Observing and quantifying behavior
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Instructions for using this lab. You must have QuickTime installed on your computer. Open one or more of the videos in QuickTime while simultaneously running JWatcher in another window. You will need to download and use the enclosed .gdf, .fmf, and .faf files.

Objectives:

1) To understand some of the decisions one must make when constructing an ethogram.
2) To become familiar with the process of quantifying behavioral observations.

Today you will begin to learn about ways to quantify animal behavior. Determining how to quantify behavior is at the essence of testing behavioral hypotheses. An accessible entry into the literature is contained in Paul Martin and Patrick Bateson's excellent book: *Measuring Behaviour: An introductory guide, 2nd ed* (Martin & Bateson 1993).

Foraging animals must trade-off time allocated to foraging with antipredator (and social) vigilance (Bednekoff & Lima 1998. Trends in Ecology and Evolution 13:284-287). We have provided a series of two 2-minute video clips of foraging mammals filmed at Rocky Mt. Biological Laboratory (www.rmbl.org), a sub-alpine field station near Crested Butte, Colorado.

The animals include:

1) Squirrel1.mov and squirrel2.mov are golden-mantled ground squirrels (*Spermophilus lateralis*), a small, asocial, resident ground squirrel. Active during the summer, golden-mantled ground squirrels hibernate throughout the winter. The clips are of two young of the year.
2) Marmot1.mov and marmot2.mov are yellow-bellied marmots (*Marmota flaviventris*), a mid-sized, social resident ground-dwelling squirrel. Active during the summer, marmots must gain sufficient mass to survive hibernation. The clips are of two young marmots which are fur-dyed as part of a long term behavioral study. The marmots were recorded in early August, a time when they are actively trying to store fat. Clip one is 'blot neck', and clip 2 is 'plus back' (the marmot on the left at the start of the video).
3) Hare1.mov and hare2.mov are snowshoe hares (*Lepus americanus*), a large, asocial, lagomorph. Hares are active throughout the year. In the summer, their fur blends in with the summer vegetation, while in the winter, their pelage turns white—which perfectly matches their snow covered meadows. Clip one is of an adult hare, while clip two is of a young hare foraging next to a willow thicket.
4) Deer1.mov and deer2.mov are mule deer (*Odocoileus hemionus*). Mule deer are year-round residents of RMBL. We have clips of two females, one with a young (deer1.mov), and one without a young (deer2.mov).

5) Cow1.mov and cow2.mov are domestic cattle (*Bos taurus*) which are grazed, seasonally, in and around the National Forest lands surrounding RMBL. Clips are of a mother (cow1.mov) and her young of the year (cow2.mov).
6) Horse1.mov and horse2.mov are domestic horses (*Equus caballus*), which are also grazed seasonally. Cattlemen use the horses to heard cattle. Clips are of two males foraging in a temporary paddock.

Developing an ethogram (20 min)
An ethogram is a catalog of behaviors. The first thing you must do when quantifying behavior is to come up with a list of behaviors. We're going to develop a 'partial ethogram' focusing on foraging and antipredator vigilance. Have a look at one of each of the clips. Focus on the foraging and vigilance behavior. Note that some species can forage while simultaneously looking and some species can look while chewing.

Divide into several groups so that several people are looking at one species. Each group should describe, for a species, the motor patterns used for foraging and for vigilance. An example is:

Horse, Foraging: Subject stands quadrupedally, head down in the vegetation, clipping and ingesting vegetation with its mouth.

Be sure to include the various postures used while acquiring food and looking (i.e., if you see animals looking while chewing, be sure to define a behavior 'looking and chewing').

Share your resulting ethogram with the other groups and discuss the specificity of your categories and your definitions.

Developing a testable hypothesis (10 min)
In order to test behavioral hypotheses, you must have focused questions. Let's consider antipredator vigilance. A number of obvious questions arise when looking at these different video clips. The one we're going to ask today is: *Are there differences between the species in the time allocated to foraging and vigilance?* We're going to test this hypothesis by estimating the time allocated to foraging and vigilance for each of these species. Because we've only got two video clips of each species, we will not conduct formal statistical analyses, but rather, we will eye-ball the differences in mean time allocation and base our conclusion on this comparison.

Assuming there will be differences, discuss what might explain these differences? For instance, species vary in their domestication, body size, and exposure to predators. While RMBL has a variety of predators for small body-sized prey (e.g., coyotes, foxes, weasles, martens, black bears, hawks and eagles all prey on wild animals at RMBL), larger body-sized animals may be relatively safe from these predators. Wolves are extinct around RMBL, and black bears do not attack deer-sized animals). The video clips include animals of different ages and sexes. How might this influence vigilance? How about group size?

Quantifying behavior (60 min)
For the purpose of this exercise, let's use a simple ethogram that allows us to make comparisons between species.

f = head down foraging
r = rearing up on two legs while foraging
l = standing quadrupedally and looking
c = standing quadrupedally and looking while chewing
u = standing bipedally and looking while chewing
w = walking or other locomotion
x = other behavior
o = out of sight

There are several ways one could estimate the time allocated to foraging and vigilance. We're going to employ a technique called *focal animal sampling*, where we focus on a single subject and note what it is doing. When focusing on a single subject, one can *time sample* or *continuously record* behavior. Time sampling involves recording what the subject is doing at pre-determined time intervals—say every 1 sec, every 5 sec, etc. Continuous recording is doing just that, noting every behavioral transition (i.e., from foraging to looking).

