Tinbergen: eggshell removal diminishes predation

15 cm	42%
100 cm	32%
200 cm	21%

How far would you carry the eggshell?

2 m or 200m?

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Eggshells carried far from nest
Take it very far away: no predation risk?

- When parent away, nest can be predated
- Time
- Energy

Every action has costs

Single action: time, energy, risk of predation, injury, infection etc.

Between actions: when you do A, you can't do B

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Trade-offs

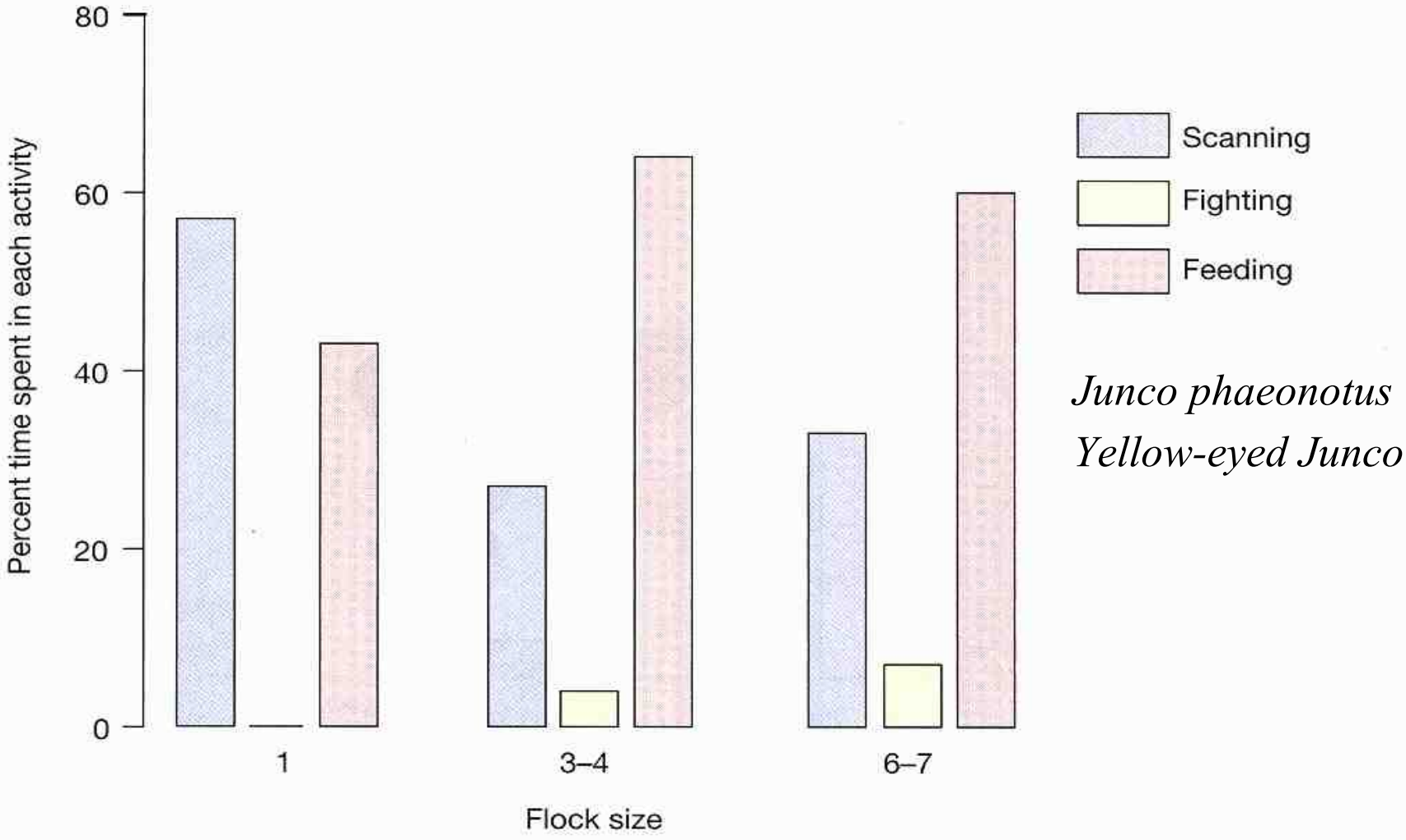

Figure 4.13 The increase in fighting and decrease in scanning of yellow-eyed juncos with increasing flock size yields the highest rate of feeding at intermediate flock size. *(From data in Caraco et al., 1980.)*

