Measuring Behavior: Rats, Mice, and Other Rodents

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Why this focus?

- Two reasons:
  - Rodents, and, Behavior

- Start with Rodents:
  - By far the largest mammalian group
    - Over 2,000 species
    - Almost certainly with the largest number of individuals
    - Varying in practically every possible dimension
    - And not to be reduced to RATS and MICE (even including HAMSTERS)
...rodents differ remarkably in size

Pygmy jerboa: 3 grams
capybara: 55 kg
.... they range from solitary to intensely social
And include what may be the world’s cutest and ugliest animals.
Summary: Rodents

- Rodents are an incredibly varied group of mammals,
- While most species are well suited for lab work, few are being used
- We need more comparative work, as well as more rodent field work, to understand interspecies variety in behaviors
And on to Behavior: The Rat that Wasn’t Doing Anything

- Honolulu, 1966
- Goal: to develop a true Pavlovian model of fear conditioning
- Procedure: find out exactly what rats do both during and after foot shock
- Ted Dielman: “It isn’t doing anything!”
- (It was freezing)
How to Study Behavior

- Attention to natural behavior in the field
- Isolate and Maximize Natural behaviors in laboratory settings that provide core features of natural environment
- Manipulation of independent variables, measurement of natural behavior as dependent variables (ethoexperimental approach)
- Comparative Perspective between species and both lab and wild animals
Social and Defensive Behavior in Rats and Mice: The Visible Burrow System (VBS)

- The VBS provides a large (≈ 1 sq m) enclosure, divided into:
  - An open or “surface” area under 12:12 hr light/dark cycle, and,
  - A “burrow system” consisting of 3 chambers connected by tunnels to the surface, and maintained under constant red light.
- This seminatural burrow system enables viewing and videotaping of social interactions and Social Communications (vocalizations)
What good is the VBS

- With marked animals, can measure:
  - Aggression and defense in all dyads, leading to identification of colony dominants and subordinates
  - Sexual behaviors, male and female
  - Occupancy of “surface” patterns
  - Responsivity to presentation of predators or predator stimuli
    - Specific defenses, e.g. flight, vocalization
    - Changes in space occupancy patterns, relative to location where predator was encountered
  - Eusocial behaviors, including huddling, different patterns of approach
  - All at different ages, and in groups of different sex composition
The
Visible Burrow System
FIG. 1. Percent time vocalizing (20–27 kHz range) and time on surface for seven visible burrow system groups of Long-Evans rats as a function of cat presence and time (0–30 min, 60–90 min and 120–150 min) after cat removal.
FIG. 2. Percent time vocalizing for one, two, or three or more colony members over the initial cat and sham exposure days for two representative colonies.
Fig. 1. A schematic diagram of the visible burrow system used with mice. Mice always selected C2 or C3 as their sleeping chamber, with the adjacent chamber as a latrine.
Huddling, & flight to front or back approach (C57Bl/6J mice)
..going on to analysis in more structured situations

- Defense....the Mouse Defense Test Battery, and
- Aggression.....resident-intruder models
MDTB Apparatus
The Mouse Defense Test Battery

- **FLIGHT**
- **RISK ASSESSMENT**
- **DEFENSIVE AGGRESSION**
- **CONTEXTUAL ANXIETY**
Main Factor Loadings of the Various Defensive Behaviors in the MDTB

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Flight

-50 -25 0 25 50

15 10 5

15 10 5

IMIPRAMINE → (ACUTE)

IMIPRAMINE ← (CHRONIC)

**

FLUOXETINE → (ACUTE)

FLUOXETINE ← (CHRONIC)

*
Summary: An Ethoexperimental Approach

- Goal is to understand evolved biobehavioral systems in wild and lab animals
- First approach may involve seminatural situations, with analysis of individual and interactive behaviors, and outcomes
- Use an adequate range of measures
- Design your apparatus and lab tests to elicit, isolate and maximize these behaviors
- Don’t let your dependent variables be determined by your apparatus!
My wife (the light saber in the middle)
Students past:
  Kevin Flannelly, Lori Takahashi, Guy Griebel, Yoav Litvin, Mu Yang, Nathan Pentkowski, Karina Borelli, Eduardo Carvalho Netto
..and present: Erwin Defensor, Brandon Pearson, Roger Pobbe
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