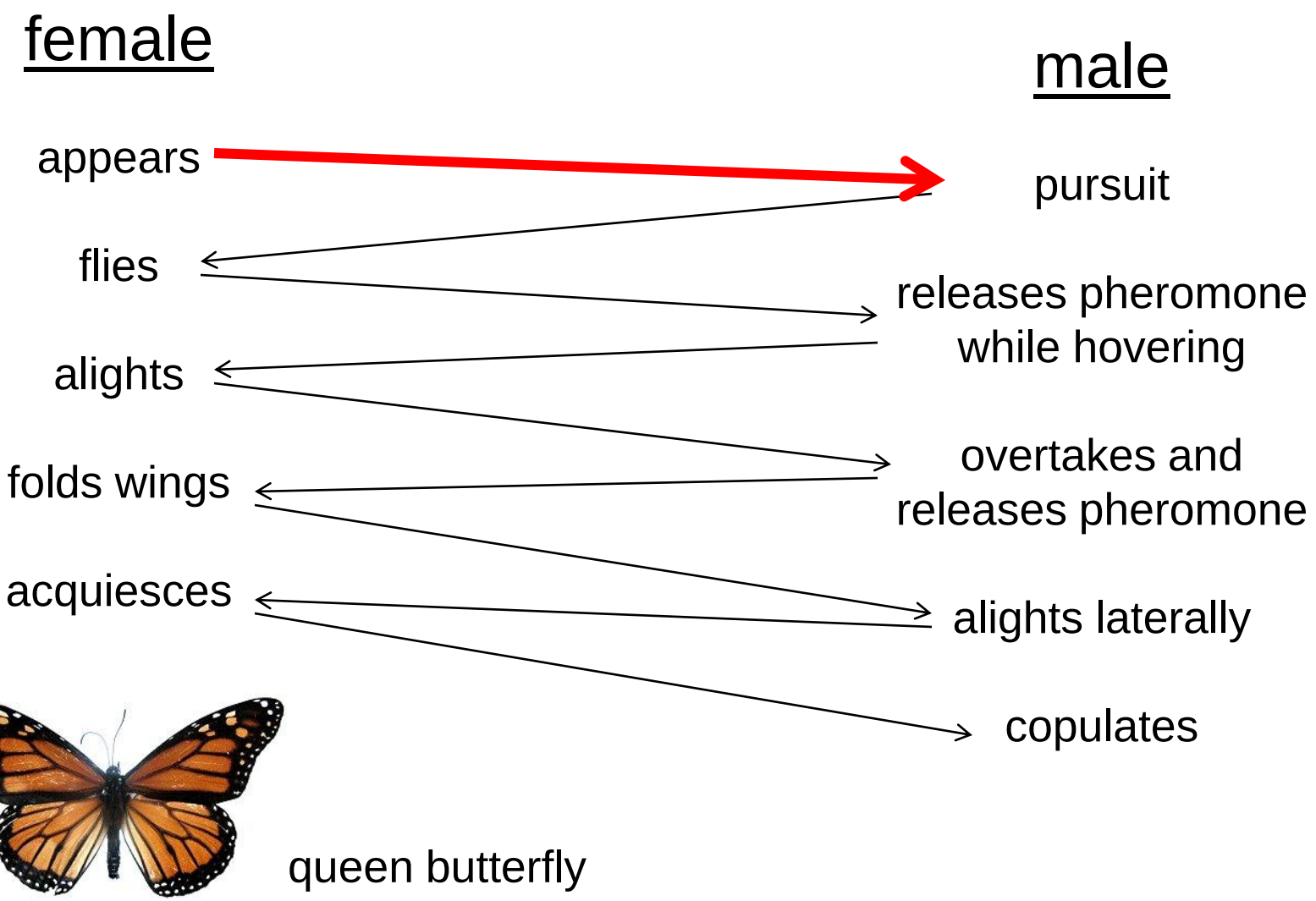


What cues trigger beewolf predatory behavior?

Tinbergen's beewolf



What about more complex behavior?



What about more complex behavior?

female

male

appears → pursuit

Three factors trigger pursuit:

