Dr. Nigel Raine

Learning Behaviour I

Much of early research on animal behaviour was governed by the idea that animals, as opposed to humans, were largely guided by "instinctive" behaviour, where stimulus-response patterns are genetically pre-programmed and hard wired into the nervous system

Where learning was acknowledged, it was in the relatively simple form of imprinting

Konrad Lorenz (1903-89)
Nobel laureate 1973

What is learning?

Definition: the process of acquiring information. Learning is a durable and usually adaptive change in an individual's behaviour traceable to a specific experience in that individual's life (Alcock)

It needs to be determined that the behavioural change is really the result of experience - not a result of development, exhaustion, satiation, etc.

When is learning advantageous?

Within-lifetime predictability

		Low	High
Between-generation predictability	Low	Ignore experience (1)	Learn (3)
	High	Ignore experience (2)	Ignore experience (4)

In changing environments

But, not too much change!

Non associative forms of learning

Habituation: strength of reaction decreases with repeated presentation of a "non-meaningful" stimulus.
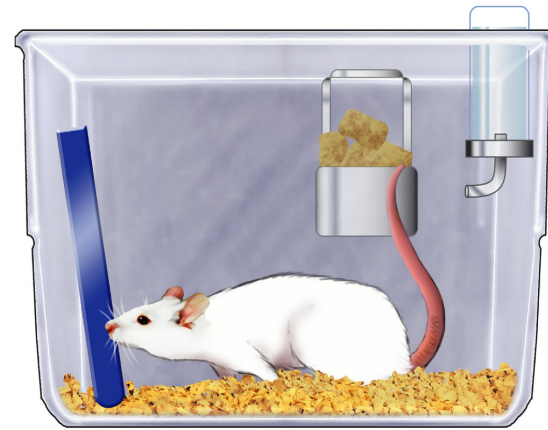
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Example – alarm call whistles in prairie dogs.

Habituation allows animals to ignore irrelevant stimuli
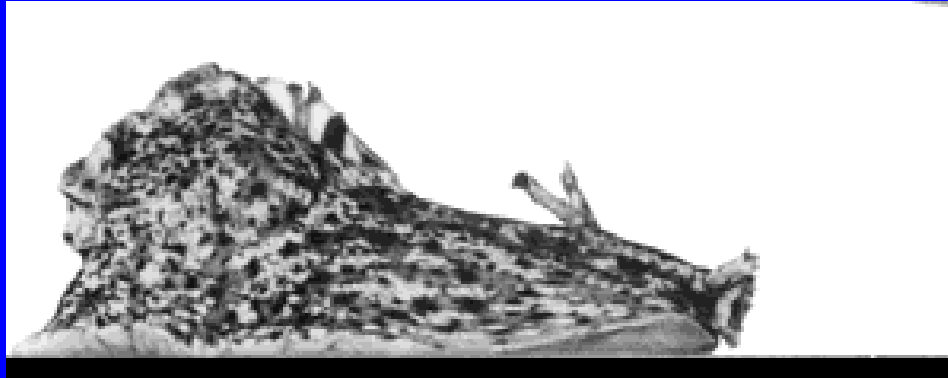
Habituation can be a problem

Predator fish

Prey fish

Prey may learn predator is not dangerous and
habituate to its presence

Non associative learning: sensitisation

Increased response to a stimulus after another or
the same stimulus, e.g. in the sea slug (*Aplysia*)

If you pinch *Aplysia* in the tail, it will quickly withdraw it.

If you touch the same animal on the tail, the snail contracts
its tail more strongly than if you had never pinched it.

Associative learning 1:
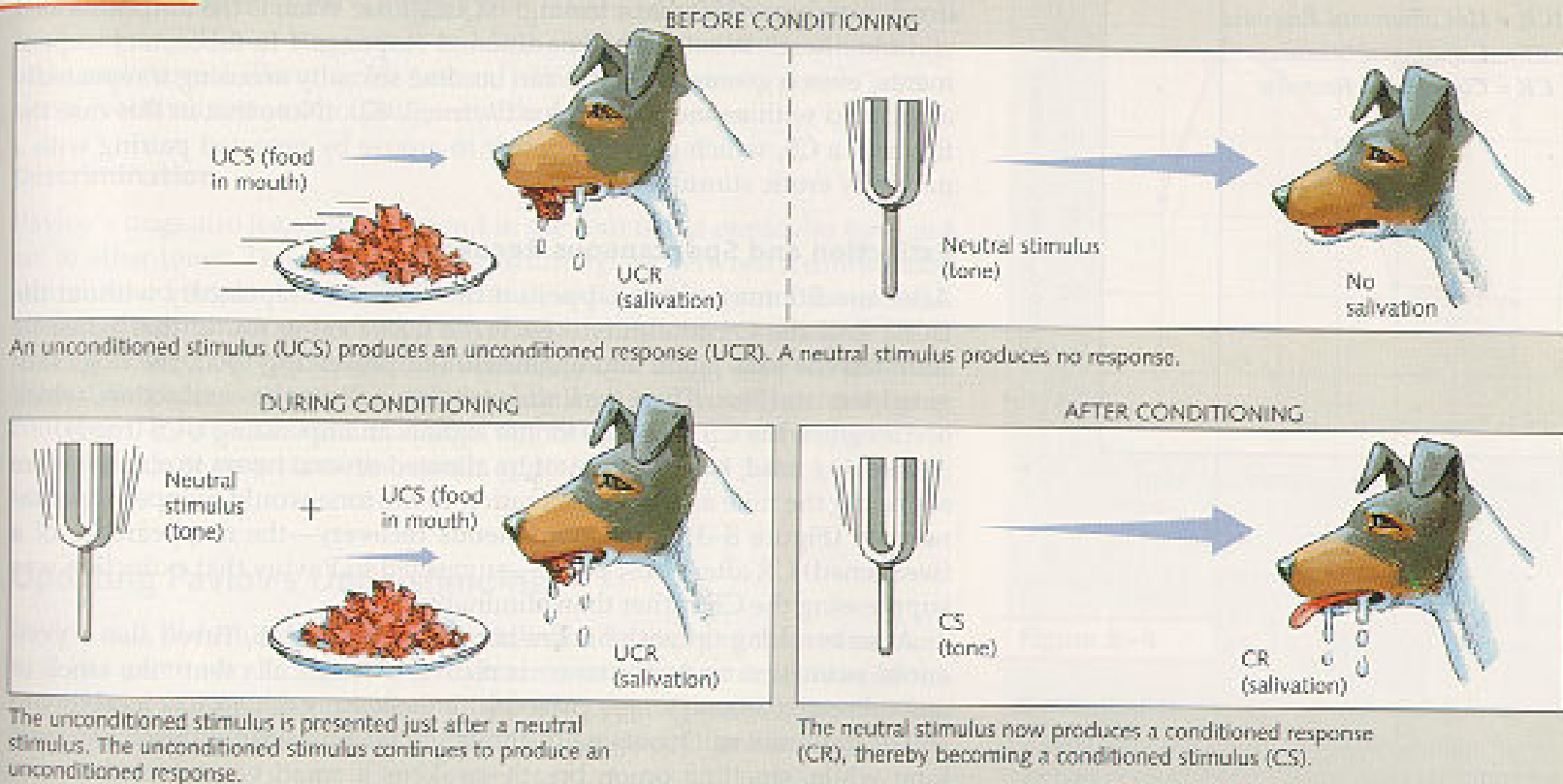# Classical (Pavlovian) conditioning

