Queen Mary
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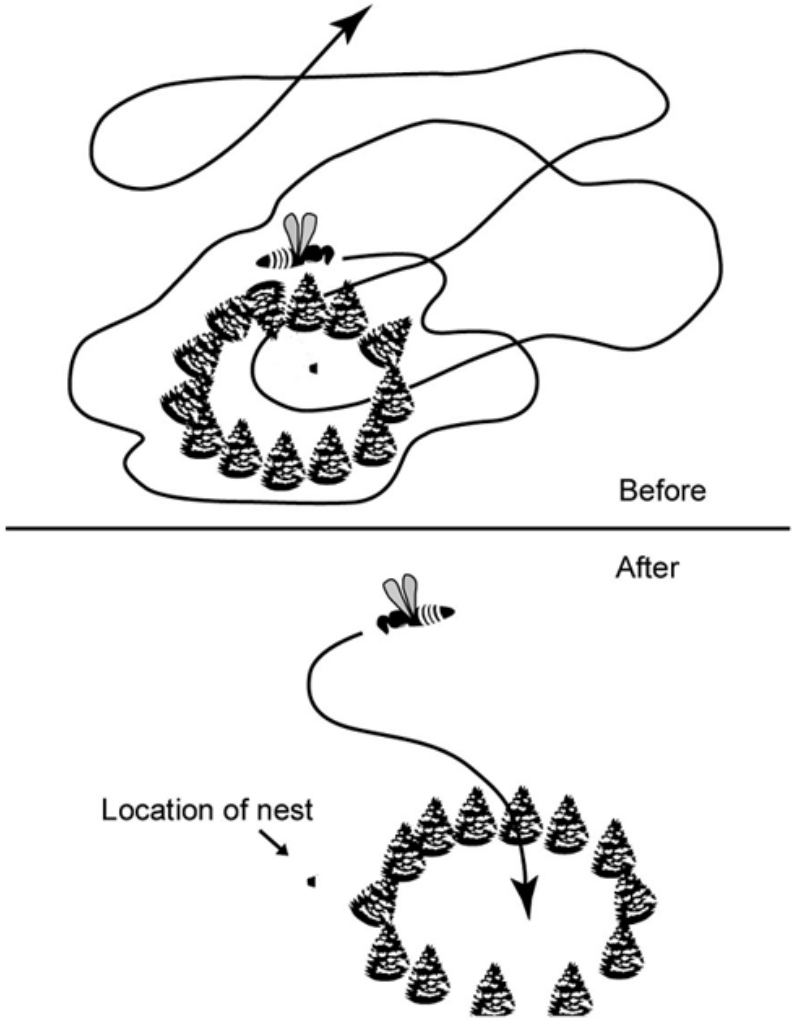
Learning Behaviour II: what do animals learn?

Learning about the location of home



Digger wasp memorises the local landmarks around nest entrance quickly.

Tinbergen (1951) moved ring of pine cones to a new location and the returning wasp followed the landmarks she learned.

Learning the location of home (birth place)

Atlantic salmon return to their native river

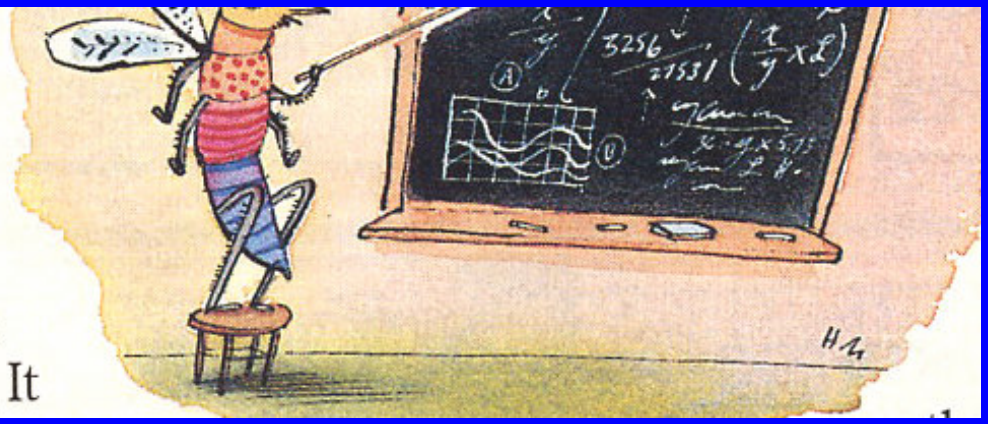
Young salmon memorise specific olfactory cues of the stream in which they were born to guide them home from the open ocean

Learning the path to a food source

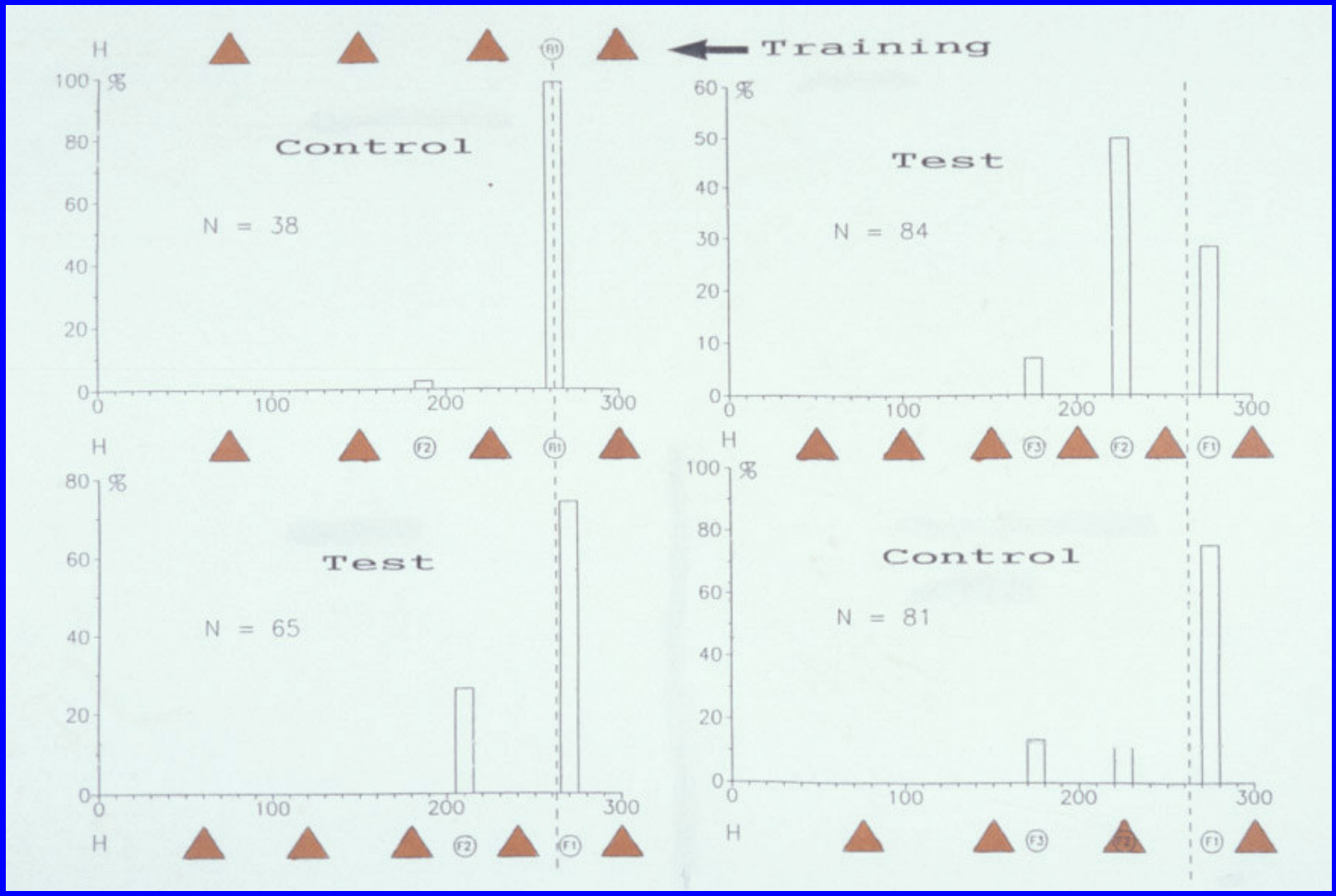
3.5 m landmark tents set up over a 300 m line from the hive