Adaptationist approach

Behaviour is shaped by selection.
Genetic selection
Mental selection (trial and error, cognition)

Every action has costs and benefits.
Lowest possible cost with highest benefit: optimal
Individuals performing optimal behaviour leave more offspring

Behavioural ecology: studying and modelling optimal behaviour

Within individual: optimisation models
Between individuals: game theory models

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Adaptationist approach

behaviour is assumed optimal within constrains

Constrain: cannot be modified (anatomy, cognitive capacity etc.)

Applied to human behaviour: evolutionary psychology

A few person with ADHD in a group can be advantagous (Attention deficit hyperactivity disorder)

Gene linked to ADHD was positively selected

Applied to in medical science: Darwinian medicine

Morning sickness in first trimester.

Benefit: avoiding toxins

Costs: weight loss (embryo weighs few grams)

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Adaptationist approach - *caveats*

Evolutionary lags

- Sudden change in the environment
  (global climate change)
- Coevolutionary arm races
  (hosts and parazites)

Rules of thumb

- Approximations
  (eat green bugs, avoid red ones)

Local versus global optima

- Two populations in different environment with gene flow

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optimisation

Assumption:
behaviour is optimal within constrains

Aim of studies:

What are the constrains?

What is the benefit, cost and profit

- Optimisation models

What are the alternative strategies?

- Game theory models

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Optimal territory size

Roebuck:
territory in spring
(fighting, chasing, marking)

Mating in summer (july-august)
with females on territory
2-3 females on average

Larger, better quality territory

- More offspring → fitness
- More costly to defend

Where is the optimum?

Optimal territory size:

Cost increases by

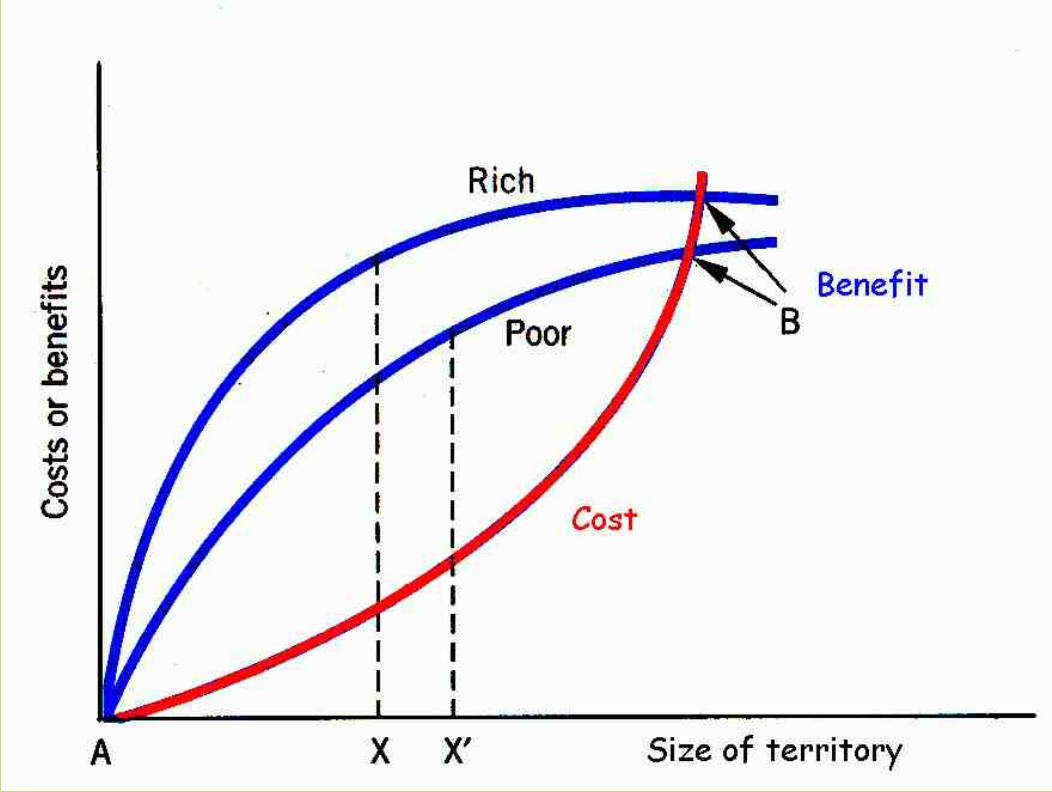
size of territory

density of males

Benefit increases by

size of territory

quality of territory



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Amerikai varjú (Corvus caurinus)

- Crows picked up only large whelks about 3.5 – 4.4 cm long
- They flew up about 5 meters to drop their chosen whelk
- They kept trying until the whelk broke, even if many flights were required

Optimality Hypothesis Predictions:

Large whelks should be more likely than small ones to shatter after a drop of 5 meters

Drops of less than 5 meters should yield a reduced breakage rate, whereas drops of much more than 5 meters should not greatly improve the chances of opening a whelk

The probability that a whelk will break should be independent of the number of times it has already been dropped.