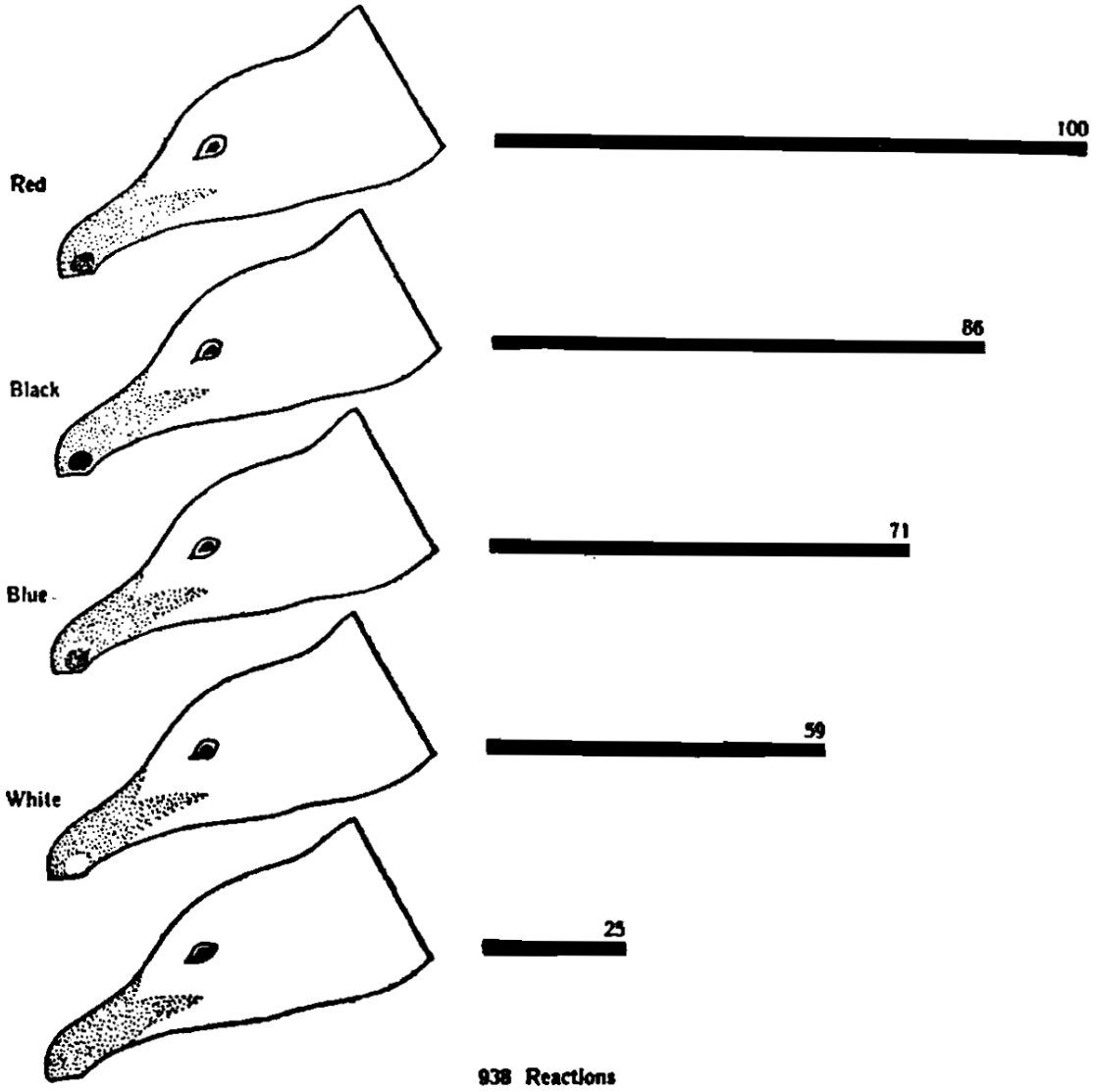
1. Dark / light contrast
2. Bobbing flight pattern
3. Rapid alteration of apparent size

queen butterfly

What do we predict about male response to an artificially accelerated flapping rate?