Bees seem to measure distance using an on board odometer, entrained by local landmarks

No, seriously, they discovered that the bees were locating the feeder by COUNTING THE LAND-MARKS. Yes! Bees can count! This means that bees, in terms of math skills, are ahead of most American high school graduates. It



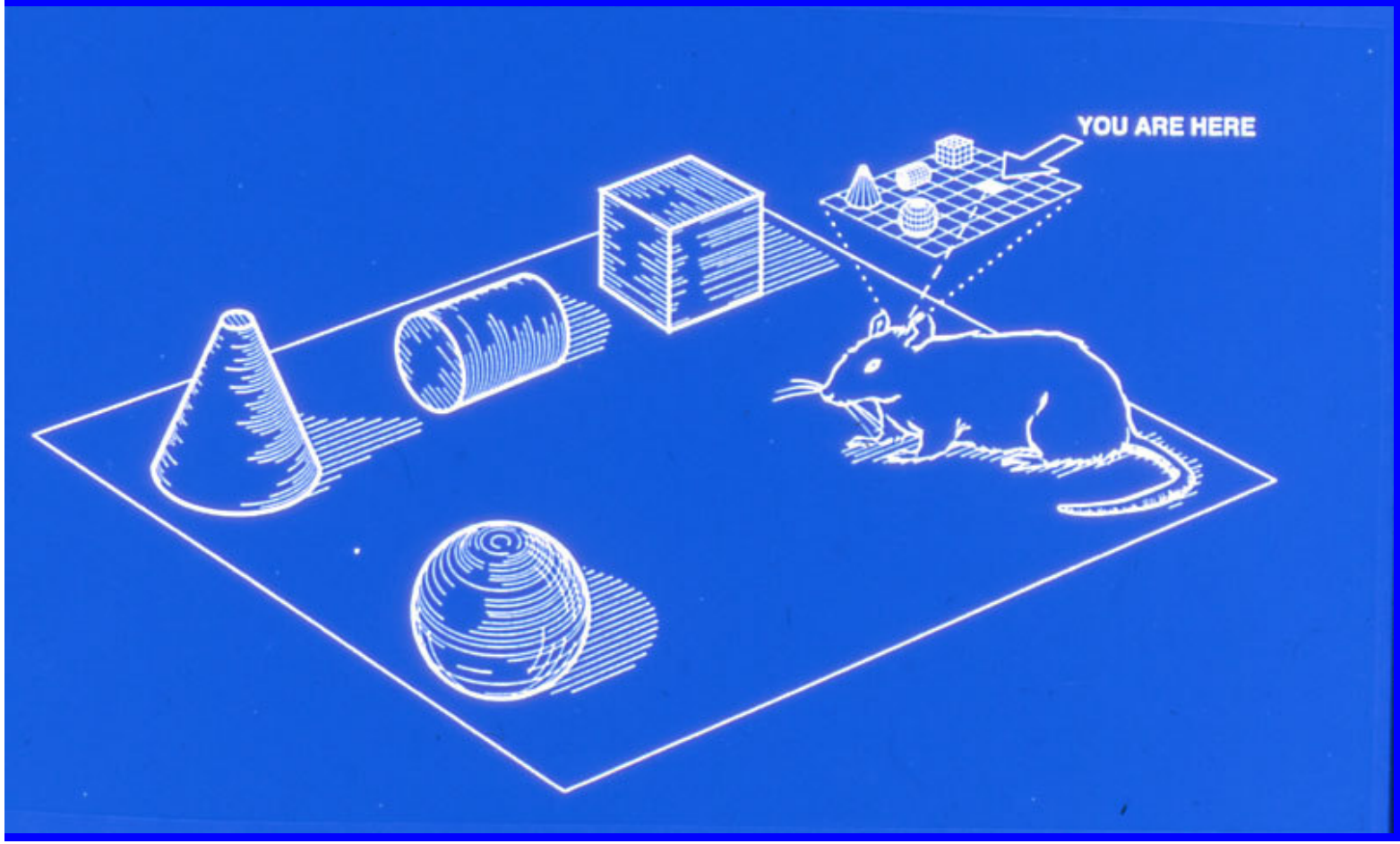
Counting bees



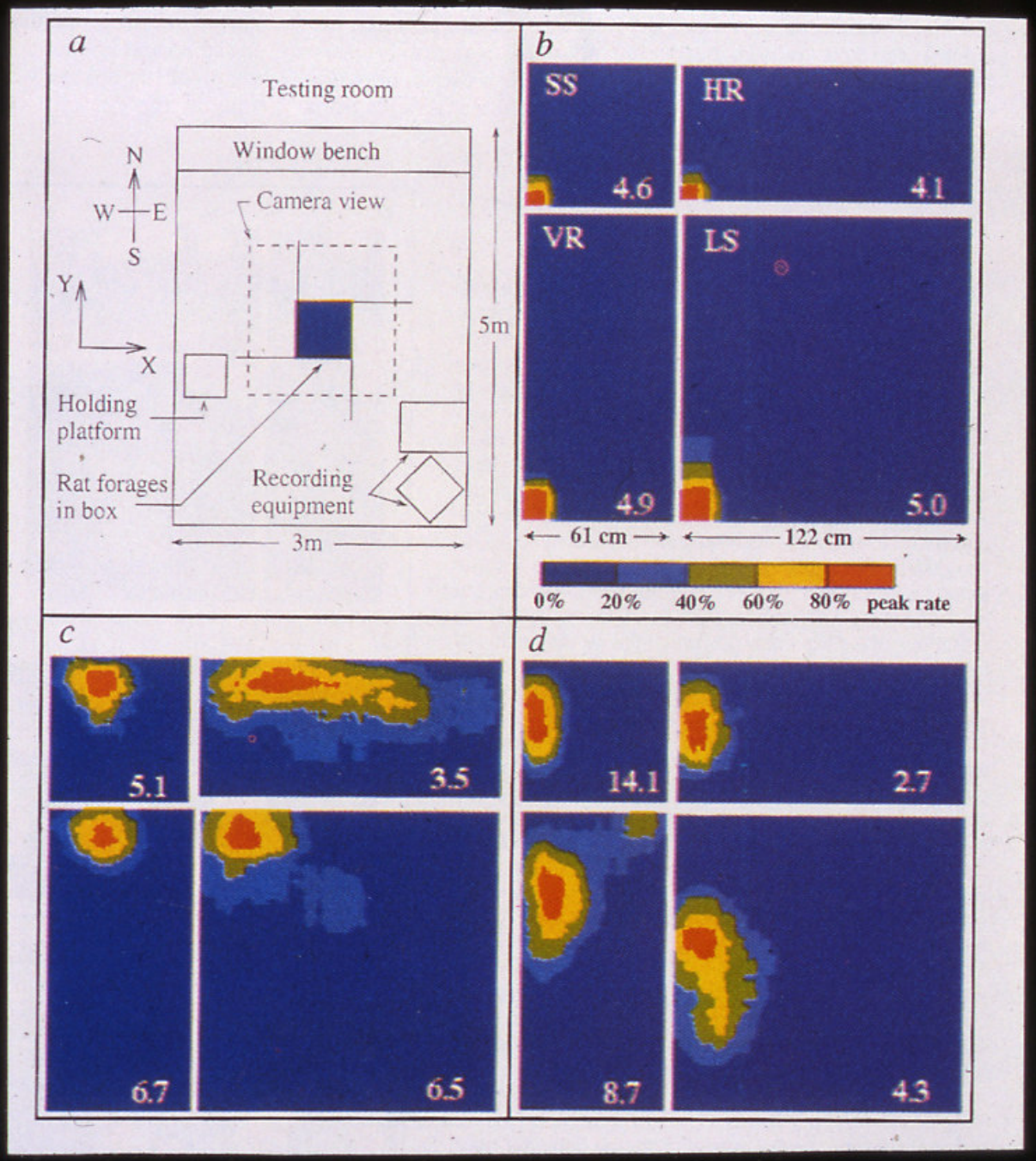
Chittka & Geiger (1995): Animal Behaviour 49: 159-164.

Spatial learning: cognitive maps

Hippocampus is involved in vertebrate spatial learning – could it act as a neural substrate for the cognitive map?



Place cells


a
Testing room
Window bench
N
W
E
S
Camera view
Y
X
5m
Holding platform
Rat forages in box
Recording equipment
3m
b
SS
4.6
HR
4.1
VR
4.9
LS
5.0
61 cm
122 cm
0%
20%
40%
60%
80%
peak rate
c
5.1
3.5
6.7
6.5
d
14.1
2.7
8.7
4.3

Neuron types found in hippocampus and adjacent brain areas:

Place cells – cell location in hippocampus strongly correlated with real position

Head direction cells (in the subiculum) – fire only when animal in particular orientation

The hippocampus receives input from 'intention cells' in prefrontal cortex – from which animal's movements can be predicted

Hippocampus and ecology in birds – what food storing birds can do:

Hide 50-100 seeds a day, so may have several 1000 caches

Dig these up after weeks or months

Remember sequence of hiding (so they unearth the ones hidden earlier)

