

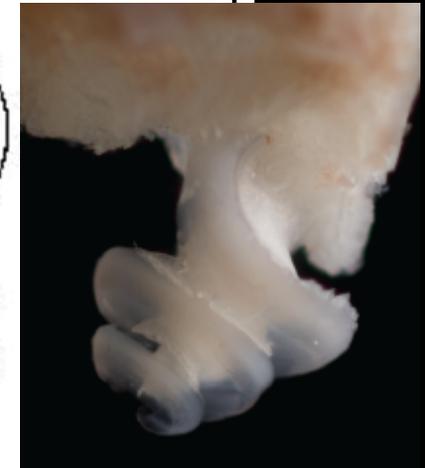
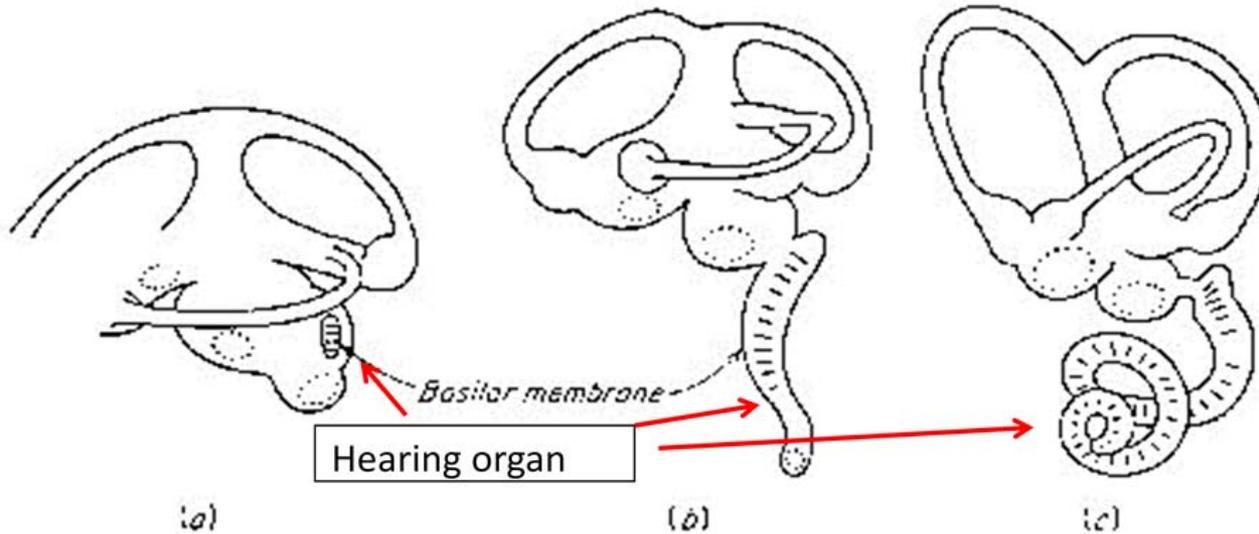


Inner ears of (a) reptile (1 kHz),

(b) bird (5 kHz)