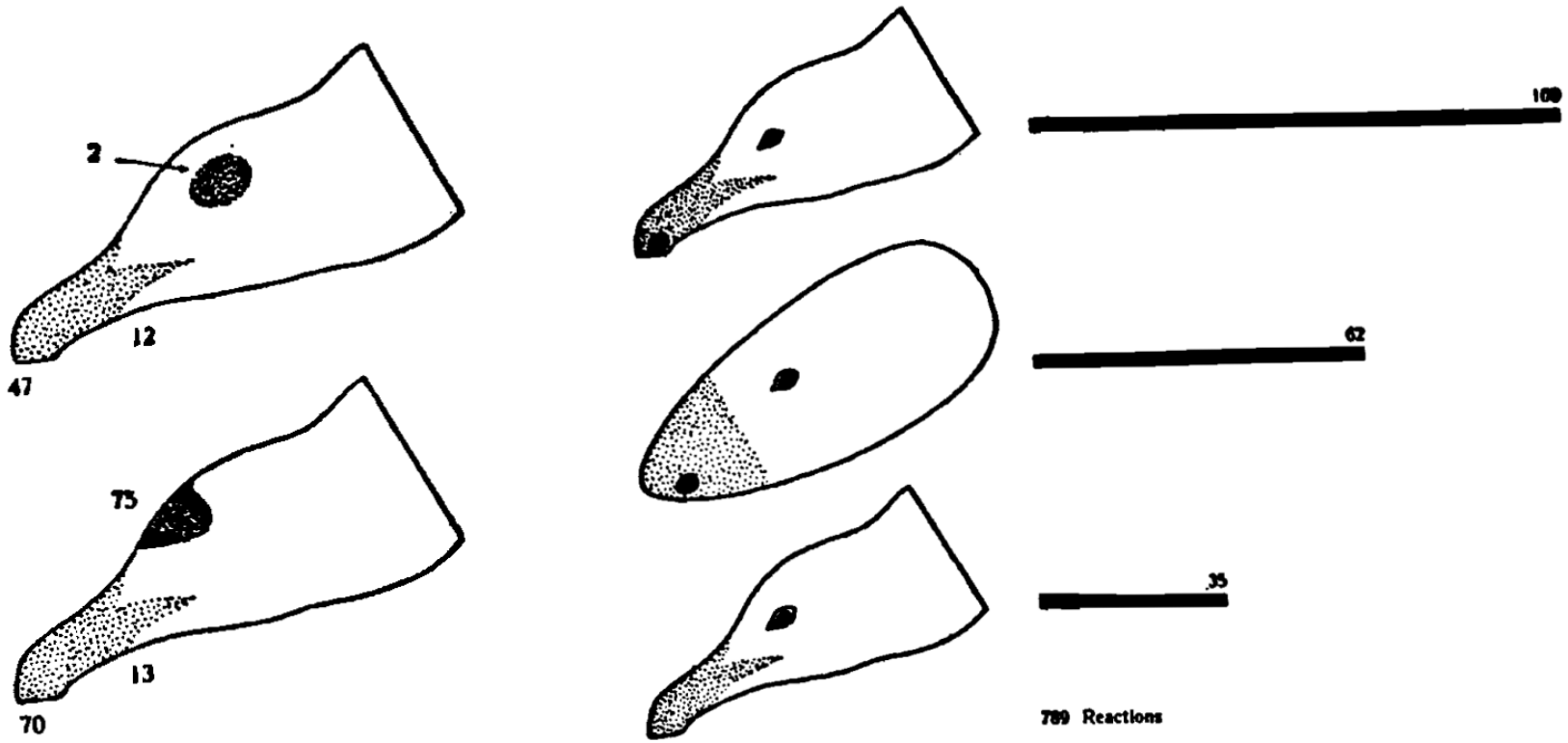
Experimental ethology

Experimental ethology



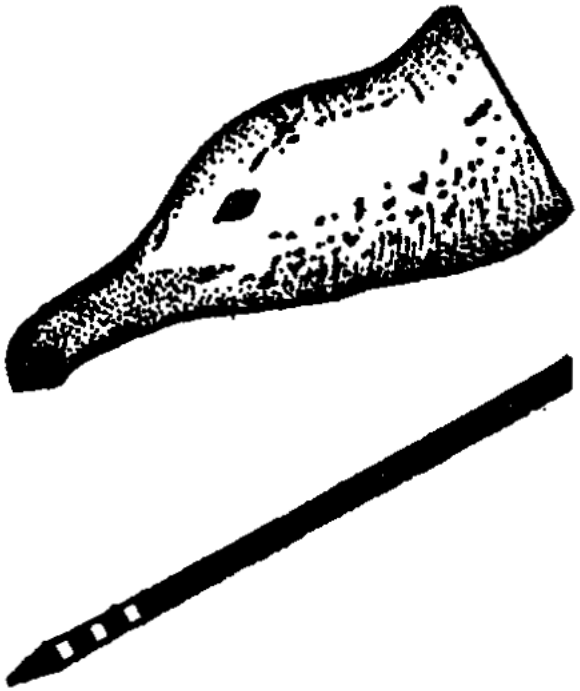
Experimental ethology

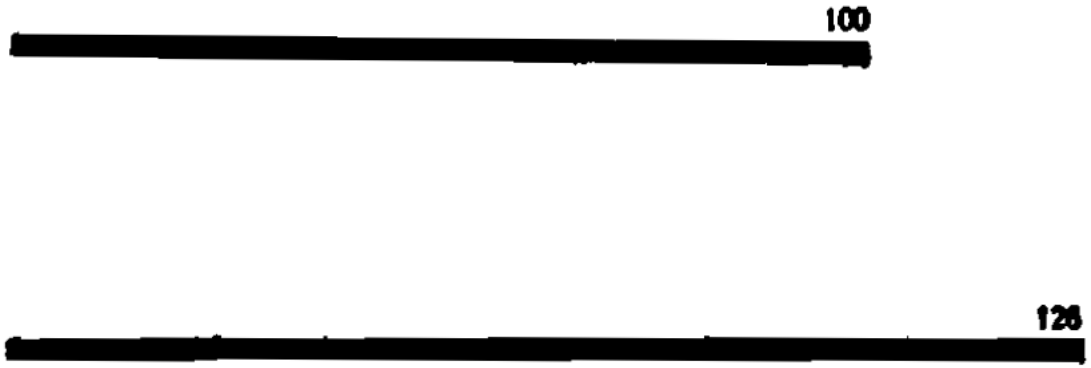
Is the red spot a classical releaser?



Experimental ethology

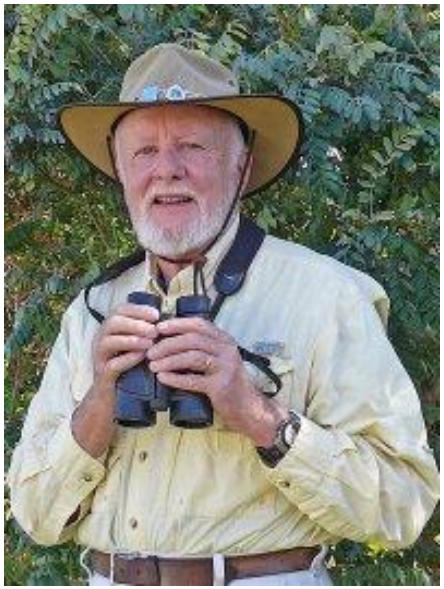
How to explain this?