Remember the quality of seeds so that they preferentially dig up the better ones

Hippocampus size and caching

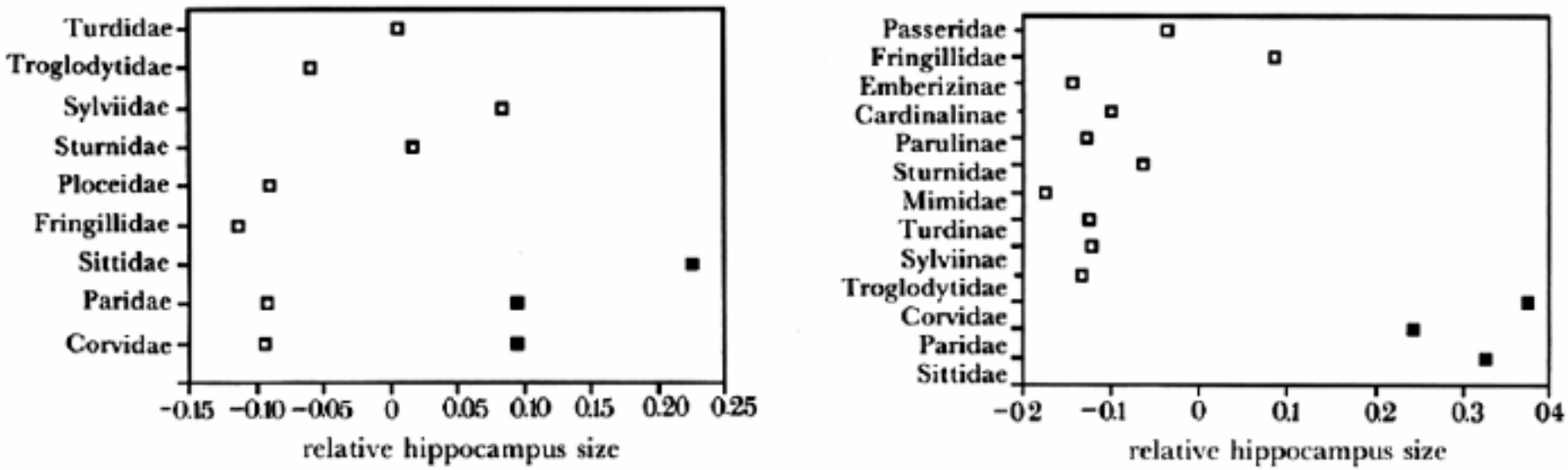
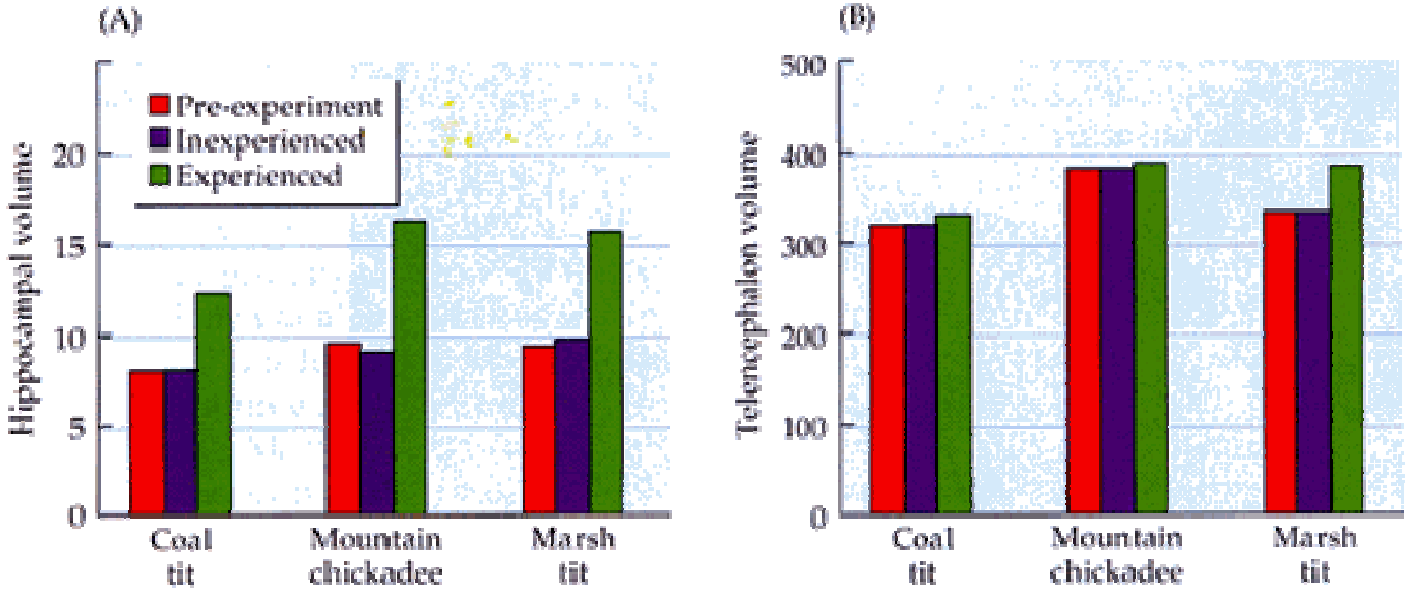


Figure 2. Residual variation in hippocampal volume after removing (by multiple regression) effects of body size and telencephalon volume (see text). ■, food storers; □, non-storers. (*a*) Data from Krebs *et al.* (1989). (*b*) Data from Sherry *et al.* (1989).

Hippocampus shows experential changes

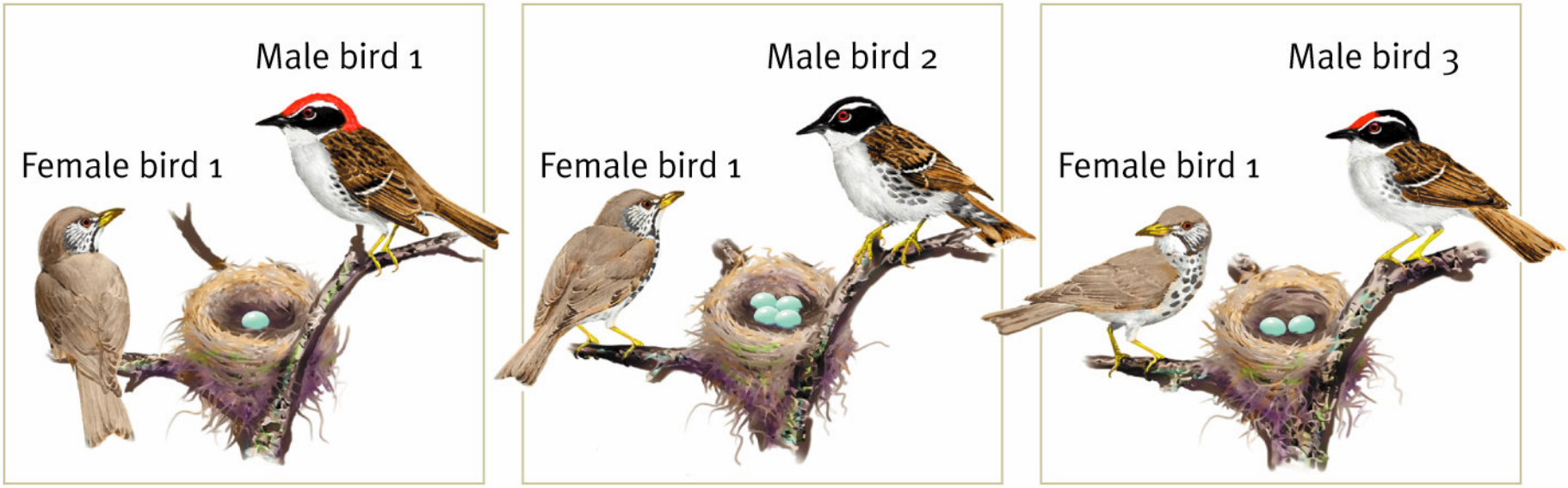
Coal tit

Mountain chickadee



17 Changes in hippocampal volume as a result of food storing experience in coal tits, mountain chickadees, and marsh tits. (A) The volume of the hippocampus was greater in birds that had had the opportunity to store food than in young birds whose brains were examined before the experiment began or in birds that had little experience in storing food. (B) The volume of the telencephalon, another brain structure not involved in spatial learning, did not vary for these three categories of birds. After Clayton [224].

Learning about mates



Imagine a female who mates with different males over the course of time. Such a female might learn which male is a good mate by keeping track of the number of eggs she laid when associated with each male.