(c) mammal (30 kHz)
(von Bekesy,

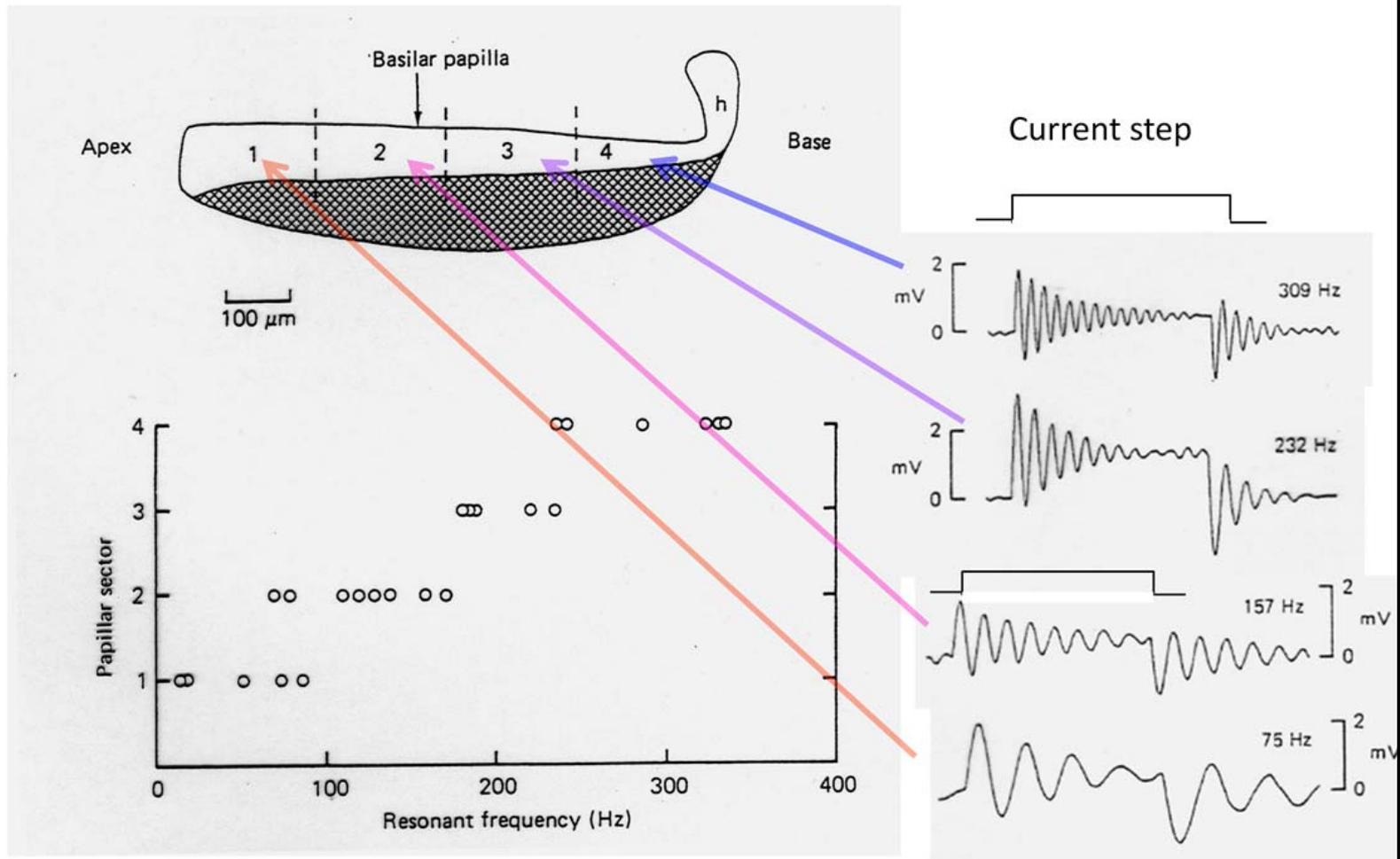
Base



Apex

so, mammalian ear specialized for higher frequency hearing – how well do nonmammalian vertebrates hear?

'Tonotopic' electrical tuning in turtle hair cells



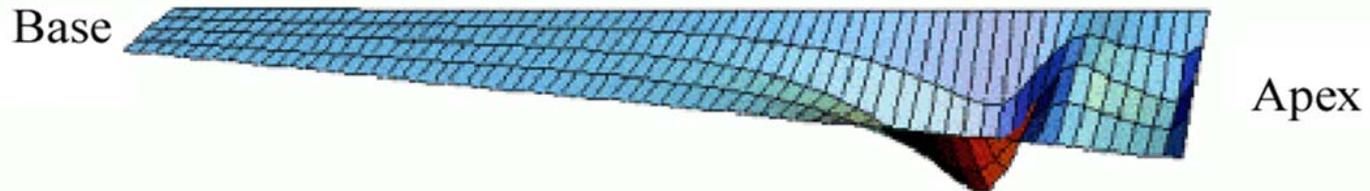
Art and Fettiplace, 1987



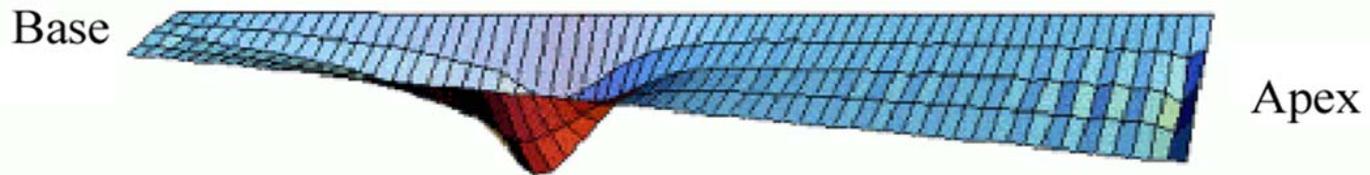
SKINNER

The cochlear 'traveling wave'