Conditioning of a response (reflex)

Here the dog salivating in response to food.
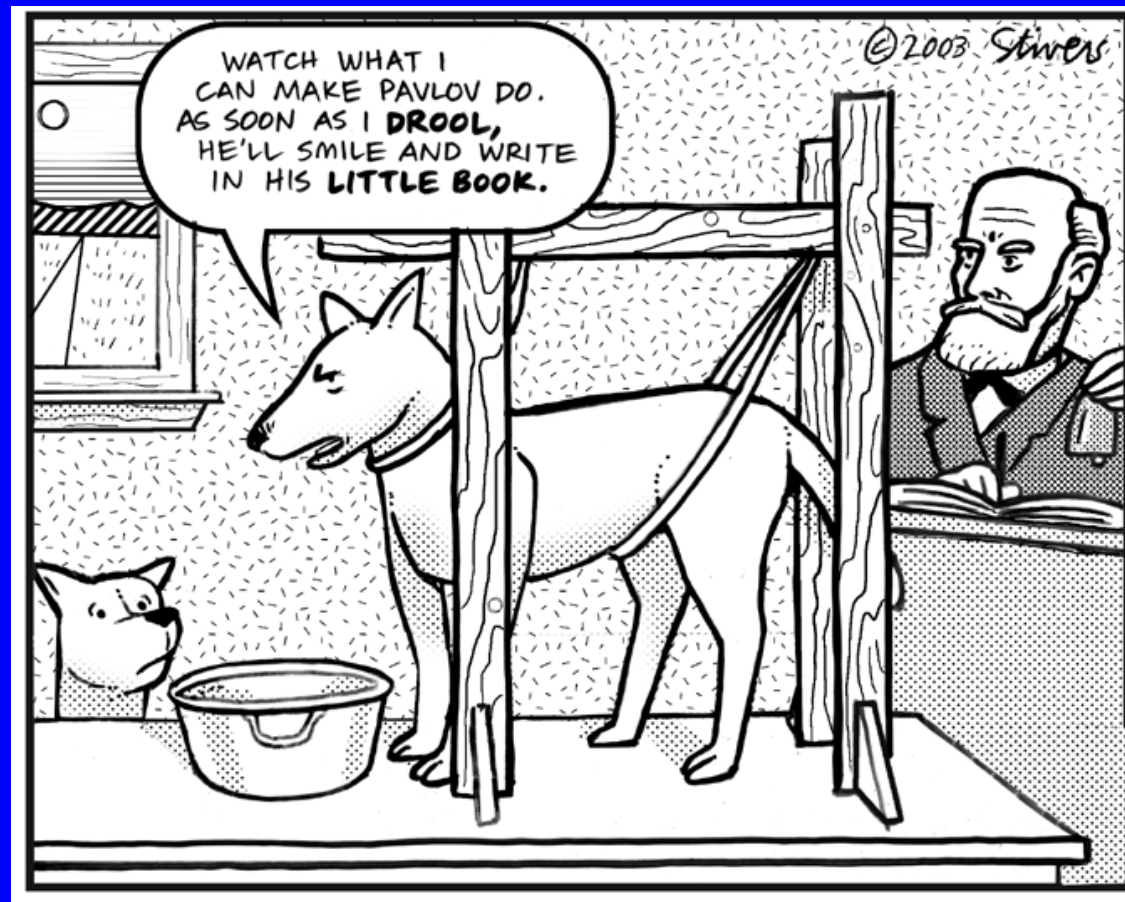
Classical (Pavlovian) conditioning

Figure 8–2

BEFORE CONDITIONING

UCS (food in mouth) → UCR (salivation)

Neutral stimulus (tone) → No salivation

An unconditioned stimulus (UCS) produces an unconditioned response (UCR). A neutral stimulus produces no response.

DURING CONDITIONING

Neutral stimulus (tone) + UCS (food in mouth) → UCR (salivation)

The unconditioned stimulus is presented just after a neutral stimulus. The unconditioned stimulus continues to produce an unconditioned response.

AFTER CONDITIONING

CS (tone) → CR (salivation)

The neutral stimulus now produces a conditioned response (CR), thereby becoming a conditioned stimulus (CS).

US (or UCS) = unconditioned stimulus, i.e. a stimulus that elicits a response without learning