FIGURE 1.10: A role for learning

Learning motor skills

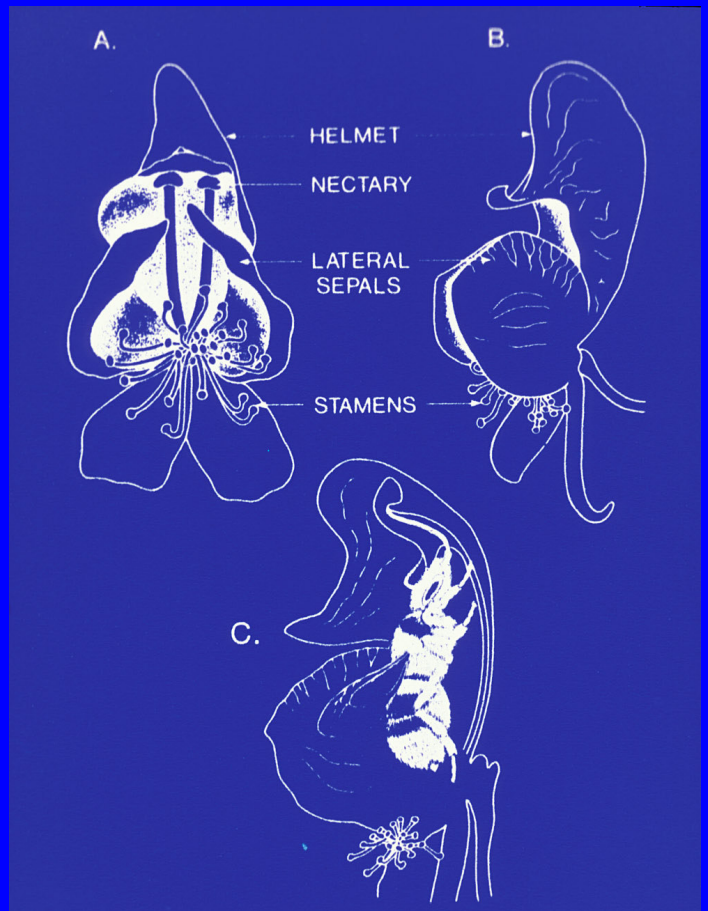
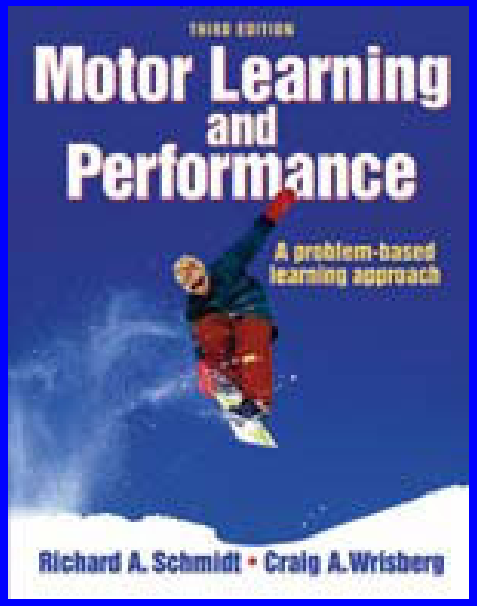


Figure 1. Flower of *Aconitum variegatum* in (A) frontal view, (B) side view, and (C) with worker bumblebee inserting tongue into nectar petal.



Motor learning is durable despite long interrruptions, e.g. skiing

As the saying goes, you don't forget how to ride a bicycle…

Learning who is part of the family

Visual recognition e.g. in Java monkeys/ Humans

In social bees nest scent is learned.

Guard bees use this information to prevent non-nest mates entering the hive.

Learning and aggression

e.g. Blue Gourami fish

Males establish territories and fight repeated contests with other males

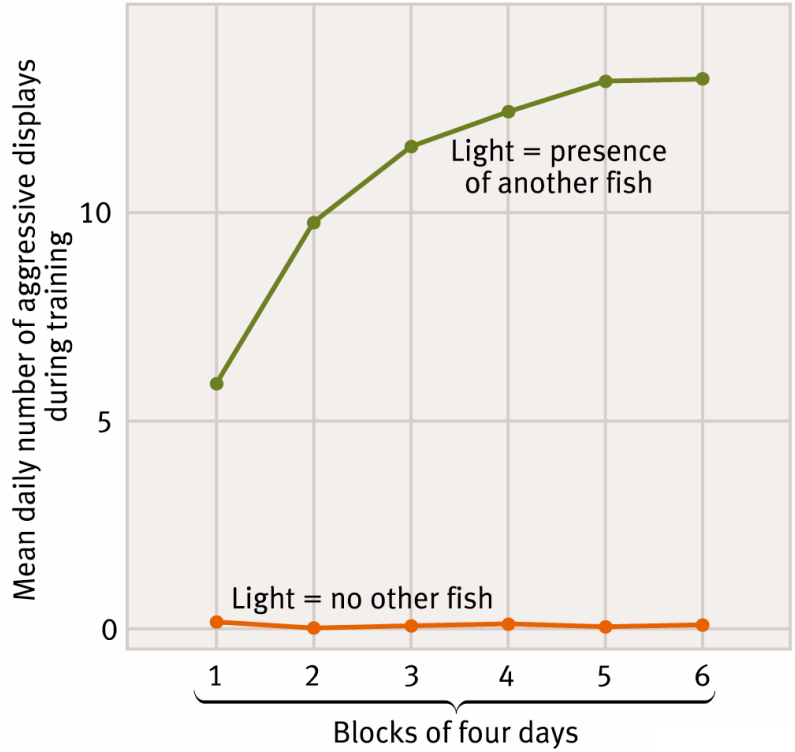


FIGURE 4.22: Pavlovian fish

Males that had learned to associate a light with the presence of another male were more aggressive when the light cue was present.