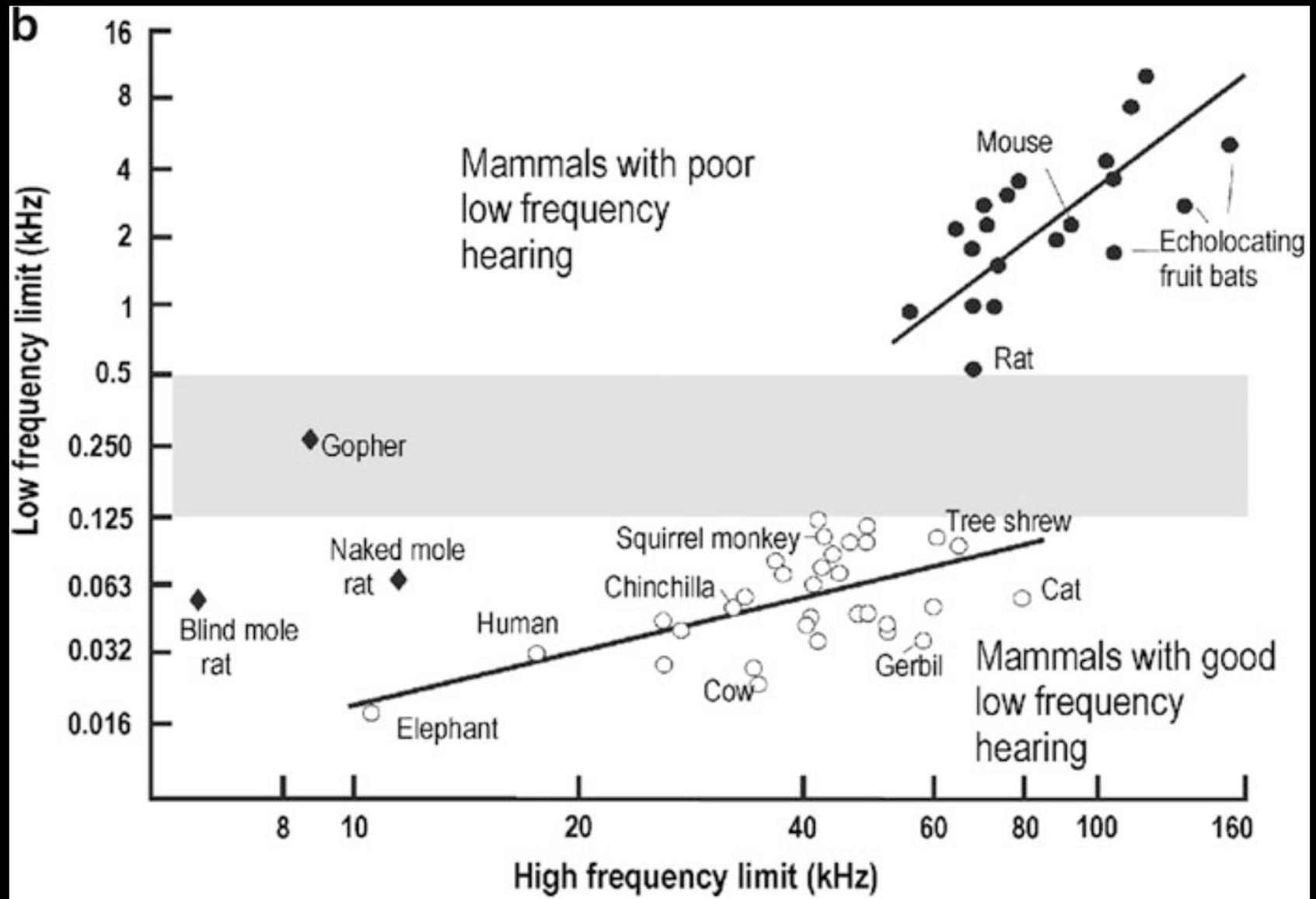
2 kHz



6 kHz



Hiroshi Wada, Tohoku University



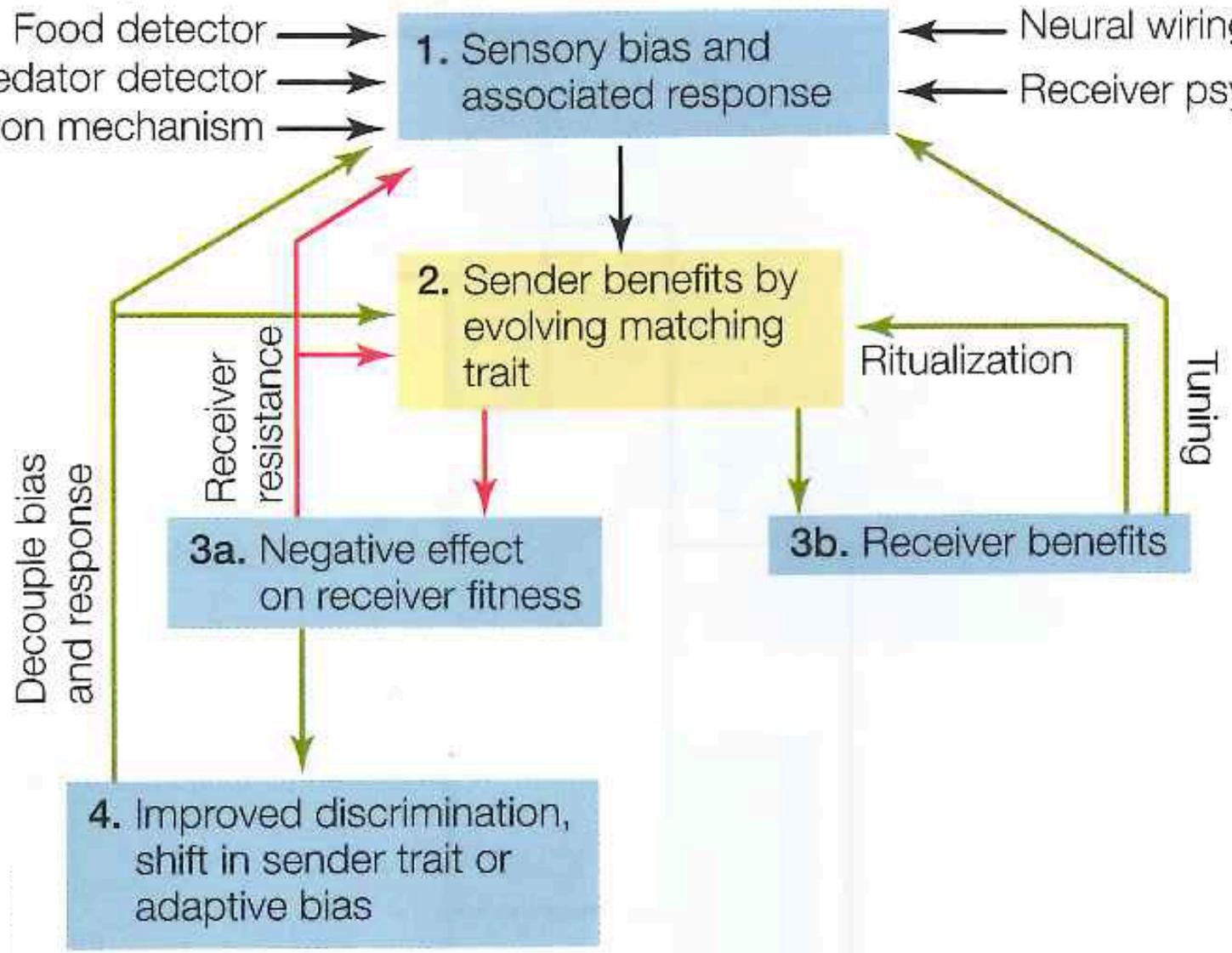
Koppl, Manley, Popper, and Fay 2014

Adaptive sensory biases

- Food detector
- Predator detector
- Navigation mechanism

Latent biases

- Neural wiring
- Receiver psychology



Receiver resistance

Ritualization

Tuning

Decouple bias and response

2. Sender benefits by evolving matching trait

1. Sensory bias and associated response

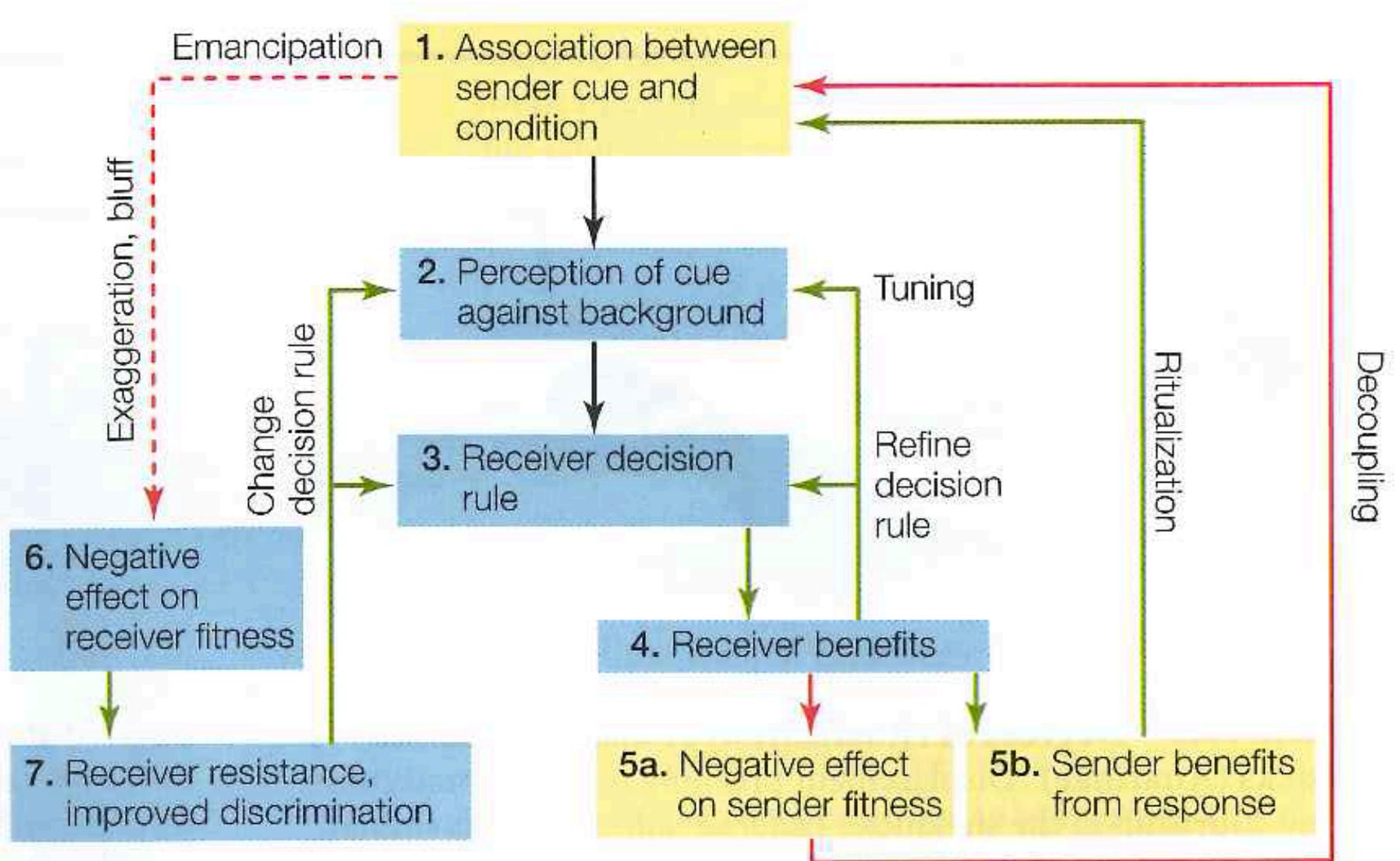