CS – conditioned stimulus, elicits no response without learning

Classical (Pavlovian) conditioning
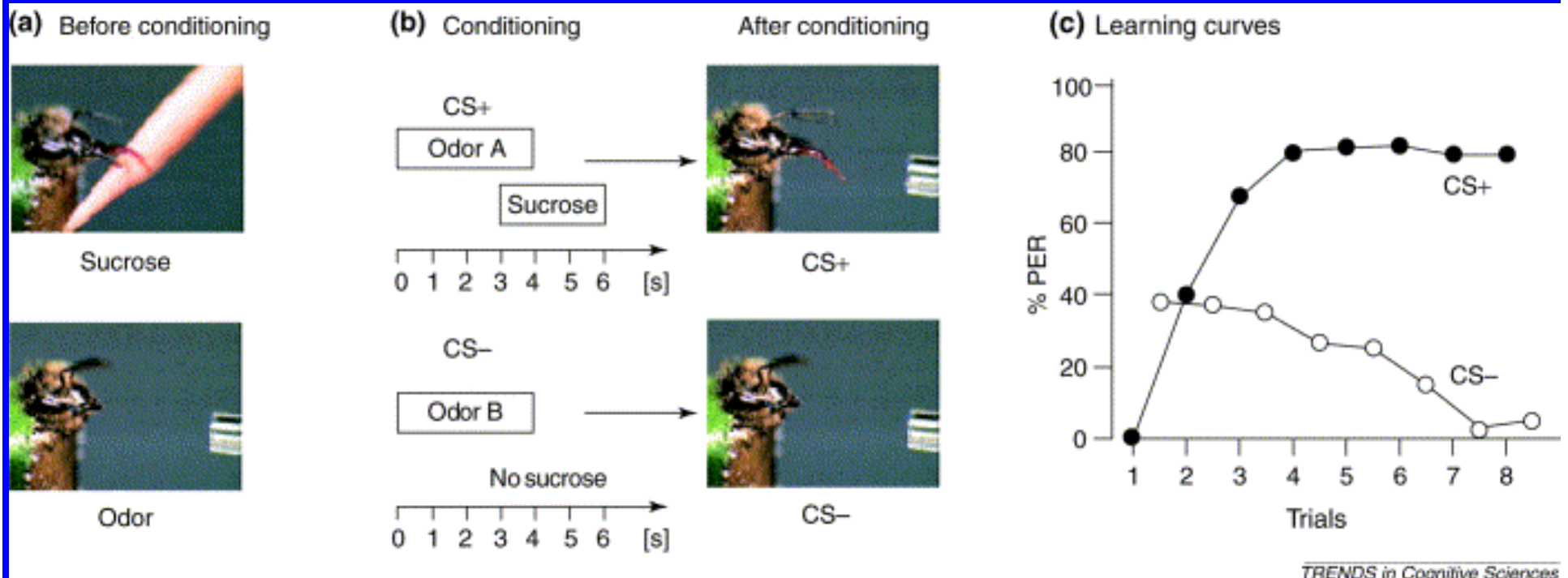
Classical (Pavlovian) conditioning
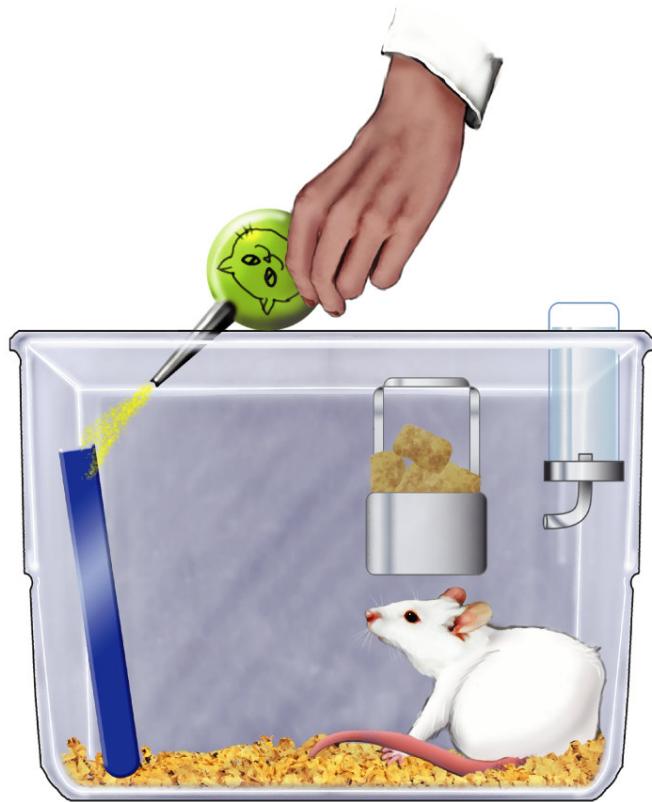
This procedure also works with aversive (as well as appetitive) stimuli – here US = cat odour, which rats innately avoid.
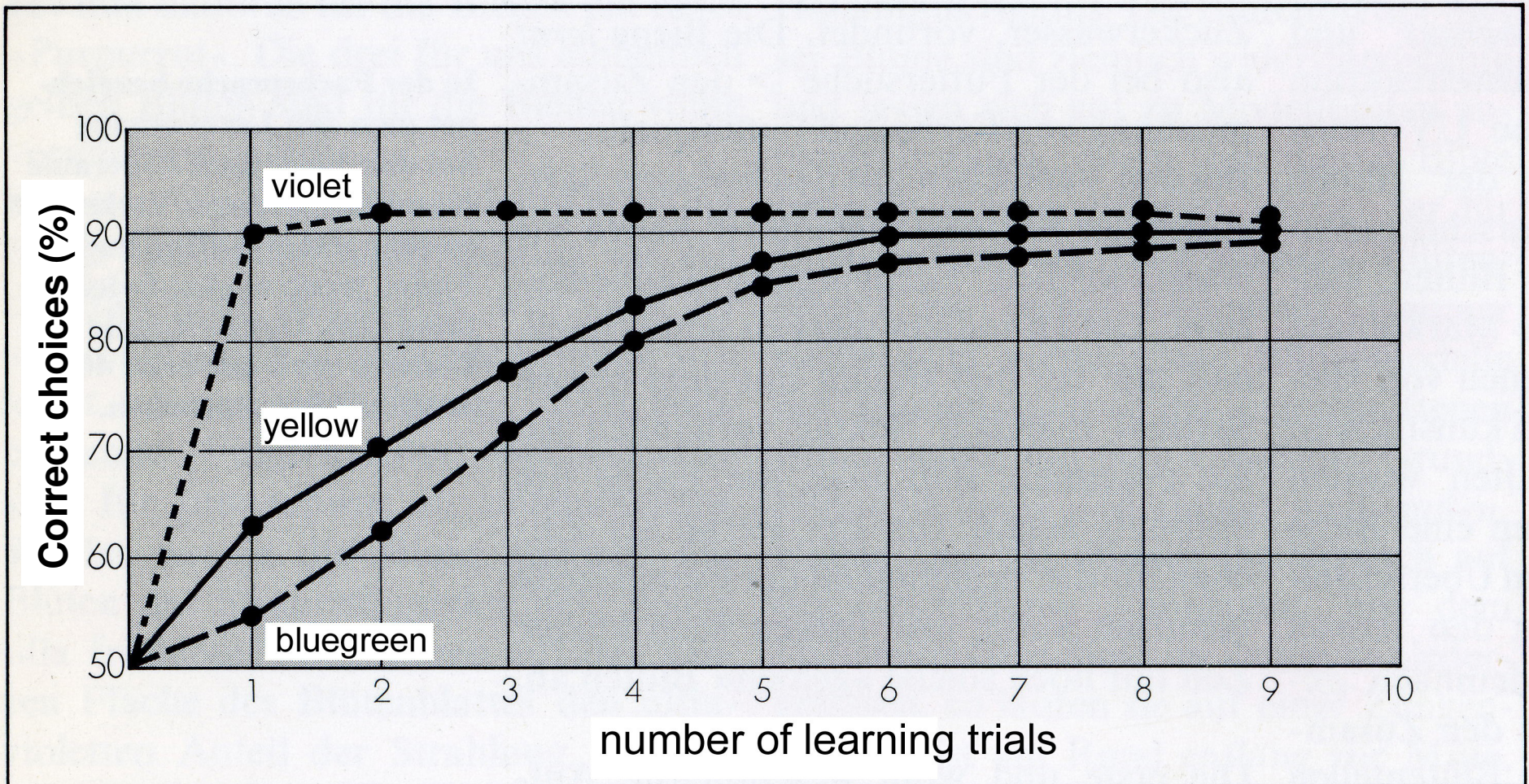
Classical conditioning in honeybees
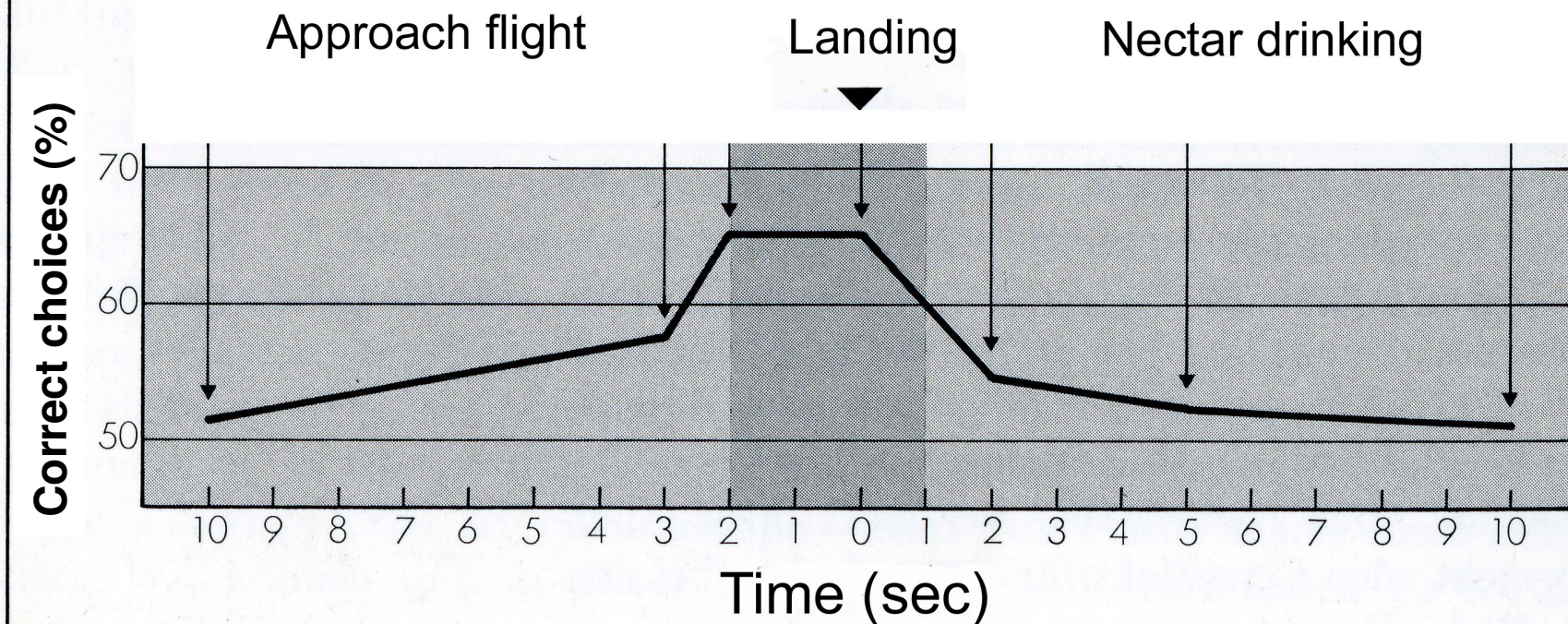
Proboscis extension response (reflex) - PER