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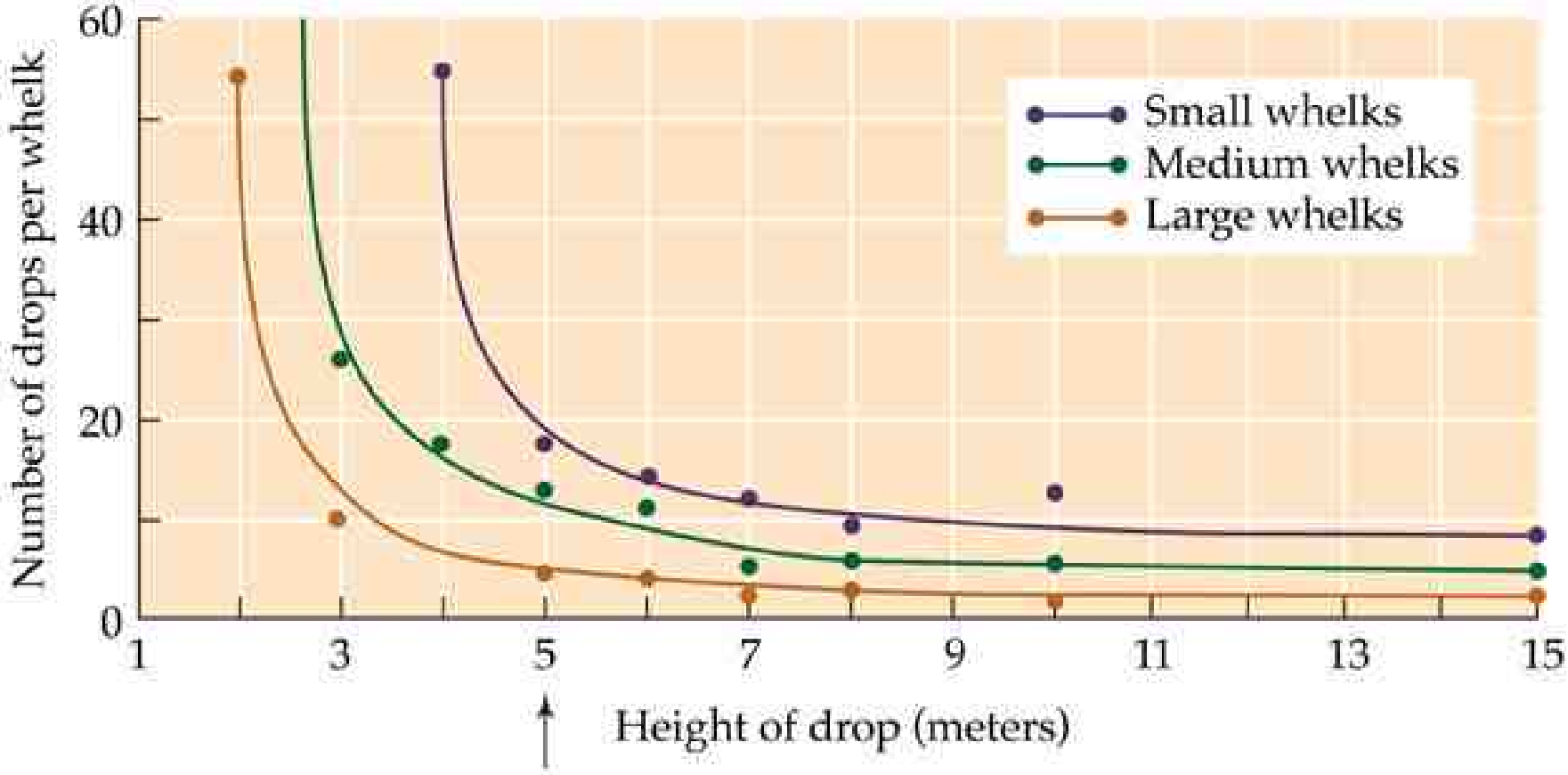