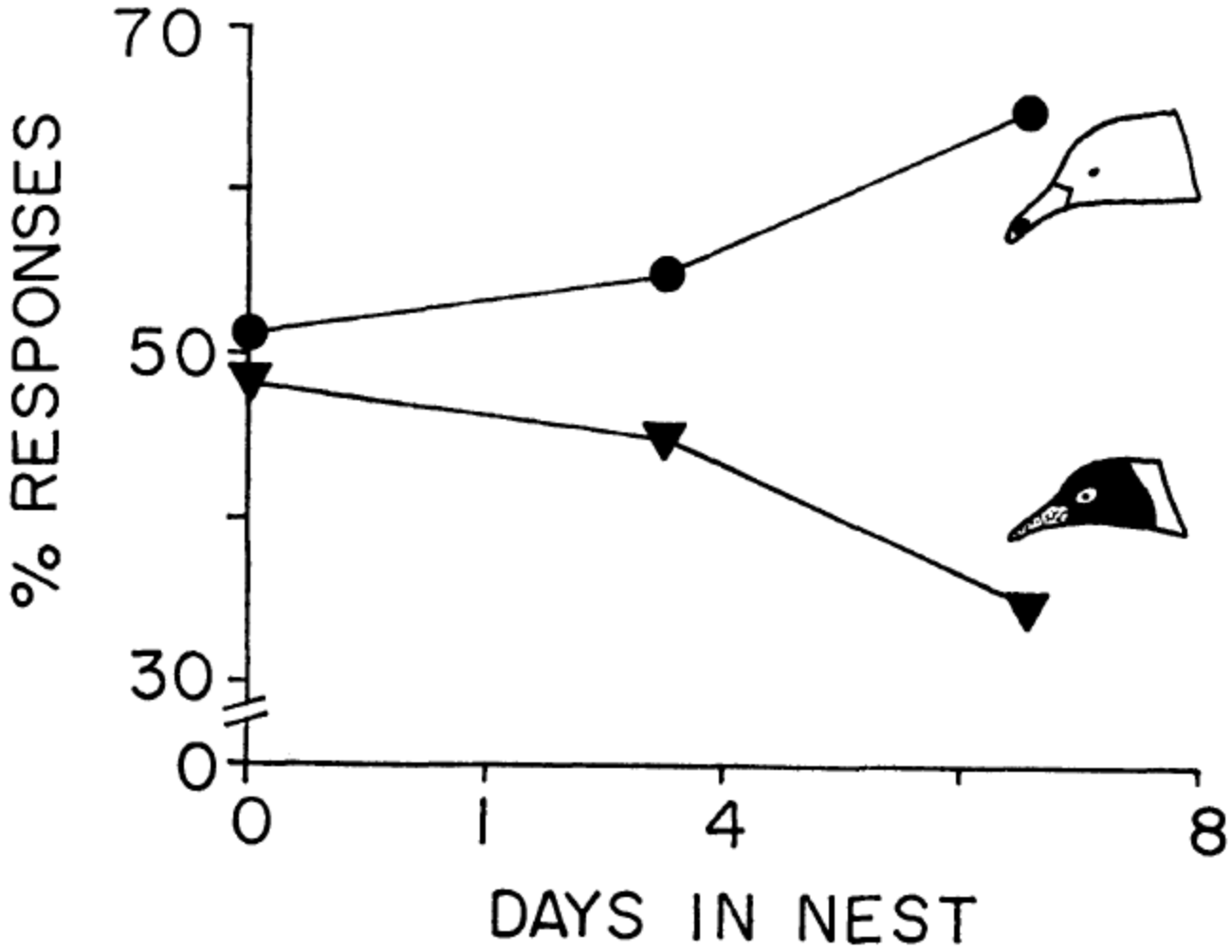
944 Reactions

Experimental ethology

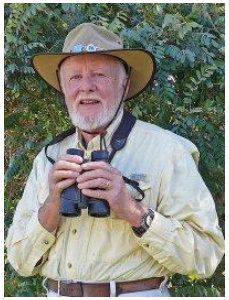


Jack Hailman
(1936-)

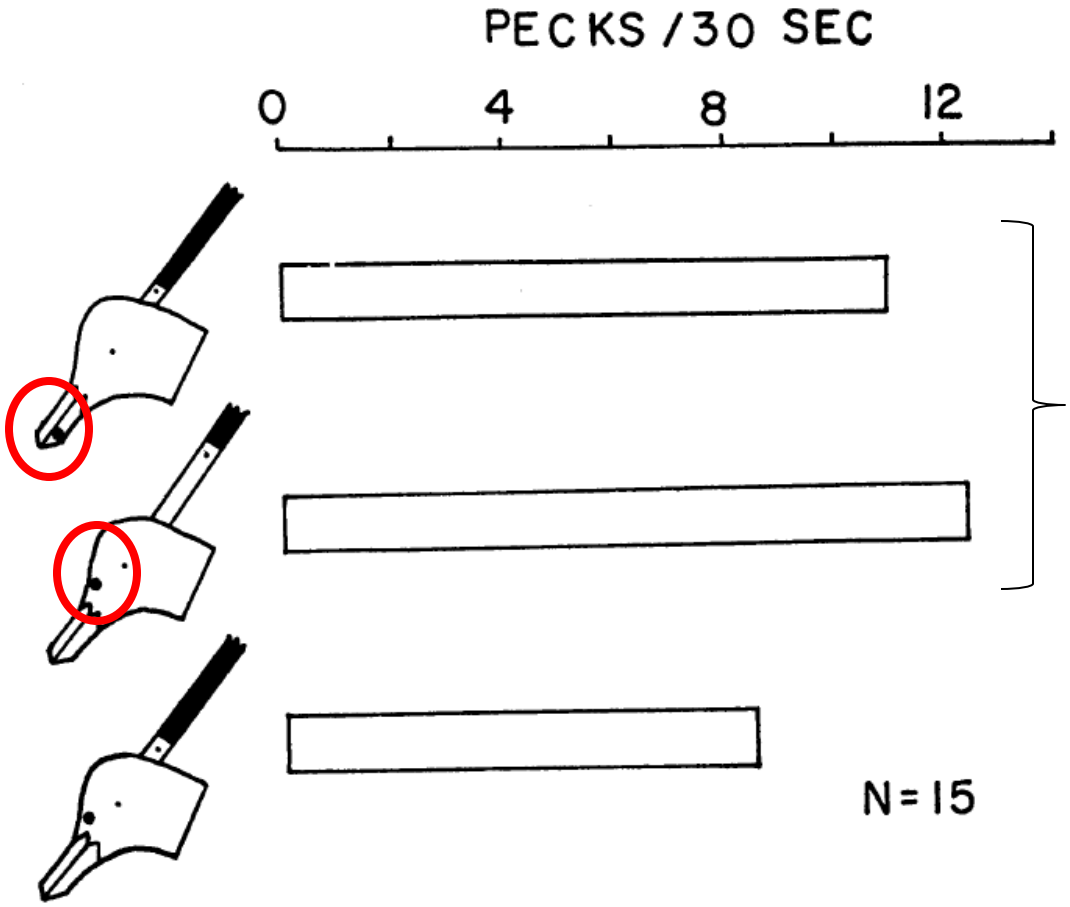
Experimental ethology



Hailman

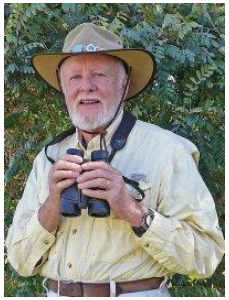


Experimental ethology



No difference between these two models… why not?