work by R. Menzel et al.

Animals show innate preparedness to learn certain things better than others

Classical conditioning (timing)

Timing is critical: maximum effect if US is directly preceded by CS (here colour learning in bees)

Approach flight   Landing   Nectar drinking

Except: nausea from eating toxic food (other than alcohol)

Applied classical conditioning

Aversion therapy uses classical conditioning techniques to treat addiction

Positive emotional associations are changed by pairing alcohol with unpleasant stimulus (e.g. emetic)

Applied from nail-biting to class A drugs

Classical conditioning has also been used to treat pathological violence
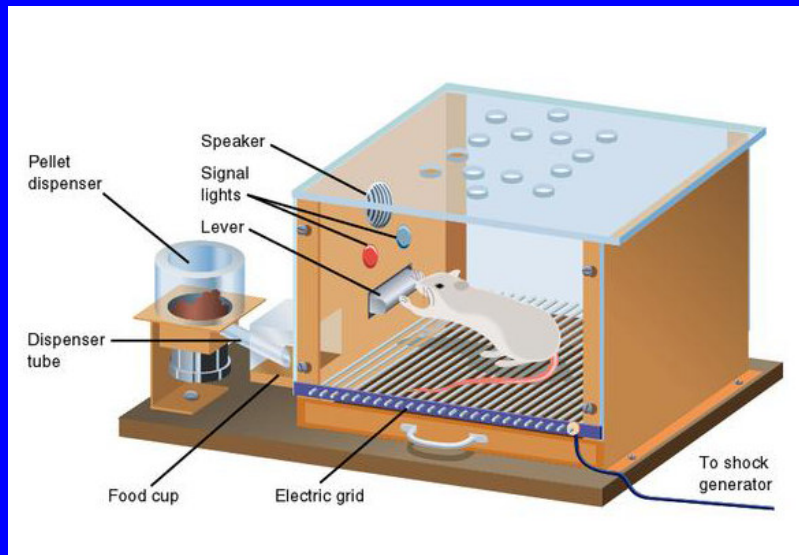
e.g. *Clockwork Orange*
One flew over the cuckoo's nest