Blue Gourami aggression

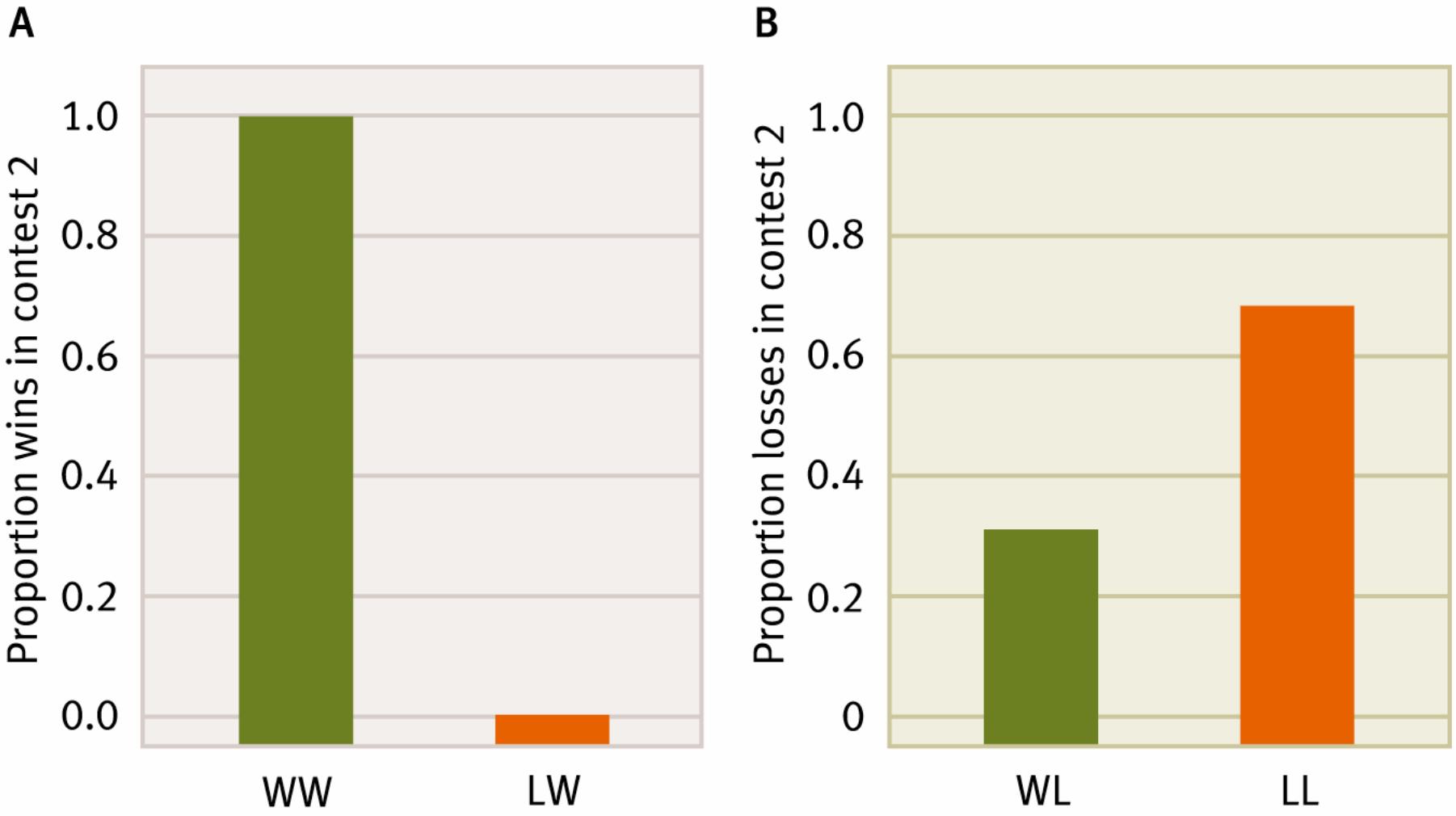
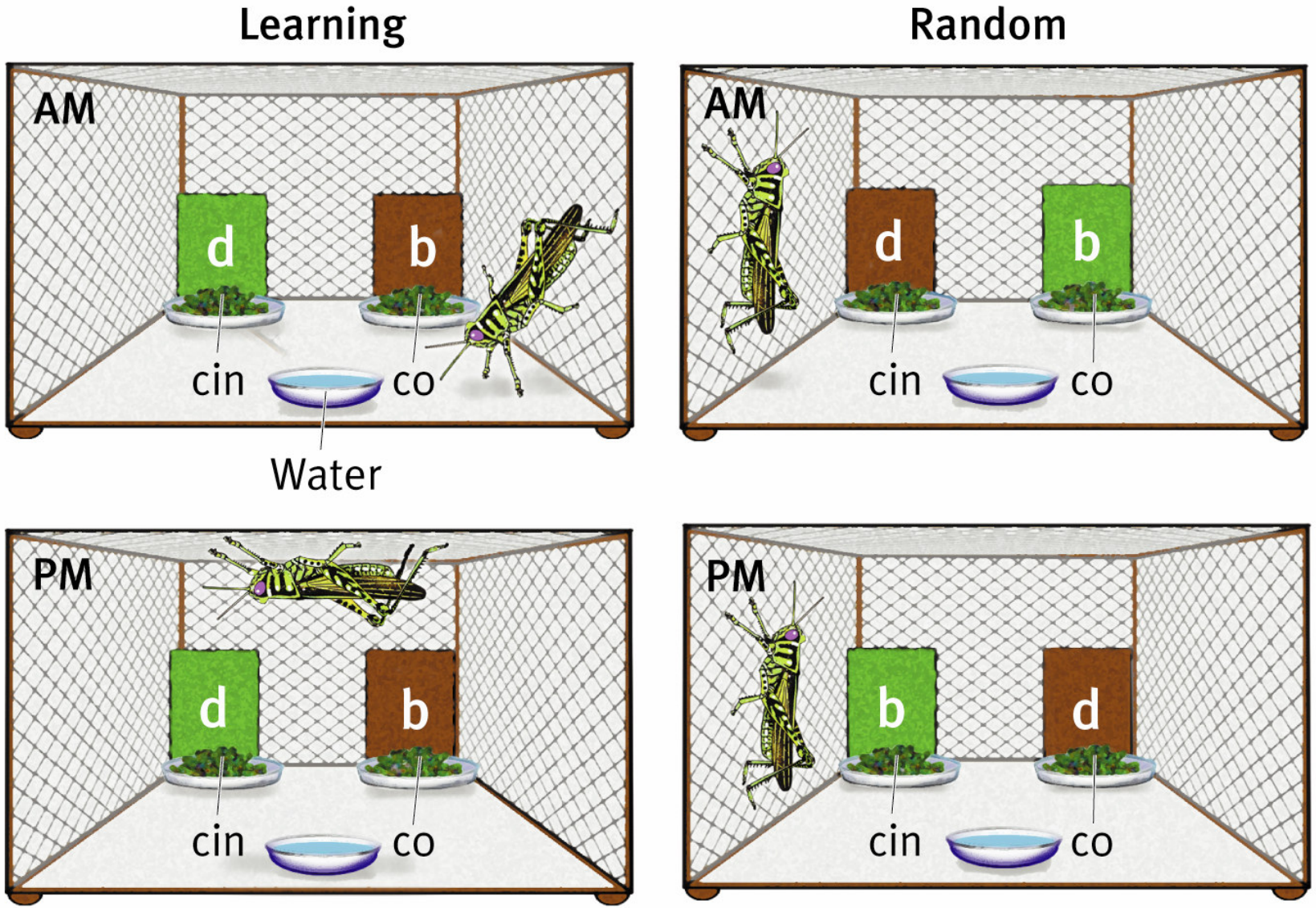


