

Chapter 1

An evolutionary approach to animal behavior

Questions
about
behavior



Proximate
vs.
ultimate
questions

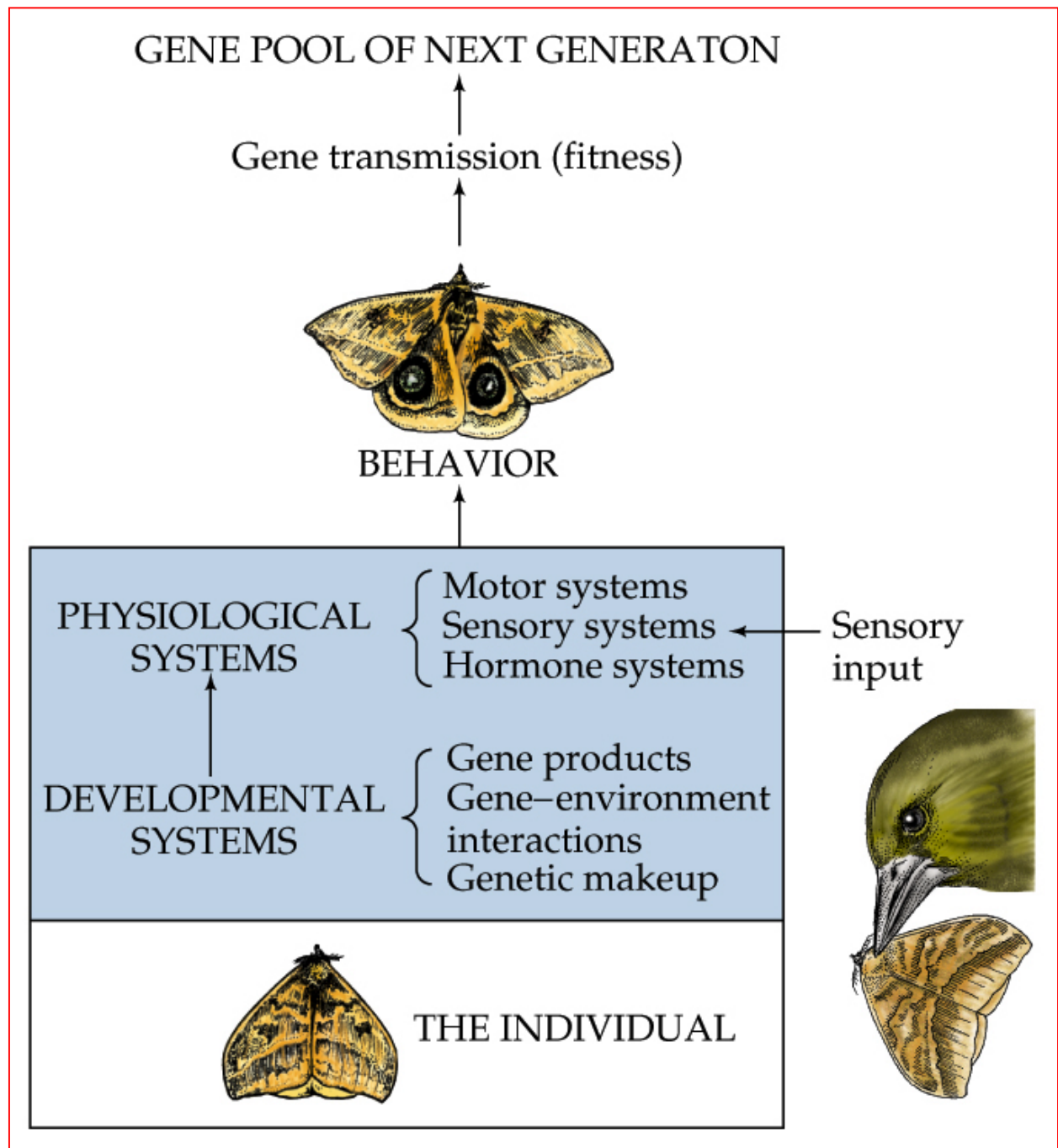


TABLE 1 Levels of analysis in the study of animal behavior

Proximate Causes	Ultimate Causes
1. Genetic–developmental mechanisms Effects of heredity on behavior Development of sensory–motor systems via gene–environment interactions 2. Sensory–motor mechanisms Nervous systems for the detection of environmental stimuli Hormone systems for adjusting responsiveness to environmental stimuli Skeletal–muscular systems for carrying out responses	1. Historical pathways leading to a current behavioral trait Events occurring over evolution from the origin of the trait to the present 2. Selective processes shaping the history of a behavioral trait Past and current usefulness of the behavior in promoting lifetime reproductive success