Associative learning 2 - Operant conditioning
(also called instrumental conditioning)

Learning by trial and error

"Animal learns to associate a voluntary action with the consequences that follow from performing it" (Alcock)
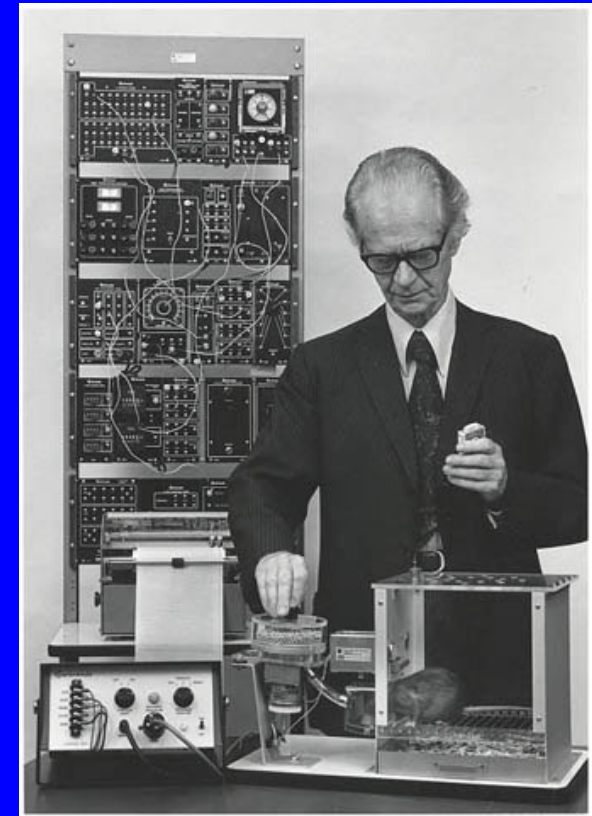

Chance behaviour strengthened via (positive) reinforcement

Example: lever pressing rat in Skinner box

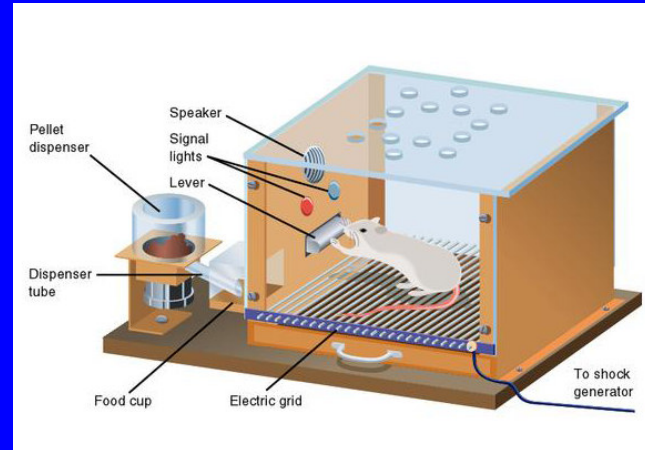# Instrumental (operant) conditioning or trial-and-error learning

B(urrhus) F(rederic) Skinner
1904-1990

Skinner built a playpen for his children with toys designed to promote learning and creative behaviour through operant conditioning

Operant (instrumental) conditioning

Rat in Skinner box

1. Reinforcement strengthens a behaviour:

a) **Positive reinforcement by** providing a consequence an individual finds rewarding (e.g. food when lever pressed)

b) **Negative reinforcement** by removing an aversive stimulus (e.g. electric current until lever pressed)