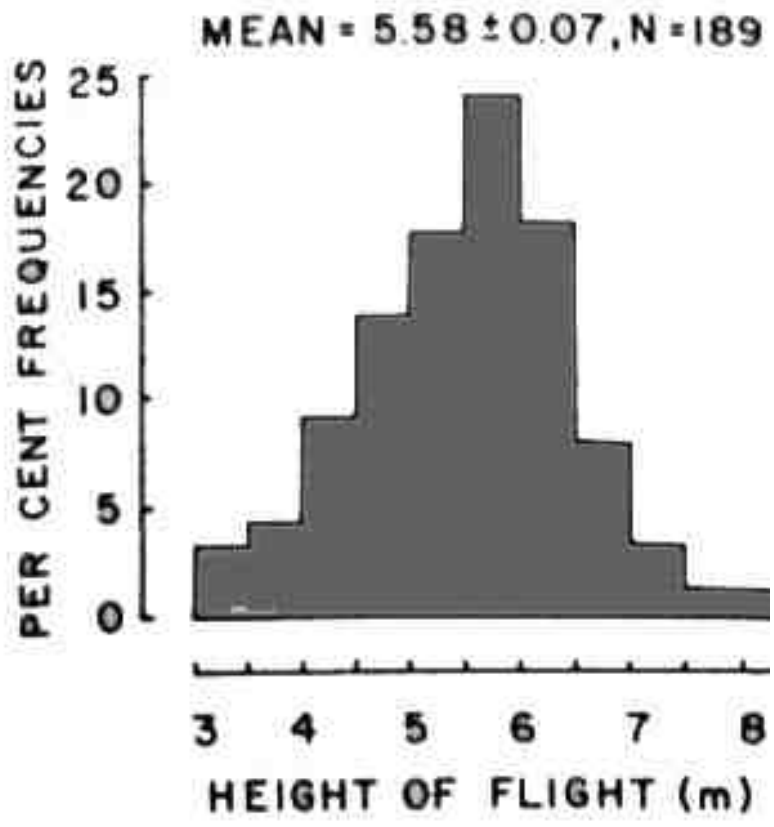
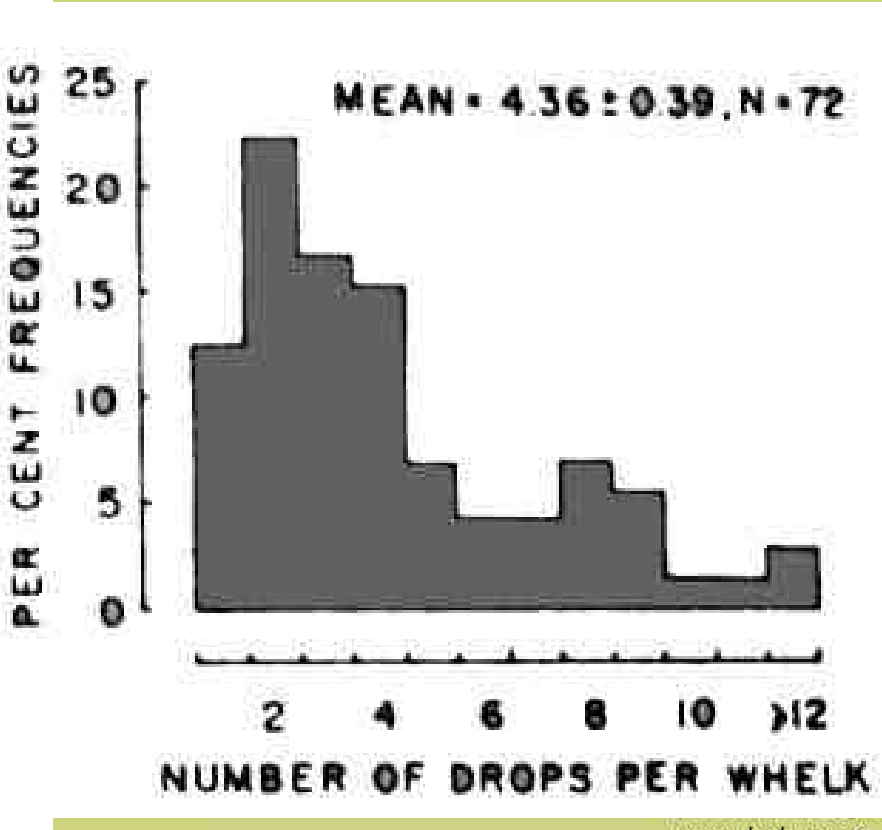
First Test: Size of Whelks