Answering a proximate question

How do beewolves find their nest entrance after returning with prey from distant hunting grounds?



The problem

The nest locations are not well marked or distinctive



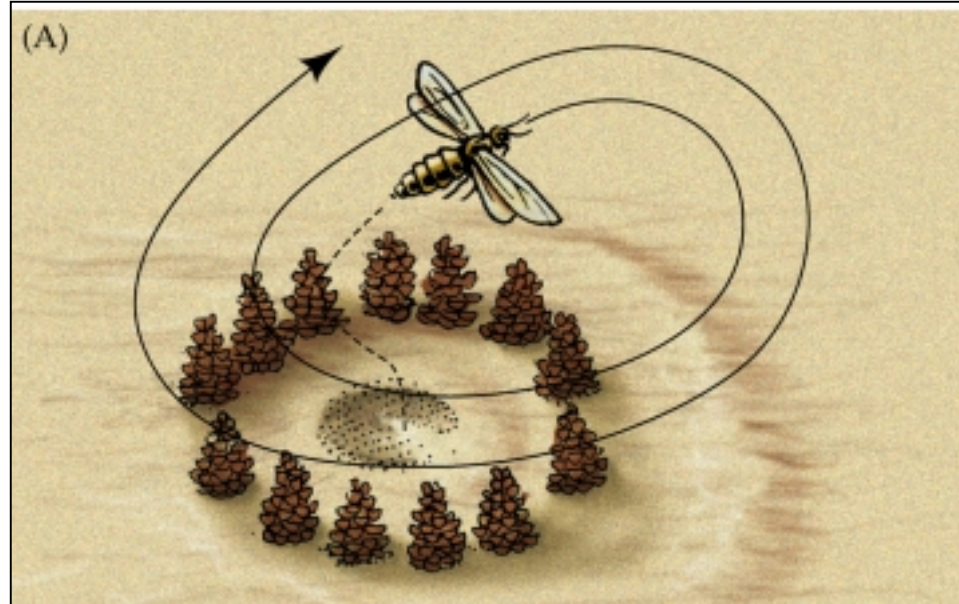


Niko Tinbergen began with a causal question:

How do beewolf wasps locate the nests after returning from a hunt?

Then he formulated a hypothesis based on an observation:

He noticed that the wasps circle above the nest immediately after taking off, particularly at the beginning of the day. **Hypothesis:** wasps memorize local landmarks around the burrow entrance.



Based on the hypothesis, he formulated a prediction:

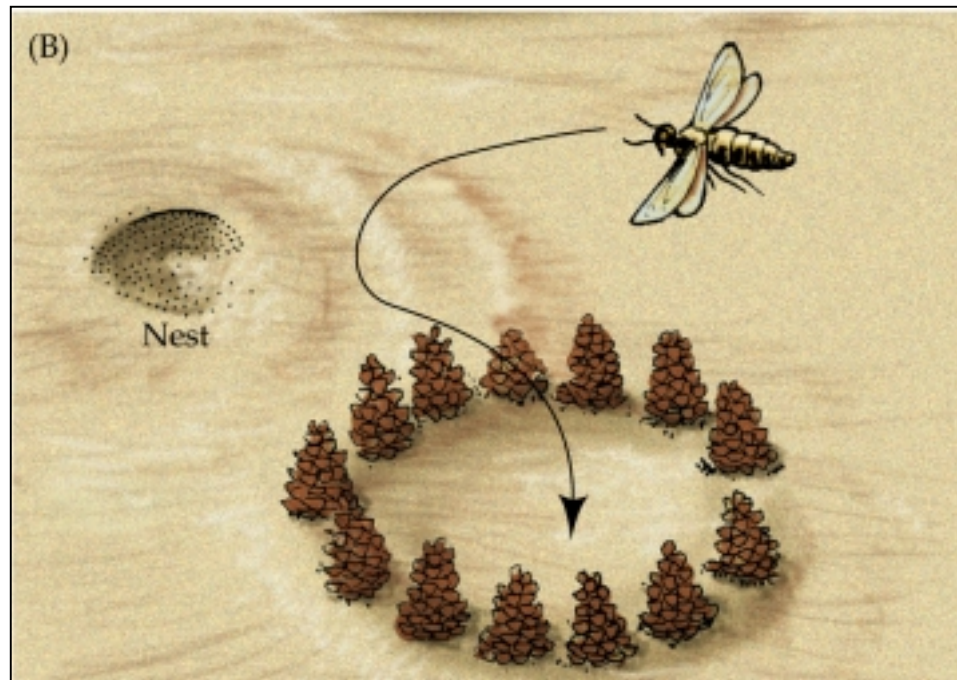
He should be able to confuse the wasp (i.e., make it difficult for her to relocate her nest) by changing the local landmarks

Next, he carried out a test of this prediction by gathering actual results

He found that when he altered the area around the burrow (i.e., carefully swept around the nest entrance, removing tufts of grass and sticks), the returning females appeared confused, hovering midair above the nests and circling repeatedly

Finally, he tested a second prediction:

If visual landmarks were important, then he should be able to mislead the returning female (i.e., make her return to the wrong place) by moving the constellation of landmarks



Tinbergen used the *scientific method* to test the validity of his proximate explanation for the wasp's behavior

Causal question



Hypothesis



Prediction



Test



Conclusion

Answering an ultimate question

Tinbergen asked why so many ground nesting birds remove broken eggshells from their nest soon after their young have hatched?

How does this question differ from a proximate question?



To explain the evolution of the eggshell removing behavior, Tinbergen made the following inferences (based on Darwin's theory of evolution by natural selection):

Variation In past, ground nesting birds differed in their tendency to remove eggshells

Heredity This behavior was under genetic control

Differential reproductive success Offspring of birds that removed eggshells were more likely to survive

Tinbergen made the following observations:

- predators (birds and mammals) eat the eggs of ground nesting birds
- eggs became more apparent after they are cracked open

➔ This led to the hypothesis that the eggshell behavior evolved because of its anti-predator benefit (i.e., it reduces the chances of predators locating a bird's eggs)

What did he do next?

He formulated a testable prediction, which followed logically from his hypothesis:

The chances of eggs falling prey to predators should decrease as a function of the distance to the nearest eggshells

Results of Tinbergen's manipulative experiment

TABLE 2 Effect of the proximity of eggshells on egg predation by crows

Distance from eggshell to egg (cm)	Eggs taken by crows	Eggs not taken by crows	Percentage (%) taken
15	63	87	42
100	48	102	32
200	32	118	21

Do these results support Tinbergen's prediction? If so, how?

What can we conclude about his original hypothesis?

What is a for-the-good-of-the-species (i.e., group selection) hypothesis?

e.g., with respect to eggshell removing behavior

Individual birds remove eggshells from their nest so as to reduce the chances of predators locating eggs of their species (and thereby reduce chances of species being driven to extinction)

Individual birds remove eggshells from nest so as to reduce of predators locating their own eggs (and thereby increase their own reproductive fitness)