2. Punishment weakens a behaviour by application of an aversive stimulus in response (shock when lever pressed)

Superstition in the pigeon

When the animal behaves as if its action and an event are related, when in fact they are not.
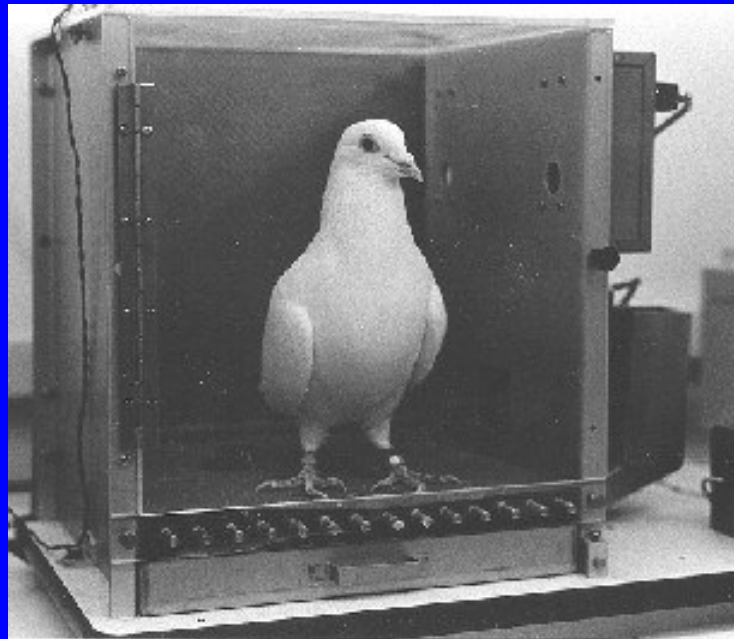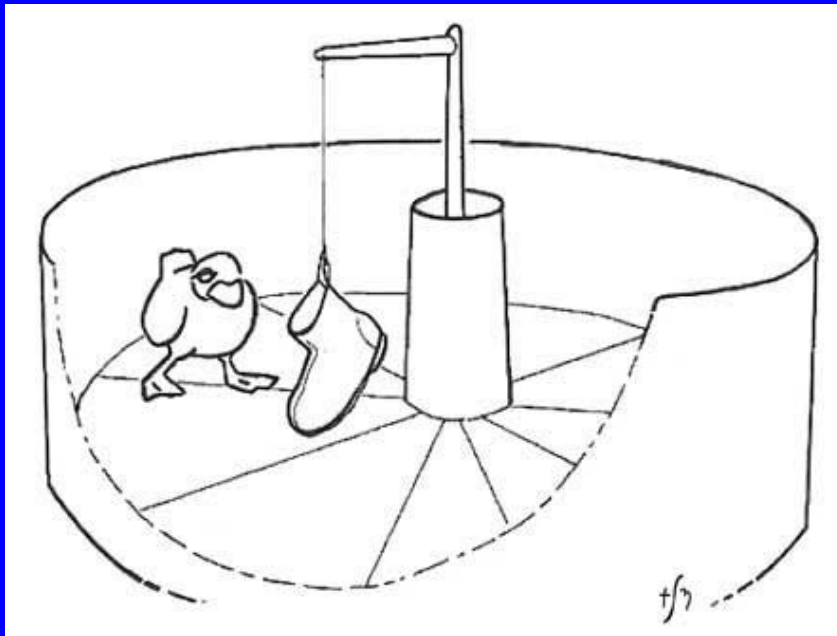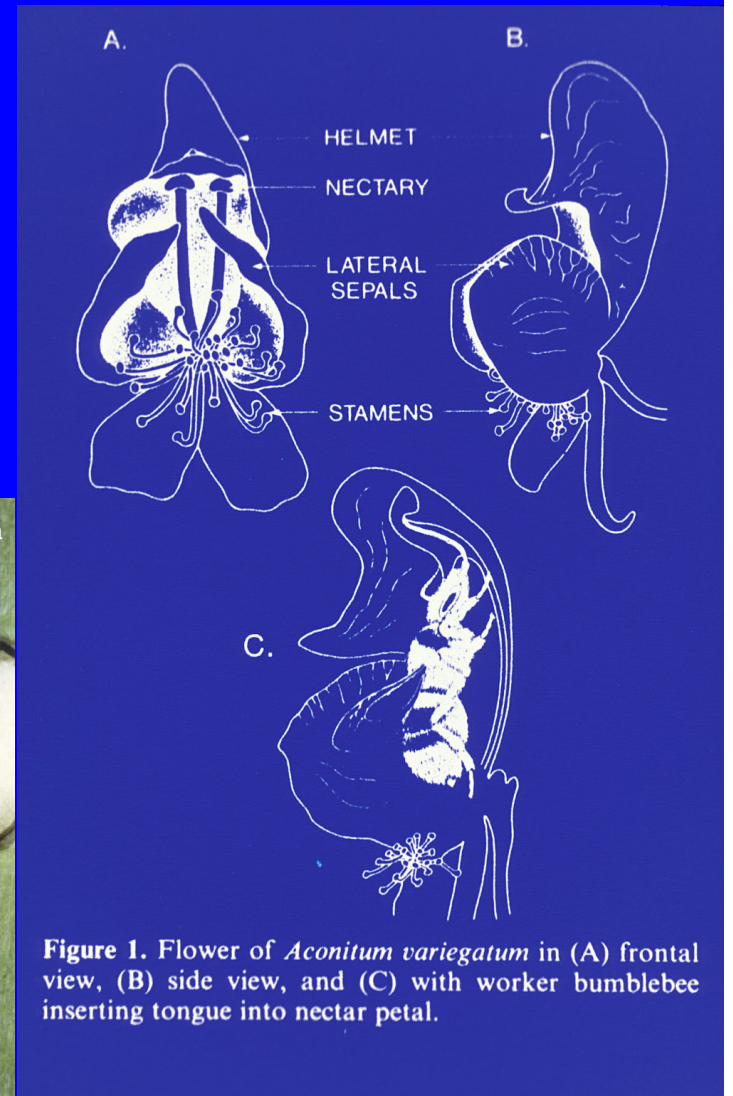

(Skinner BF 1948)

Imprinting

Irreversible learning that occurs in a critical time window.

Example: young birds after hatching get imprinted on a parental image in some species.

Motor learning

Learning improves speed, accuracy and smoothness of movements (motor skills)

© Isidro Vila Verde

© Lars Chittka

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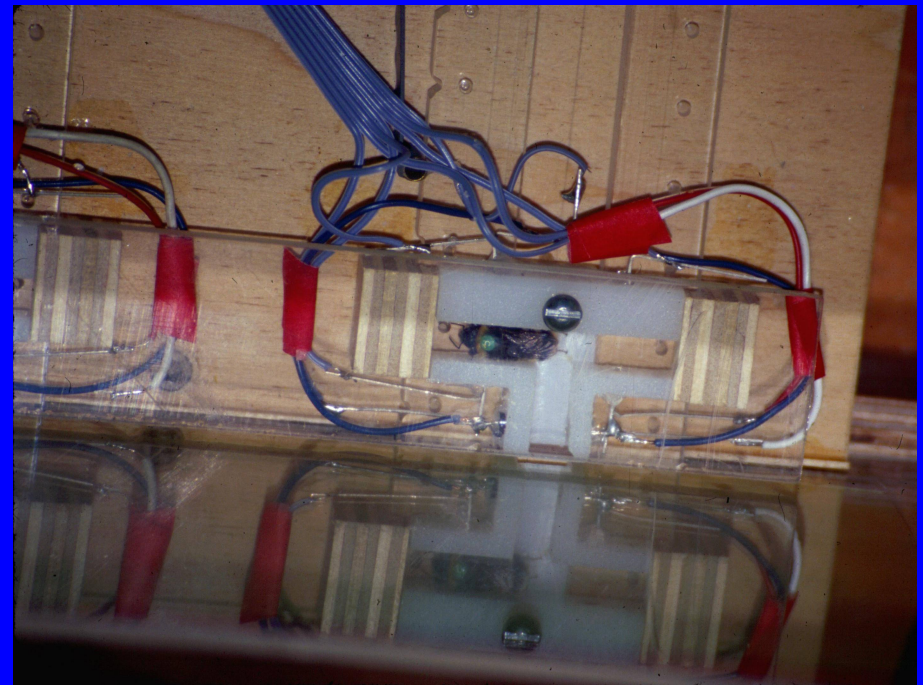
Motor learning in artificial flowers