3a. Negative effect on receiver fitness

3b. Receiver benefits

4. Improved discrimination, shift in sender trait or adaptive bias

What is Animal Communication?

		Benefit to Receiver	
		+	0/-
Benefit to Sender	+	True Communication	Deception, Manipulation
	0/-	Cues, Eavesdropping, Exploitation	Ignoring, Spite



Adaptive sensory biases

Food detector →

Predator detector →

Navigation mechanism →

1. Sensory bias and associated response

Latent biases

← Neural wiring

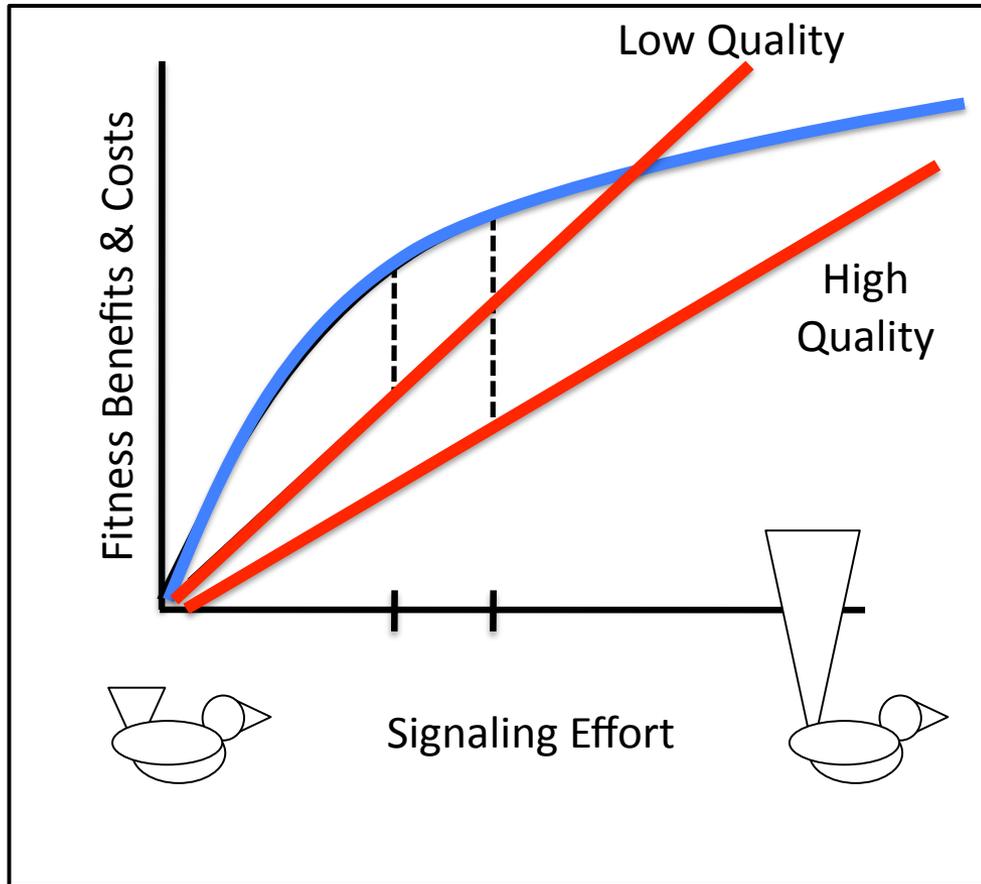
← Receiver psychology

How signal honesty is maintained

TABLE 10.1 *Classification of signals based on cost that guarantees honesty*

Category	Cost	Signal design	Type of information
HANDICAP SIGNALS			
Quality handicap	Differentially costly to produce or bear	Graded display, intensity correlated with sender quality	Condition, health, stamina, fighting ability
Signal of need	Differential benefits per investment cost	Graded display, intensity correlated with sender need	Motivation, need, resource valuation

Handicaps: Quality Handicap (Costs)