FIGURE 4.23: Winners and losers

Learning to forage



d = deficient; b = balanced

Grasshopper choices of 'balanced' diet

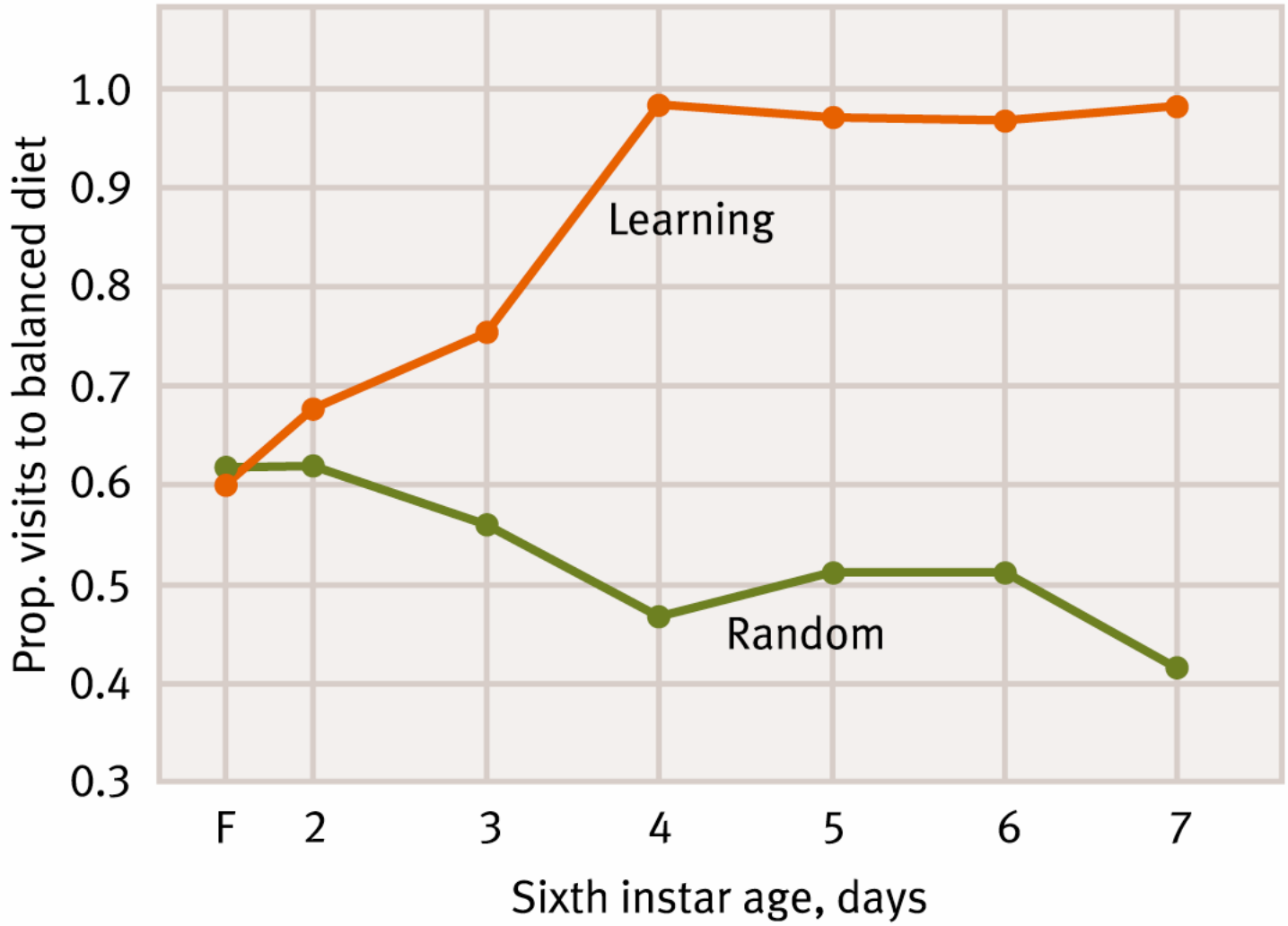
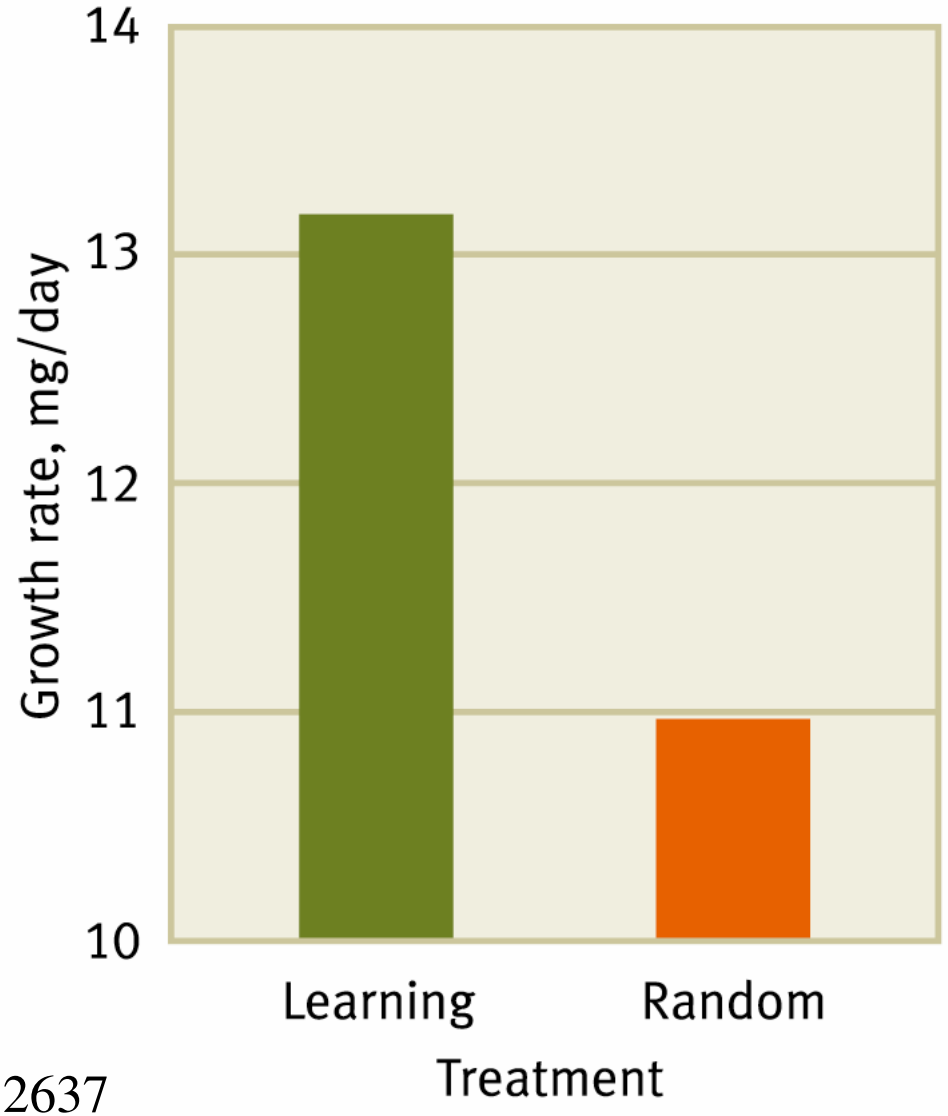