Bees must perform different behaviours depending on flower colour
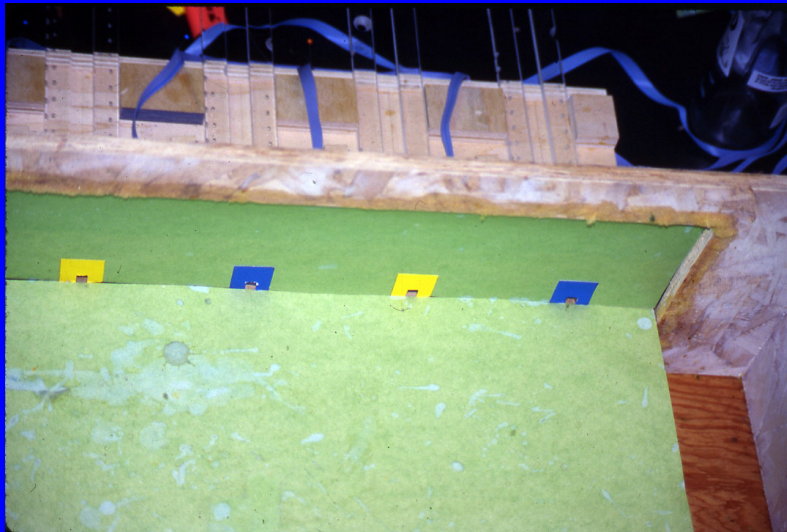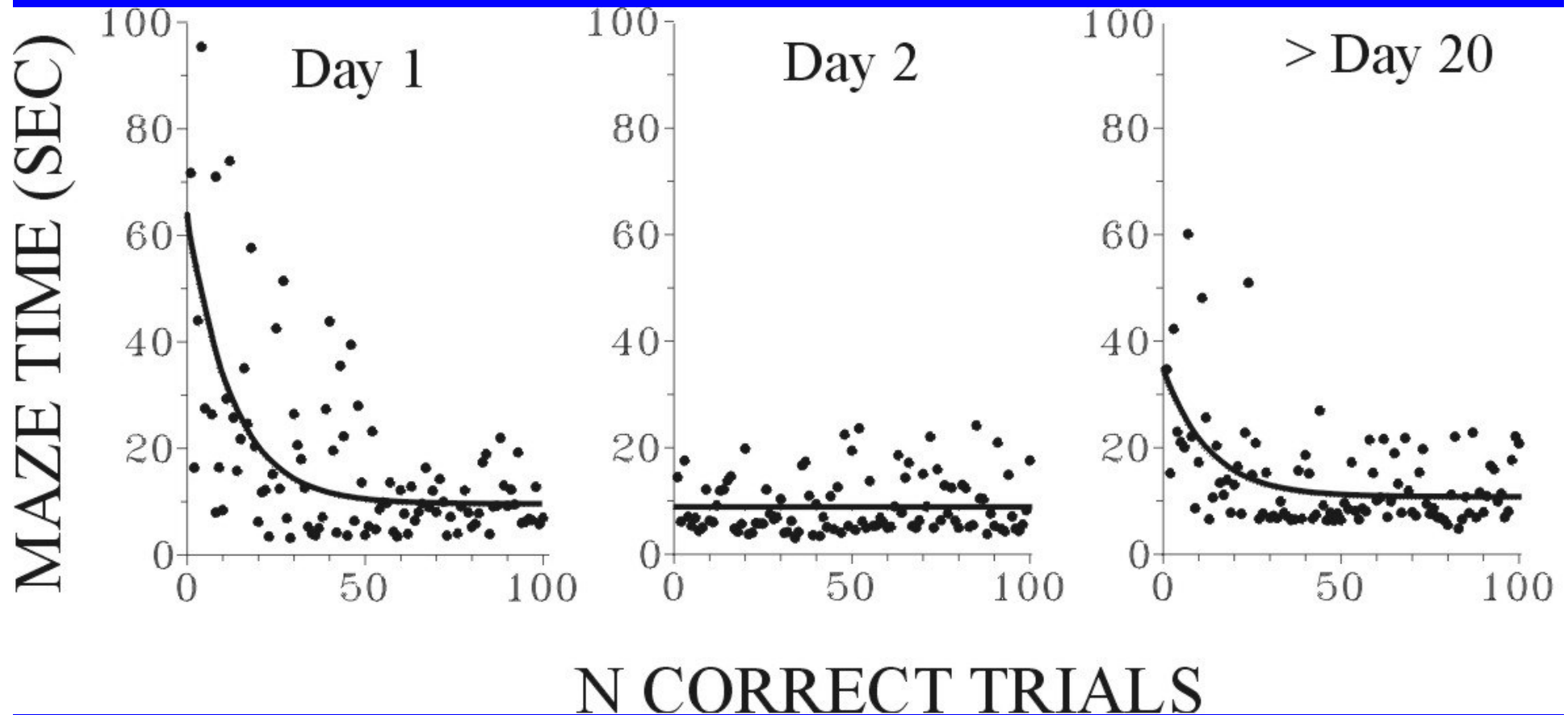