See Figure 10.24

Costs lead to honest signaling IF they are affected by individual quality

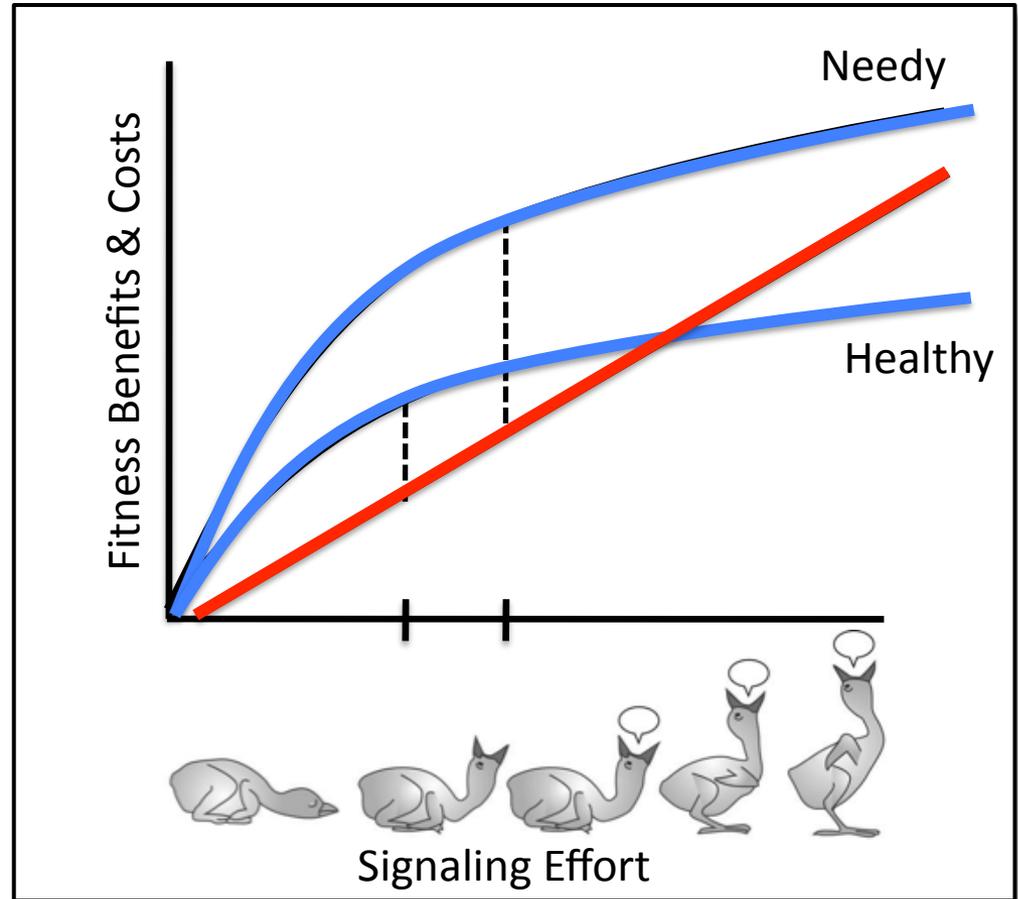
Blue = benefits
Red = costs

Handicaps: Signals of Need (Benefits)



Differential benefits can also lead to honest signaling....

Blue = benefits
Red = costs



See Figure 10.26

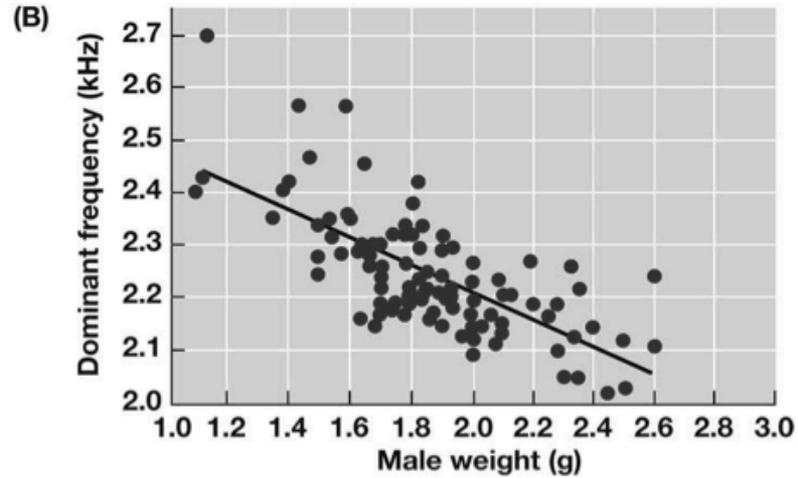
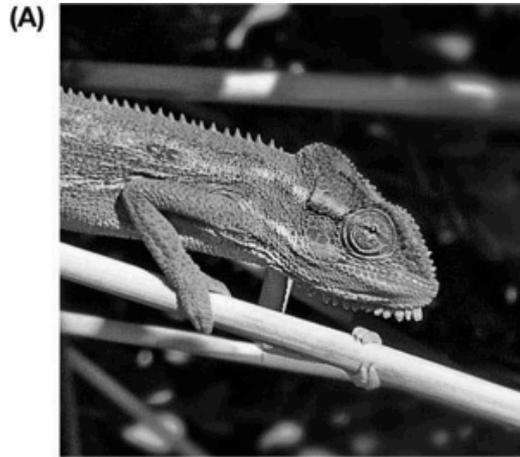
How signal honesty is maintained