FIGURE 1.13: A balanced diet in grasshoppers (top)

Grasshoppers able to predict better diet grew faster

Schistocerca americana

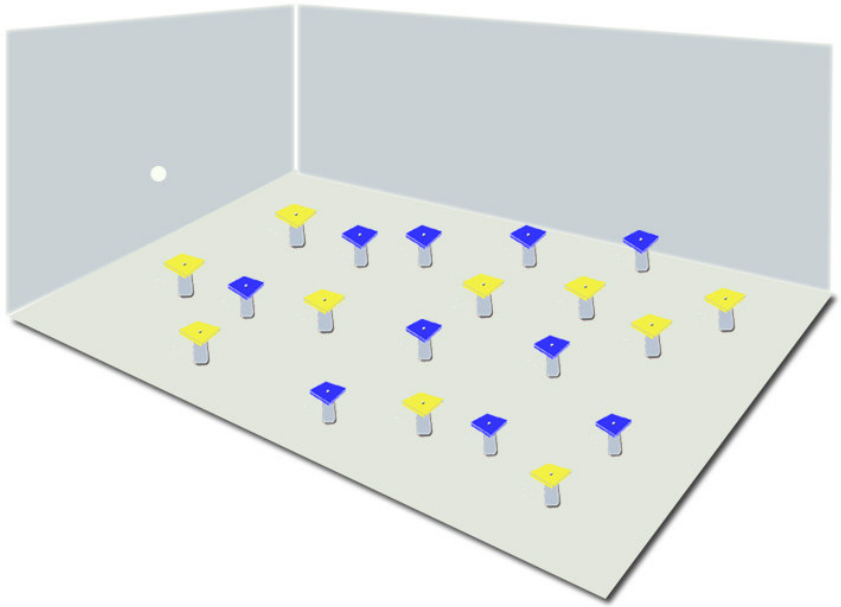
Learning outperforms an inability to learn in this task



Dukas & Bernays (2000): PNAS 97: 2637

Adaptive value of variation in learning

Colour learning performance assessed in the lab



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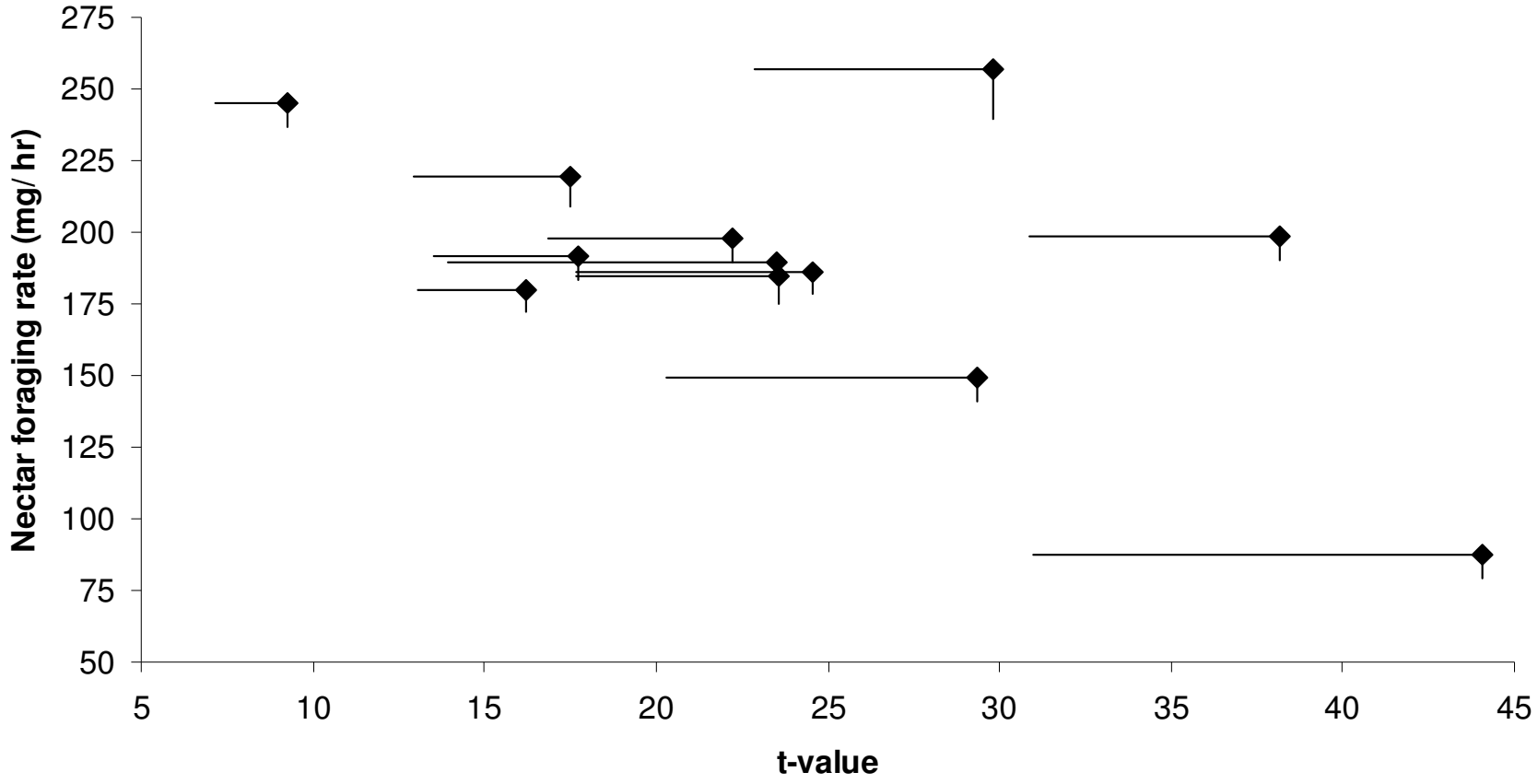
Nectar foraging performance of same colonies assessed in the field

Fast learning colonies bring in more nectar



Natural variation in learning performance can affect foraging performance, and hence fitness

Raine & Chittka (2008) Proc Roy Soc B 275: 803