Second Test: Height of Drop

Why do the crows consistently fly to about 5.25 m and use about 4.4 drops to split open a whelk? Is this explained by minimizing the energy spent, thus supporting an optimal foraging strategy?





Third Test: Chance of breaking a Whelk

Third Prediction: The chance that a large whelk would break was unaffected by the number of previous drops.

It was always about 1 in 4 on any given drop

So a crow who abandoned an unbroken whelk would not have a better chance of breaking a replacement whelk of the same size on its next attempt

Plus it will lose energy in the new search

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Mobbing behavior of colonial, ground-nesting gulls

ANIMAL BEHAVIOR 9e, Figure 6.1

Alternative strategies

Approach a Herring Gull colony, the birds will fly at you

Cost: risk of predation

Benefit: predator distracted from nest

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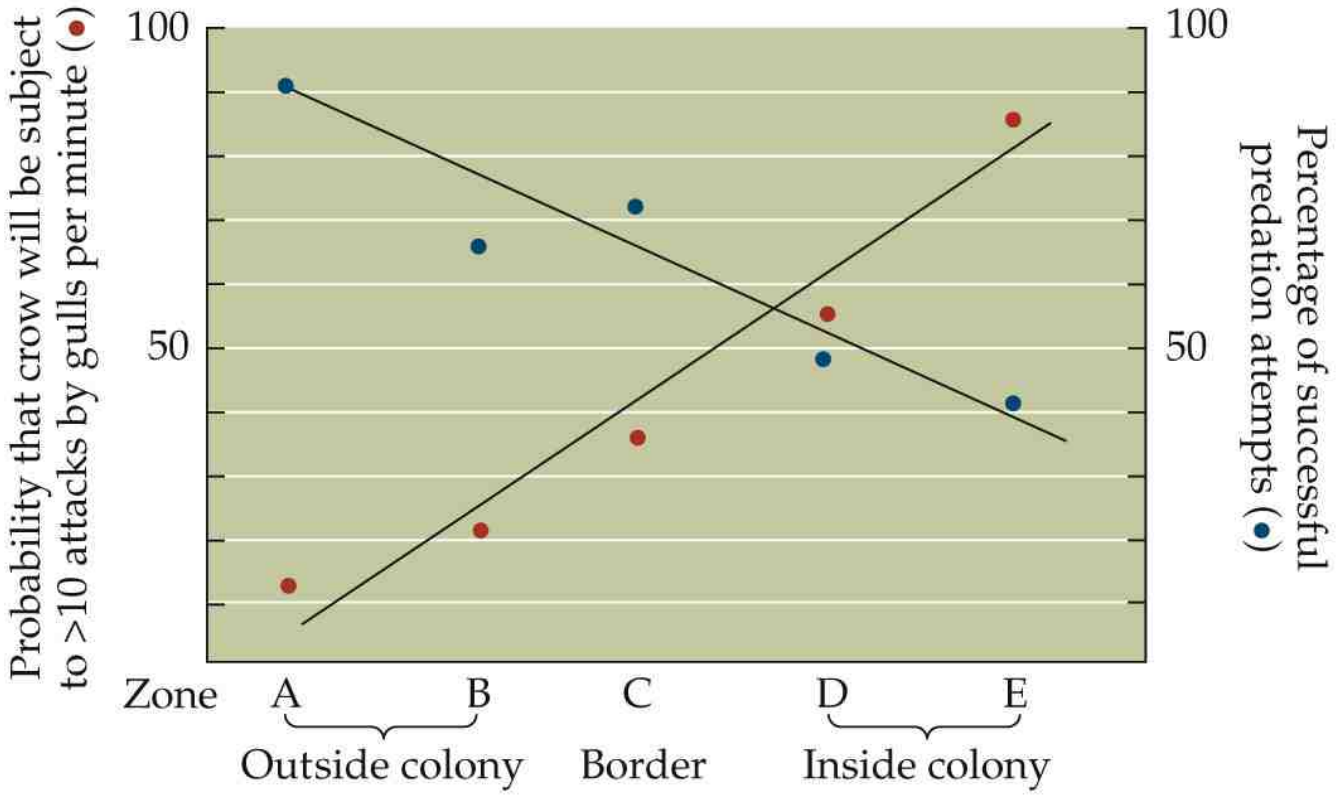
Does mobbing protect eggs?