TABLE 10.1 *Classification of signals based on cost that guarantees honesty*

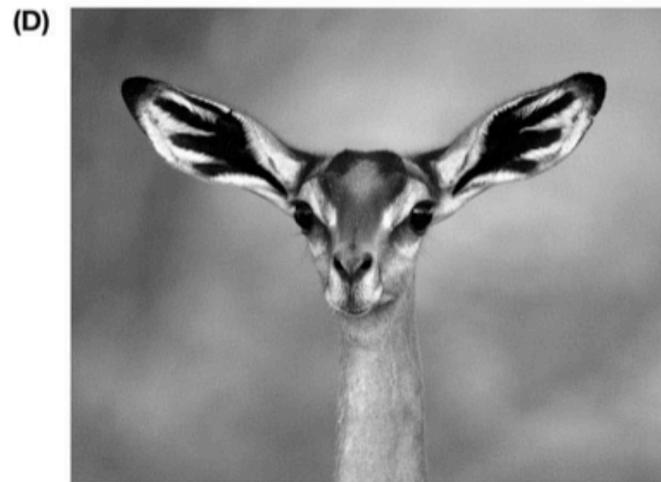
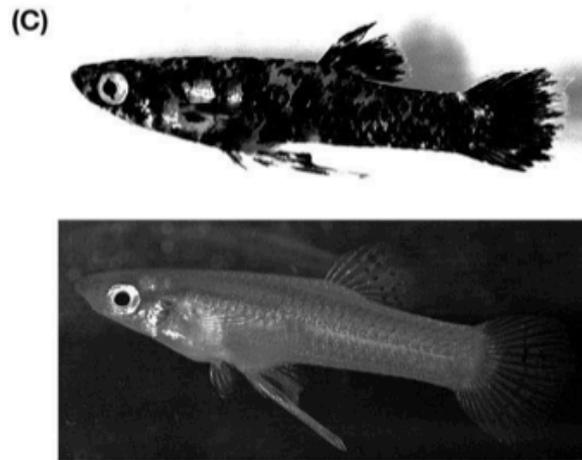
Category	Cost	Signal design	Type of information
HANDICAP SIGNALS			
Quality handicap	Differentially costly to produce or bear	Graded display, intensity correlated with sender quality	Condition, health, stamina, fighting ability
Signal of need	Differential benefits per investment cost	Graded display, intensity correlated with sender need	Motivation, need, resource valuation
INDEX SIGNALS			
Quality index	Physical/physiological constraint	Discrete or graded display, form linked to sender attribute	Body size, strength, age, natal area
Pointing	Informational constraint	Linked to target of sender's attention	Identify object of sender's attention

Index Signals

Figure 10.29



Quality Indices



Information
Constraint

How signal honesty is maintained

TABLE 10.1 *Classification of signals based on cost that guarantees honesty*

Category	Cost	Signal design	Type of information
HANDICAP SIGNALS			
Quality handicap	Differentially costly to produce or bear	Graded display, intensity correlated with sender quality	Condition, health, stamina, fighting ability
Signal of need	Differential benefits per investment cost	Graded display, intensity correlated with sender need	Motivation, need, resource valuation
INDEX SIGNALS			
Quality index	Physical/physiological constraint	Discrete or graded display, form linked to sender attribute	Body size, strength, age, natal area
Pointing	Informational constraint	Linked to target of sender's attention	Identify object of sender's attention

CONVENTIONAL SIGNALS

Cost-free signal	No or minimal cost, no conflict of interest	Low-amplitude signal derived from cue	Coordination of cooperative activities
Conflict conventional signal	Socially-imposed cost	Arbitrary form, antithetical discrete or graded signal	Status, motivation, willingness to escalate, fighting ability