There are advantages and disadvantages to each of these recording methods: time sampling necessarily involves missing behavior, but may be less labor intensive. For animals that engage in behaviors that have relatively long durations, time sampling may be appropriate. In contrast, time sampling animals that quickly change behaviors and engage in a number of different activities over a short period of time may lead to inadequate estimates of time allocation. Of course, the shorter the time interval between samples, the more 'continuously' you're recording behavior.

We're going to employ continuous recording to estimate the time allocated to foraging and vigilance in these mammals, and we're going to use an 'event recorder' to help us. Event recorders are computer programs (or dedicated pieces of hardware) that record keystrokes as they occur over time. In our case, keystrokes will represent behavioral transitions. For instance, when the animal is foraging, you will type an 'f, when the animal is looking, you will type 'l', etc. Using analysis algorithms included in JWatcher, the event recorder, we will then calculate the time allocated to foraging and vigilance. The full JWatcher program and manual is freely available on-line at: http://galliform.psy.mq.edu.au/jwatcher/ or at http://www.jwatcher.ucla.edu

Using JWatcher to score behavioral transitions

1) Click on the JWatcher icon to launch JWatcher
2) In the 'Data Capture' tabbed window, name the data file you will be scoring by clicking on the file navigator icon (it looks like a sheet of paper) to the right of the Focal Data window. Choose the location where you wish to save your new file. Type in the name of your new file in the 'filename' box and click 'open'. Keep the names simple. For instance, name the data file for the first ground-squirrel video clip, squirrel1.dat.

3) Specify a 'Focal Master File' (the ethogram along with additional specifications for recording the focal observation by clicking on the file navigator icon). In this case, the focal master file is called, lab.fmf.
4) Click the 'next' button at the bottom right to tab into the next page.
5) Answer the two questions by typing the species and the video clip into the boxes below the questions and click the 'next' button to advance.
6) Cue up the video clip. There is a 4 sec count down sequence. When ready, click on the 'start' button. Immediately type the key code representing the behavior the subject is currently engaged in. Whenever the behavior changes, type the key code for the new behavior. Continue for the two full minutes (JWatcher will automatically time out).

Notes:
JWatcher is case sensitive: 'f' will NOT be recorded the same way as 'F'. For this exercise, you should *use lower case letters*.

If you wish to see a list of the behavioral codes on your computer screen, click the 'Behaviors' tab in the upper right corner of the JWatcher screen.

Hints:
If you made a data entry mistake, discard the resulting data file and start again.

If you are not a good touch typist, you may combine the different types of looking and just type 'l', and the different types of foraging and just type 'f'. If you do this, be sure to also type 'x' and 'o' (for other behaviors and out-of-sight, respectively).

Using JWatcher to Analyze focal animal samples

1) Once you have scored the video clip or clips, analyze the data by tabbing to the Analysis tab.
2) Use the file navigator icon to select the lab.faf—a focal analysis file that specifies the types of analyses we're going to calculate.
3) Use the file navigator tab to select the data file (e.g., squirrel1.dat) to select the data file to analyze.
4) Specify the Results folder in the Observing Behavior folder as the destination for the results (note: this is automatically created—simply verify that you know where it will be placed).
5) Select 'Print results for all behaviors'
6) Click the 'Analyse' button at the bottom of the file window to analyze your data.

Viewing the results files

You will need to use Excel (or another spread-sheet program) to view the results files. There are two results files, *.cd.res, and *.tr.res. The *.cd.res file has the quantitative results, while the *.tr.res has a file that you can open and graph the 'behavioral traces'. For today's exercise, let's just open the *.cd.res files.

1) View the *.cd.res file by opening it through Excel. Excel will not automatically recognize JWatcher files; you will need to 'tell' Excel to 'list all file types' or 'show all documents'. The *.cd.res file is a comma delimited text file.

2) Once opened, you should see a list of the behavioral codes and several summary statistics for each behavioral code.

   N: Occurrence
   TT: Total Time (in milliseconds)
   X: Average Time (in milliseconds)
   SD: Standard Deviation of the average time (in milliseconds)
   PROP IS: Proportion of Time in Sight

3) Write your results for your focal on the board. Your TA will work with someone to combine the results from different focals to create a summary results spreadsheet.

Discuss, as a class, the following issues (20 min)

1) Are the species different? How? Why might this be?
2) How would you more formally test the hypothesis that there are differences between the species?
3) What other hypotheses could you test using these data?
4) We did not talk about errors, or the reliability of observers, but these issues are essential for those scoring behavior. There are two types of reliability that are very important here. Inter-observer reliability measures how different observers code the same behavior. Intra-observer reliability measures how the same observer codes the same behavior on multiple occasions. Discuss these types of reliability and suggest ways to quantify them.