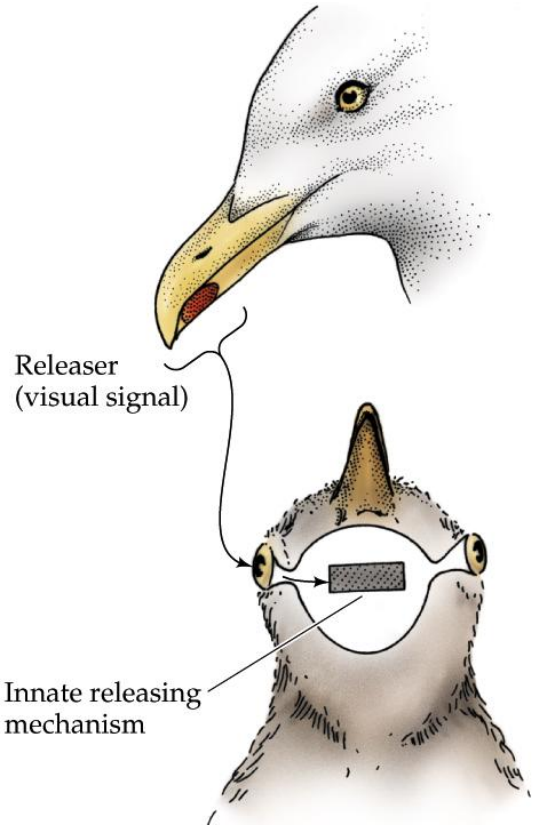
Hailman



Experimental ethology

1. Releasers are discrete features

2. Genes cannot encode pictures



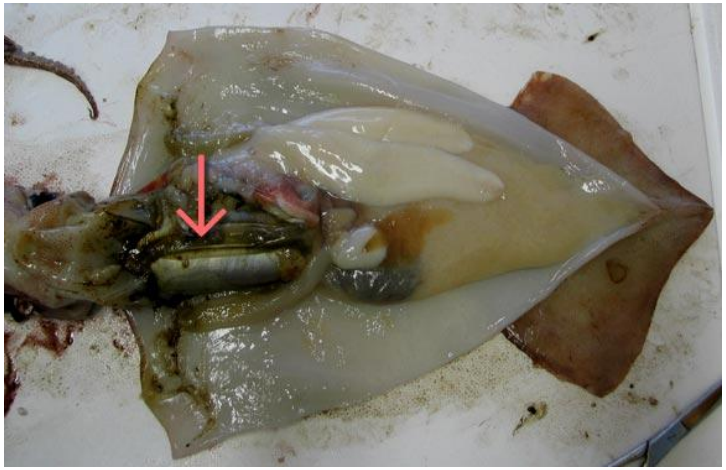
Tinbergen's four "questions"

Animal behavior can be explained in terms of

a. causation
b. development
c. evolution
d. function

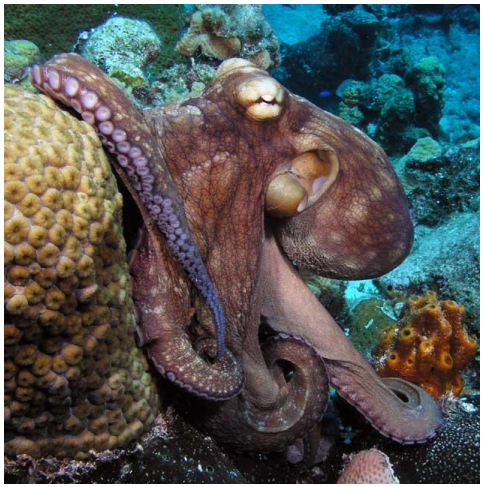
Why do cephalopods ink?