Conventional Signals

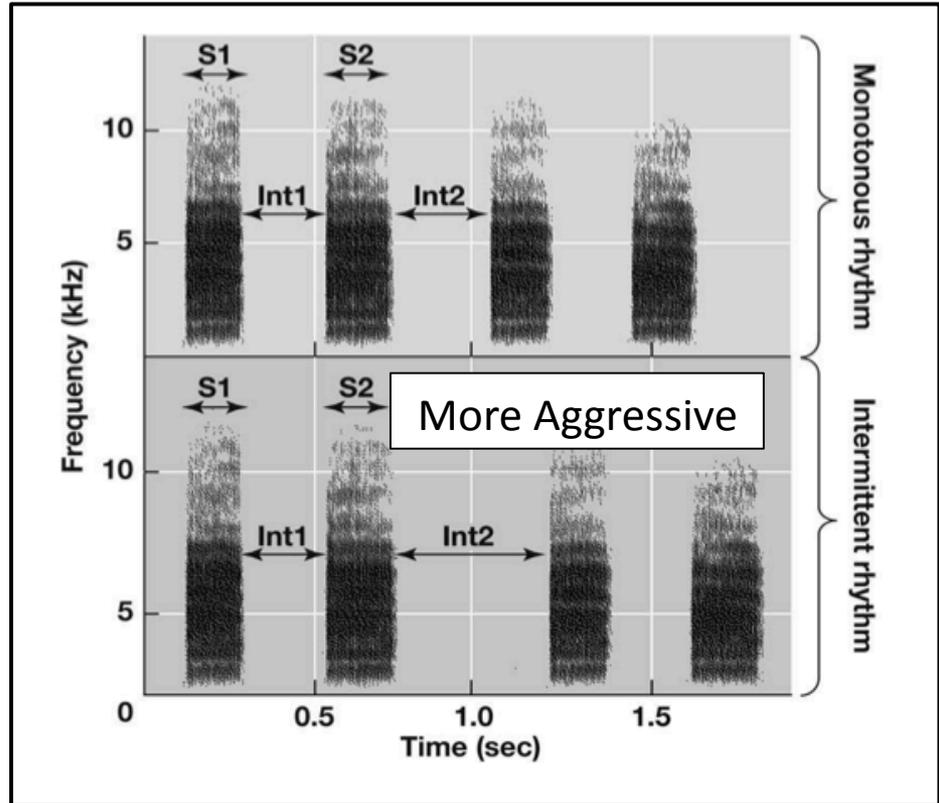
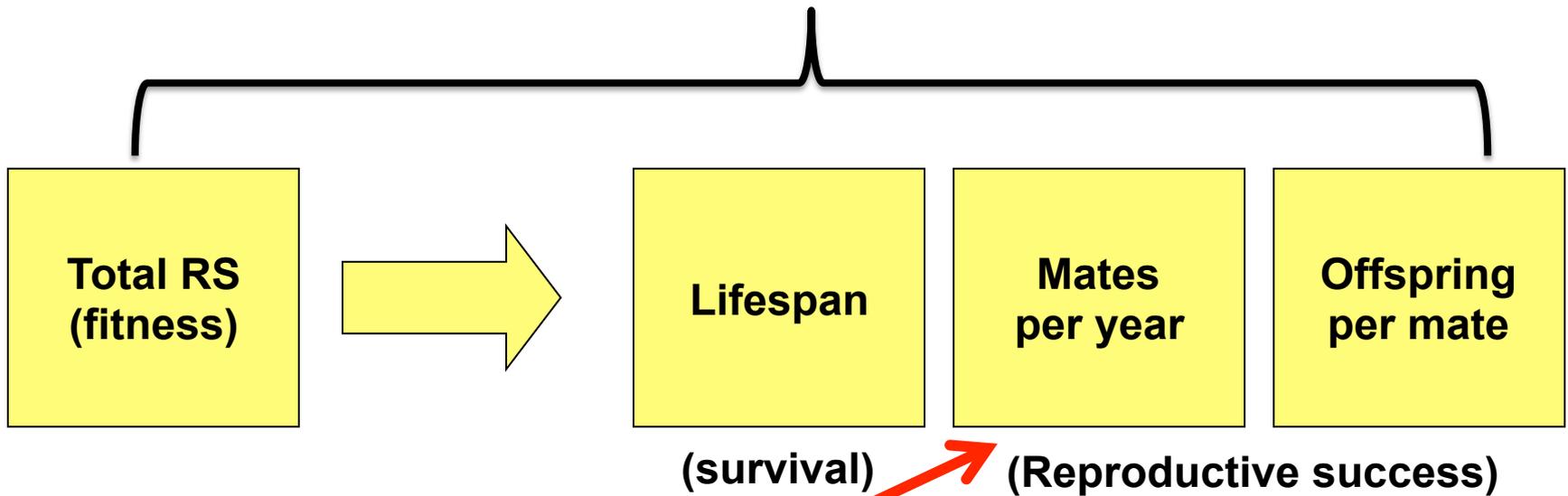


Fig. 10.33

Signal benefits

Natural selection



sexual selection



Signal functions

Signals of need/solicitations

- Interests aligned?
- Benefits to sender/receiver?
- How honesty maintained?

Signal functions

Food calls

- Interests aligned?
- Benefits to sender/receiver?
- How honesty maintained?

Signal functions

Alarm signals

- Interests aligned?
- Benefits to sender/receiver?
- How honesty maintained?

Signal functions

Mating signals

- Interests aligned?
- Benefits to sender/receiver?
- How honesty maintained?

Signal functions

Threat/aggression/dominance signals

- Interests aligned?
- Benefits to sender/receiver?
- How honesty maintained?

Movie: signal functions

- List functions of signals shown
- What component of the signaler and receiver's fitness are increased through the use of each signal?

Announcements

- Field trip
- Singing mice!