T-shaped flowers:
yellow - rewards in left arm
blue – rewards in right arm

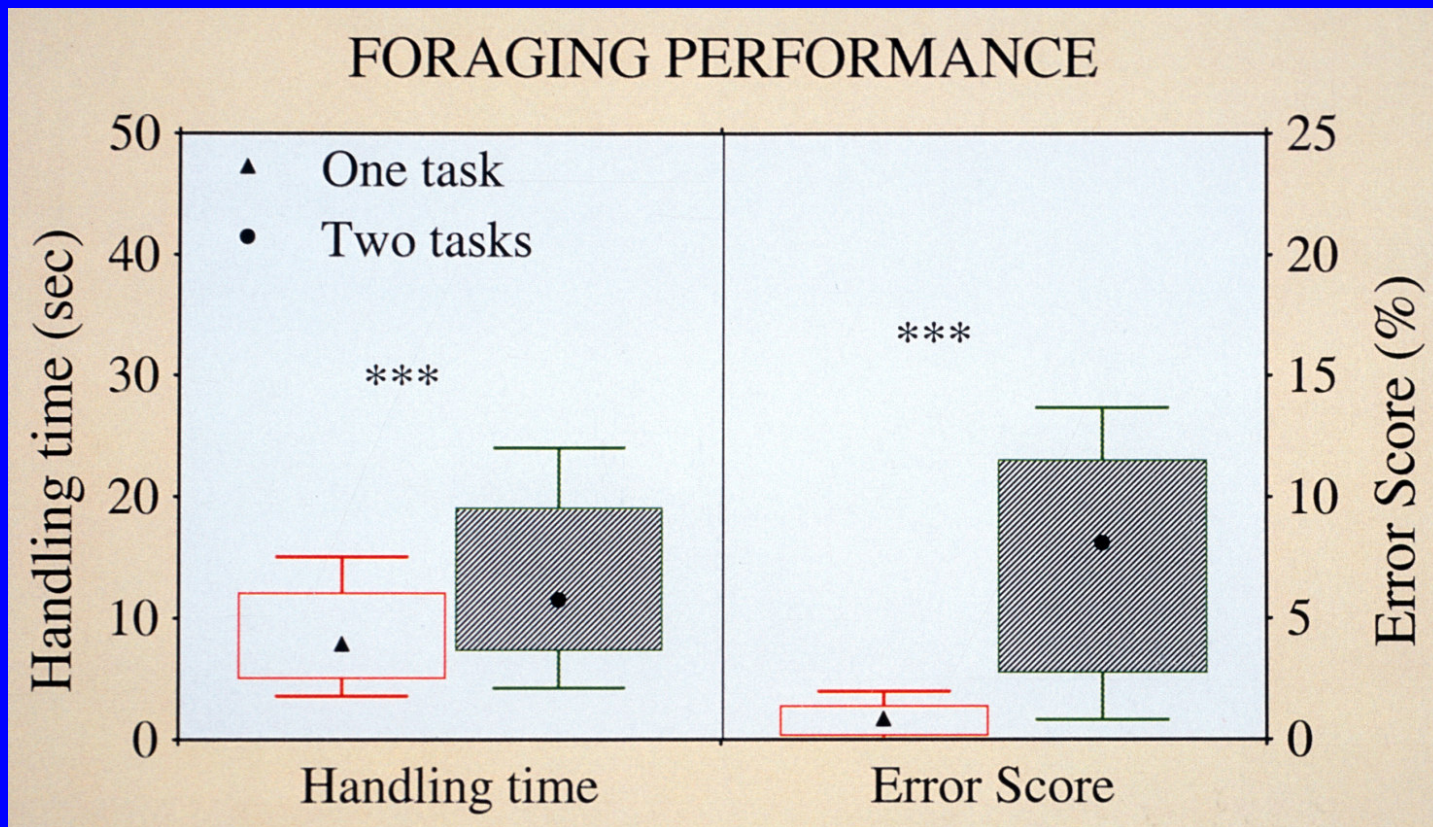Yellow flower

Learning to handle flowers in bumblebees

Chittka (1998) J Exp Biol 201: 515

Performance improves with experience

Skill re-learned quickly after long delay (18 days)

Bumblebees can juggle two motor tasks, but with lower efficiency

Handling time and error rates both increase when handling the same flower species after switching from another species.

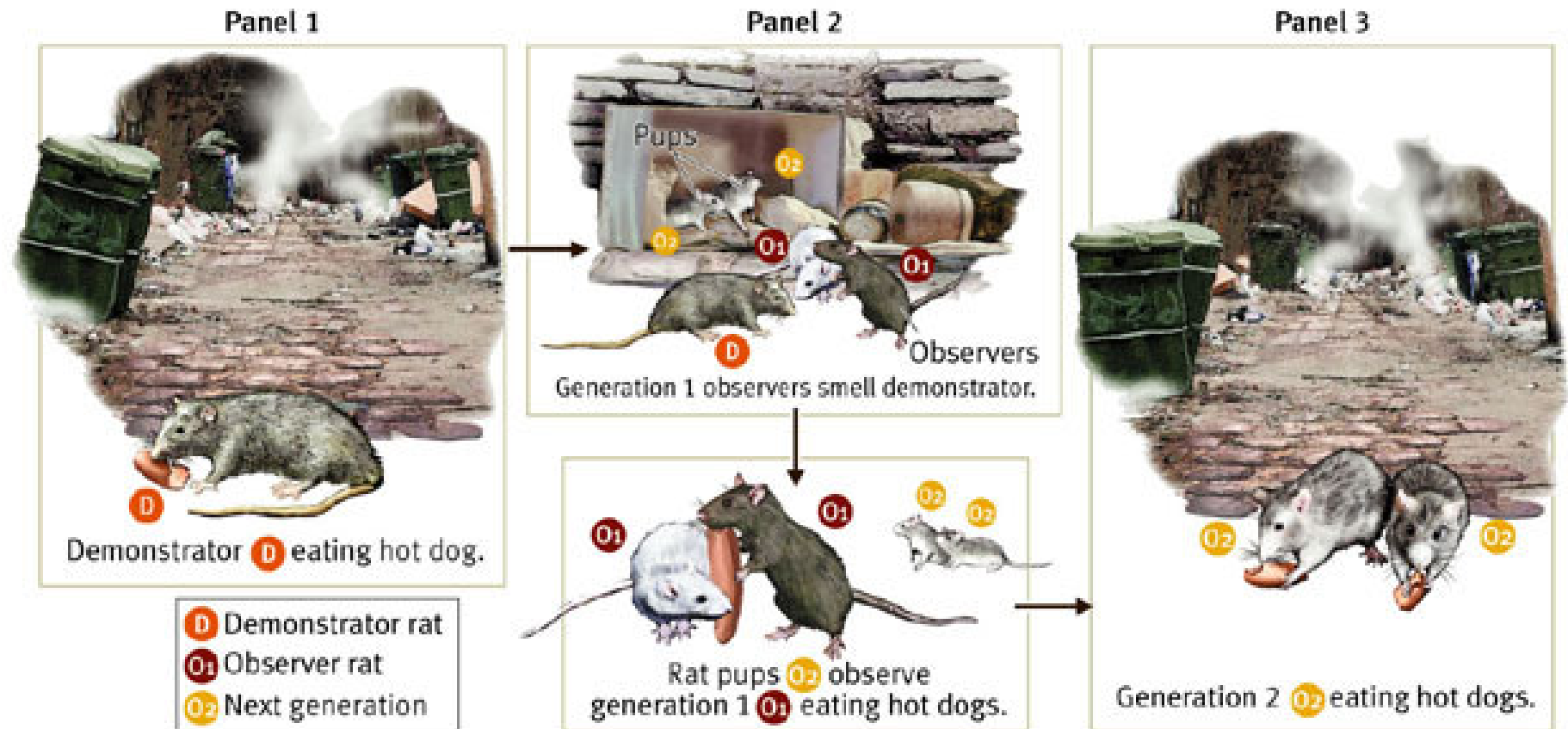# Social learning in animals

FIGURE 1.16: Two rats smell one another
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Learning or obtaining information from other individuals (e.g. learning by observation):

From parents/ family, peers or others in the community

Social learning in rats

FIGURE 1.18: A role for cultural transmission

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Social learning in insects: the honeybee waggle dance

Photo Scott Camazine

The waggle dance

Summary

Know the various forms of learning, e.g. habituation, sensitisation, classical conditioning, operant learning, motor learning, social learning

For those interested: also read up on: insight learning, learning to use tools, and language acquisition