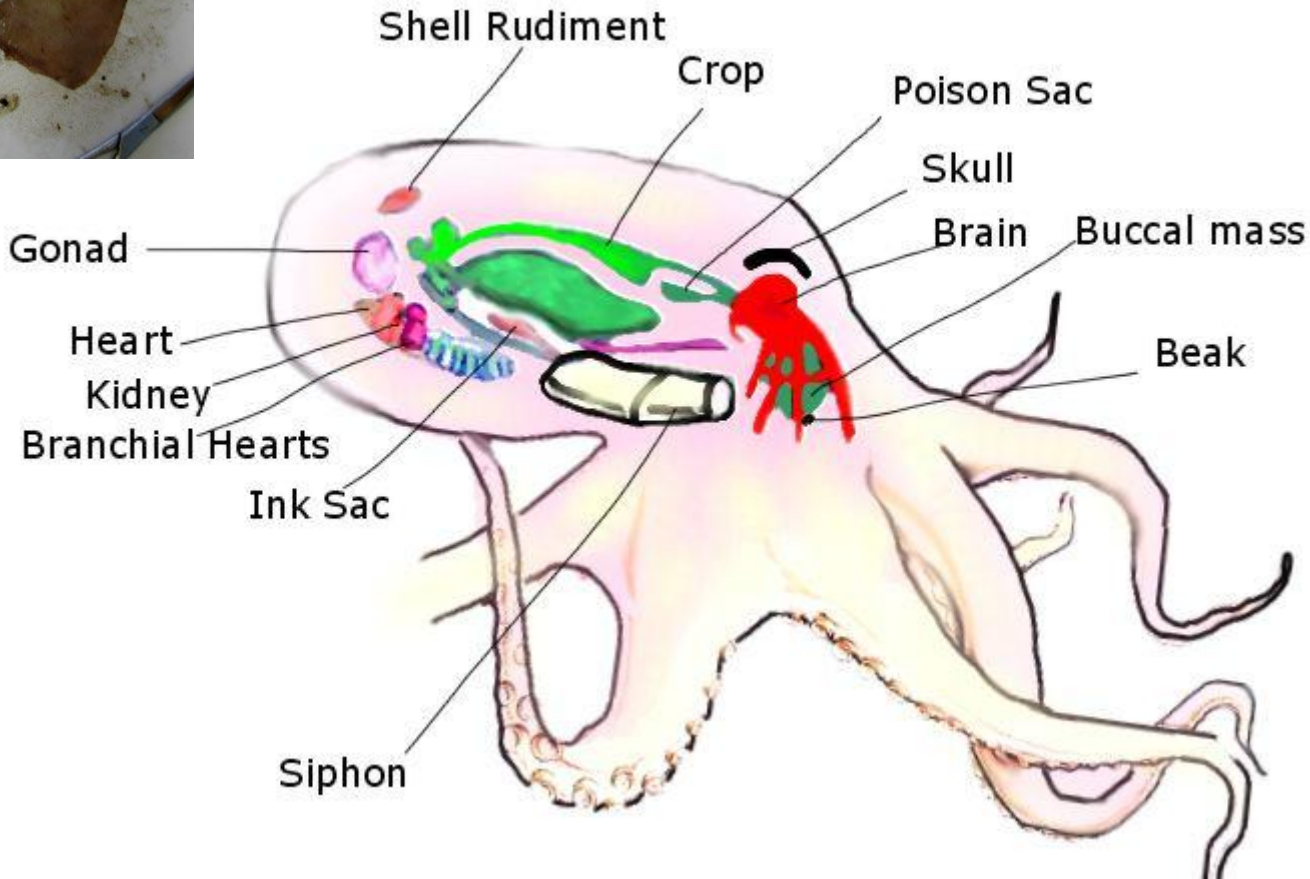
Causation



Ink production

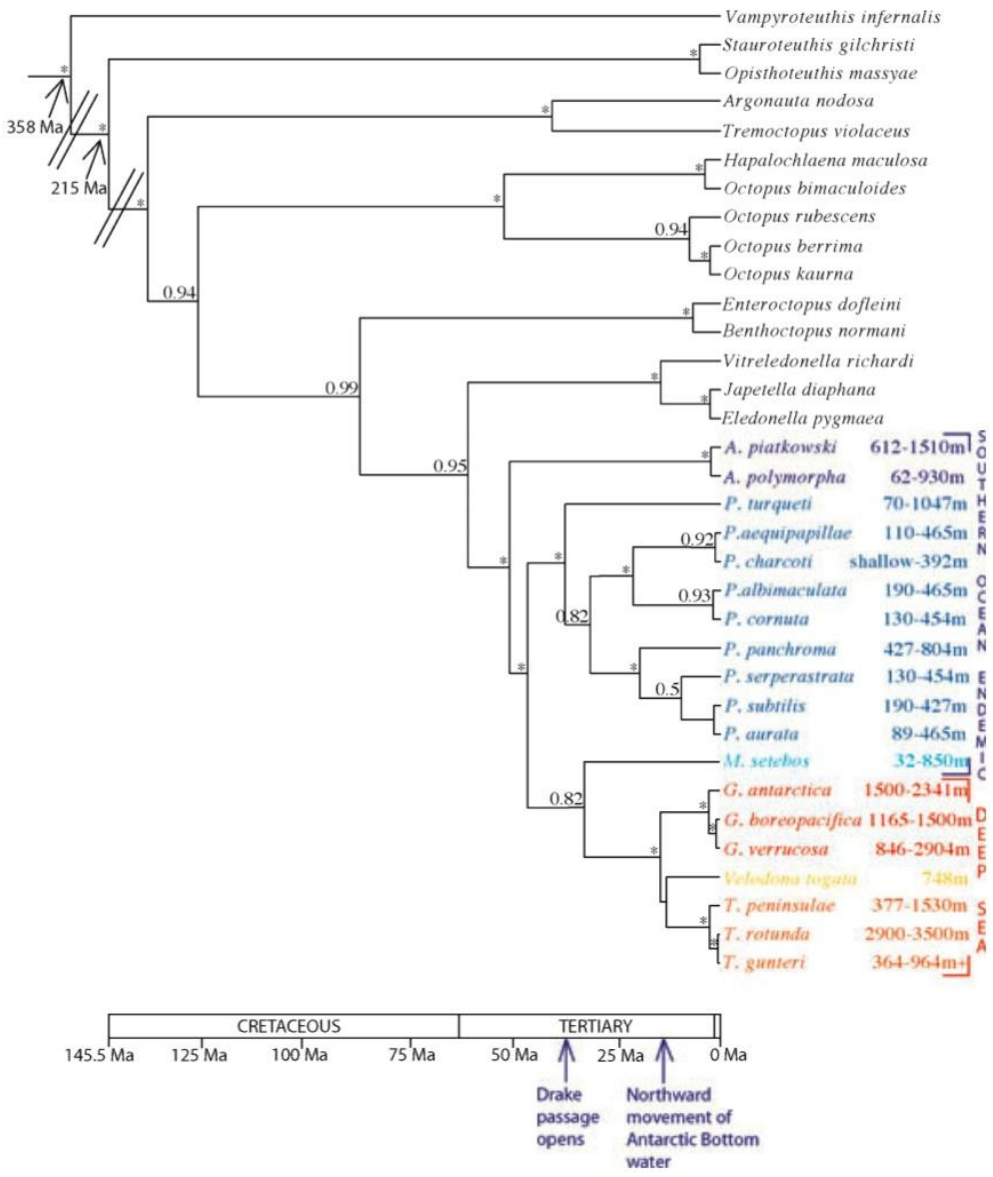
tyrosine ⟶ melanin

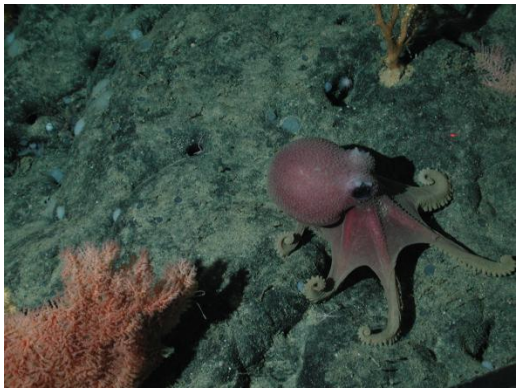


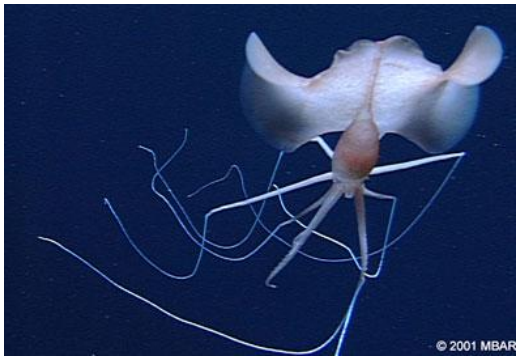


Development

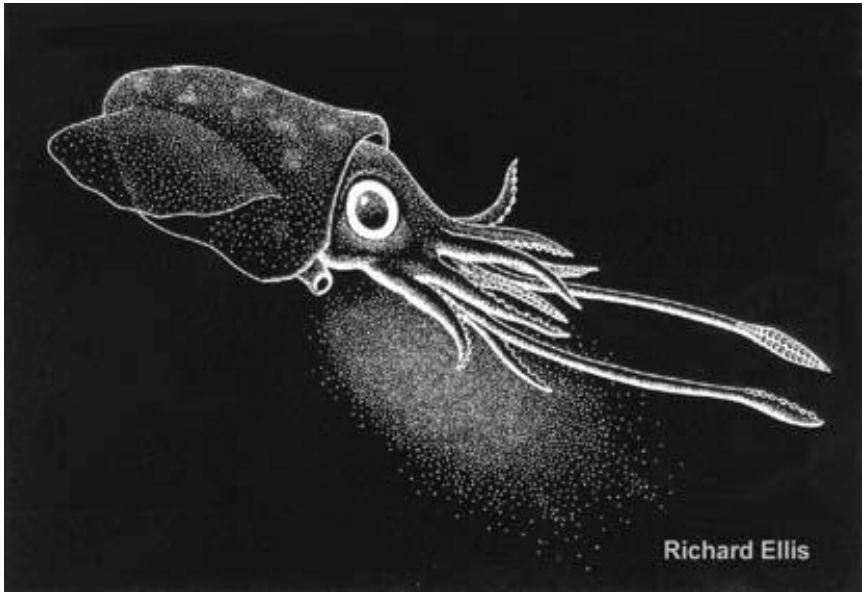
Evolution


Vampyroteuthis infernalis
Stauroteuthis gilchristi
Opisthoteuthis massyae
Argonauta nodosa
Tremoctopus violaceus
Hapalochlaena maculosa
Octopus bimaculoides
Octopus rubescens
Octopus berrima
Octopus kaurna
Enteroctopus dofleini
Benthoctopus normani
Vitreledonella richardi
Japetella diaphana
Eledonella pygmaea
A. piatkowski 612-1510m
A. polymorpha 62-930m
P. turqueti 70-1047m
P.aequipapillae 110-465m
P. charcoti shallow-392m
P.albimaculata 190-465m
P. cornuta 130-454m
P. panchroma 427-804m
P. serperastrata 130-454m
P. subtilis 190-427m
P. aurata 89-465m
M. setebos 32-850m
G. antarctica 1500-2341m
G. boreopacifica 1165-1500m
G. verrucosa 846-2904m
Velodona togata 748m
T. peninsulae 377-1530m
T. rotunda 2900-3500m
T. gunteri 364-964m+
SOUTHERN OCEAN ENDEMIC
DEEP SEA
358 Ma
215 Ma
0.94
0.99
0.95
0.92
0.93
0.82
0.5
0.82
0.94
CRETACEOUS
TERTIARY
145.5 Ma
125 Ma
100 Ma
75 Ma
50 Ma
25 Ma
0 Ma
Drake passage opens
Northward movement of Antarctic Bottom water




© 2001 MBAR

Evolution



Function

Morgan's canon

"It was sympathetic help, such as man only among the higher Mammalia shows. The excitement and ardor 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. This observation seems unequivocal as proving fellow-feeling and sympathy, so far as we can trace any analogy between the emotions of the higher animals and those of insects."

George Romanes
(1848-1894)

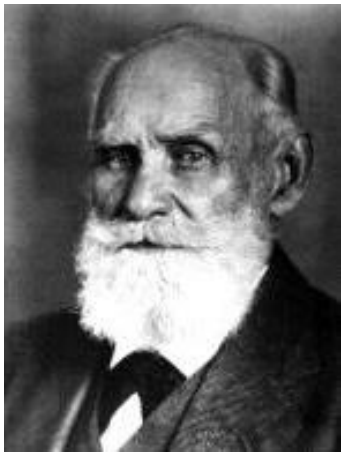
"In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale."

C. Lloyd Morgan
(1852-1936)

Criticisms of ethology

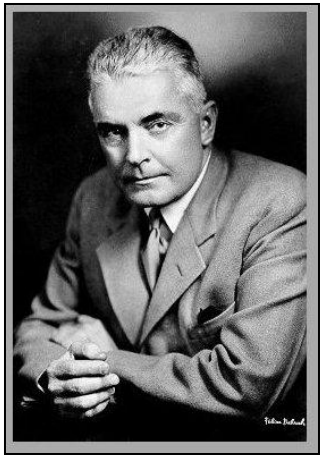
Pavlov's work provided fodder for critics of ethology

Comparative psychology



Ivan Pavlov
(1849-1936)

Edward Thorndike
(1874-1939)



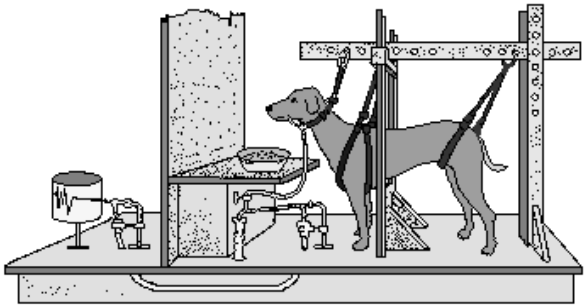
John B. Watson
(1878-1958)

B.F. Skinner
(1904-1990)

Comparative psychology

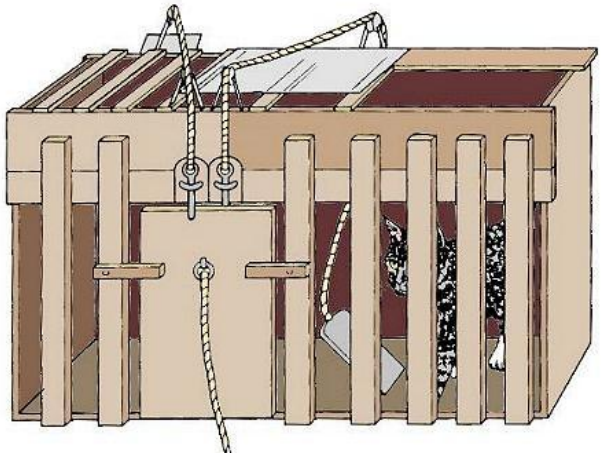
Placed primary emphasis on
elucidating mechanisms of learning

Pavlov's experiments in
classical conditioning



Comparative psychology

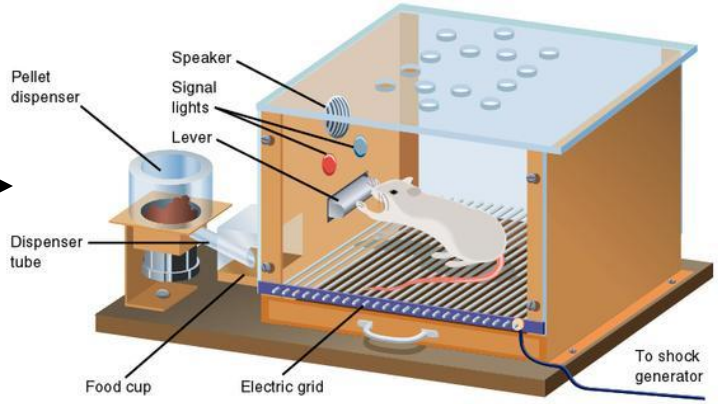
Thorndike's puzzle box



"In the first place, most of the books do not give us a psychology, but rather a eulogy of animals. They have all been about animal intelligence, never about animal stupidity."

Comparative psychology

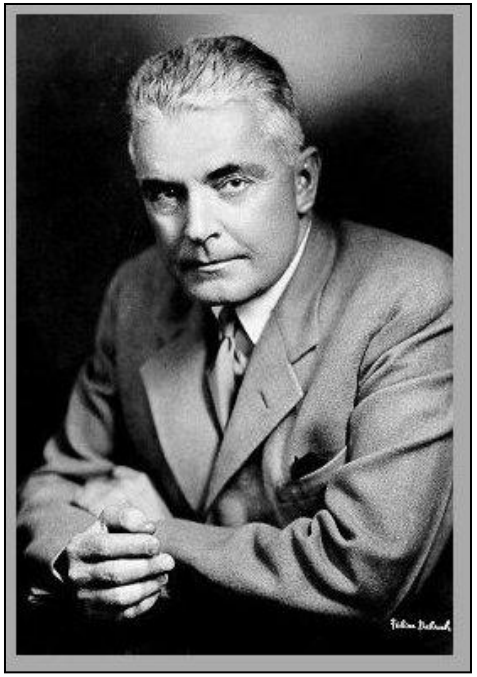
Skinner box
(operant conditioning)



Behaviorism

Rise of the school of Behaviorism

"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 beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors."



"We are now almost at the point of throwing away the word 'instinct.'"

Modern animal behavior

Dichotomy between comparative psychology and ethology now blurred