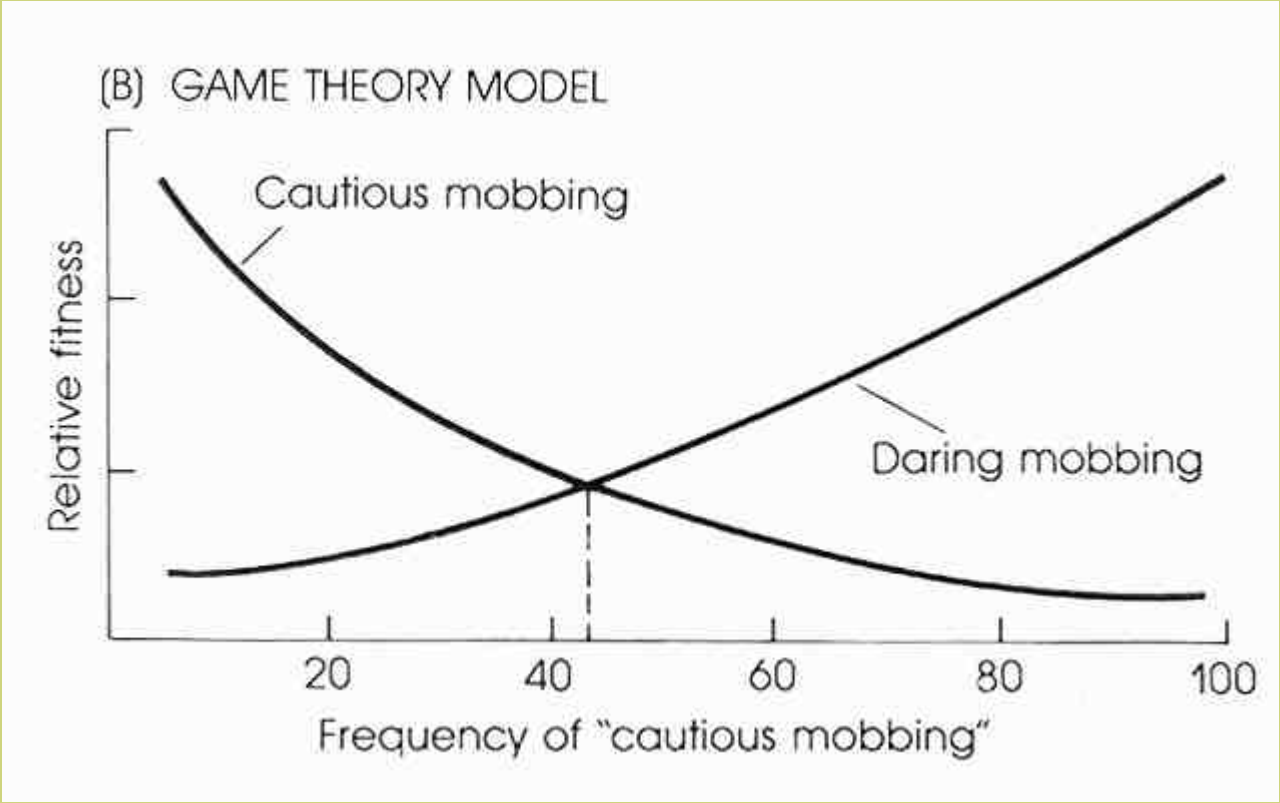
Black-headed gull



ANIMAL BEHAVIOR 9e, Figure 6.4

Evolutionary Stable Strategy (ESS)

Benefit depends on others



If most gulls are daring, cautious strategy wins

If most gulls are cautious, daring strategy wins

ESS: stable ratio

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Interaction among individuals

	donor	receiver
Mutualism:	+	+
Reciprocity:	+ (delayed)	+
Altruism :	-	+
Selfishness	+	-
Spite:	-	-

which of these can work?

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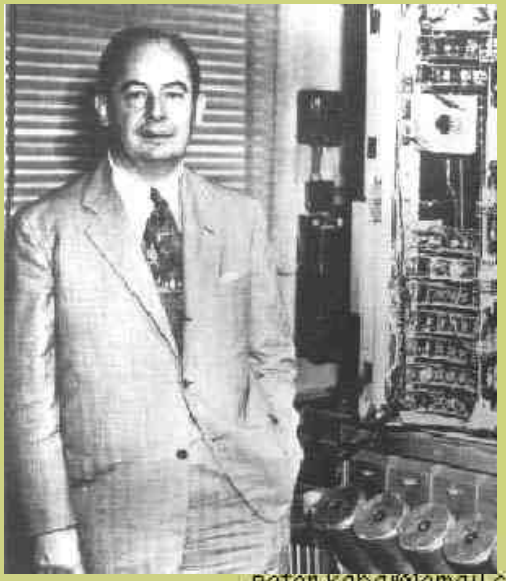
Game theory developed by János Neumann
Neumann (1928)
On the Theory of Parlor Games
Neumann és Morgenstern (1944):
Theory of Games and Economic Behavior

In economics: e.g. John Nash (A beutiful mind)
In ethology: John Maynard-Smith



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Evolutionary game theory

Dove – hawk game

Rules

two animals compete for a resource valued „B”, the winner has a an increase in fitnes by „B”
individuals have any of two strategies depending on genotype

- Dove: no war, cuing, if other attacks, withdraws immidiatly
- Hawk: always attacks until wins or loses, inflicts or receives injury costing „C” drop in fitness

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Evolutionary game theory

Payoff matrix

	H	D
H	(B-C)/2	B
D	0	B/2

D: dove
H: hawk

- **H vs H**: 50% chance to get resource and 50% chance of injury
- **H vs. D**: hawk gets the reward, dove retreats, none of them hurted
- **D vs. D:** one receives (or they share) the resource by 50-50% chance (or ratio)

Let B > C. what happens?

Let C > B. what happens?

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Evolutionary game theory

Payoff matrix

	H	D
H	(B-C)/2	B
D	0	B/2

D: dove
H: hawk

Evolutionary Stable Strategy (ESS):

1) If one strategy has higher fitnesz than the other
2) If fitnesz of the two strategy is equal at a given ratio
3) Mixed strategy: individuals can shift strategy
    1) Randomly by chance of ESS ratio.
    - By assesing their chances

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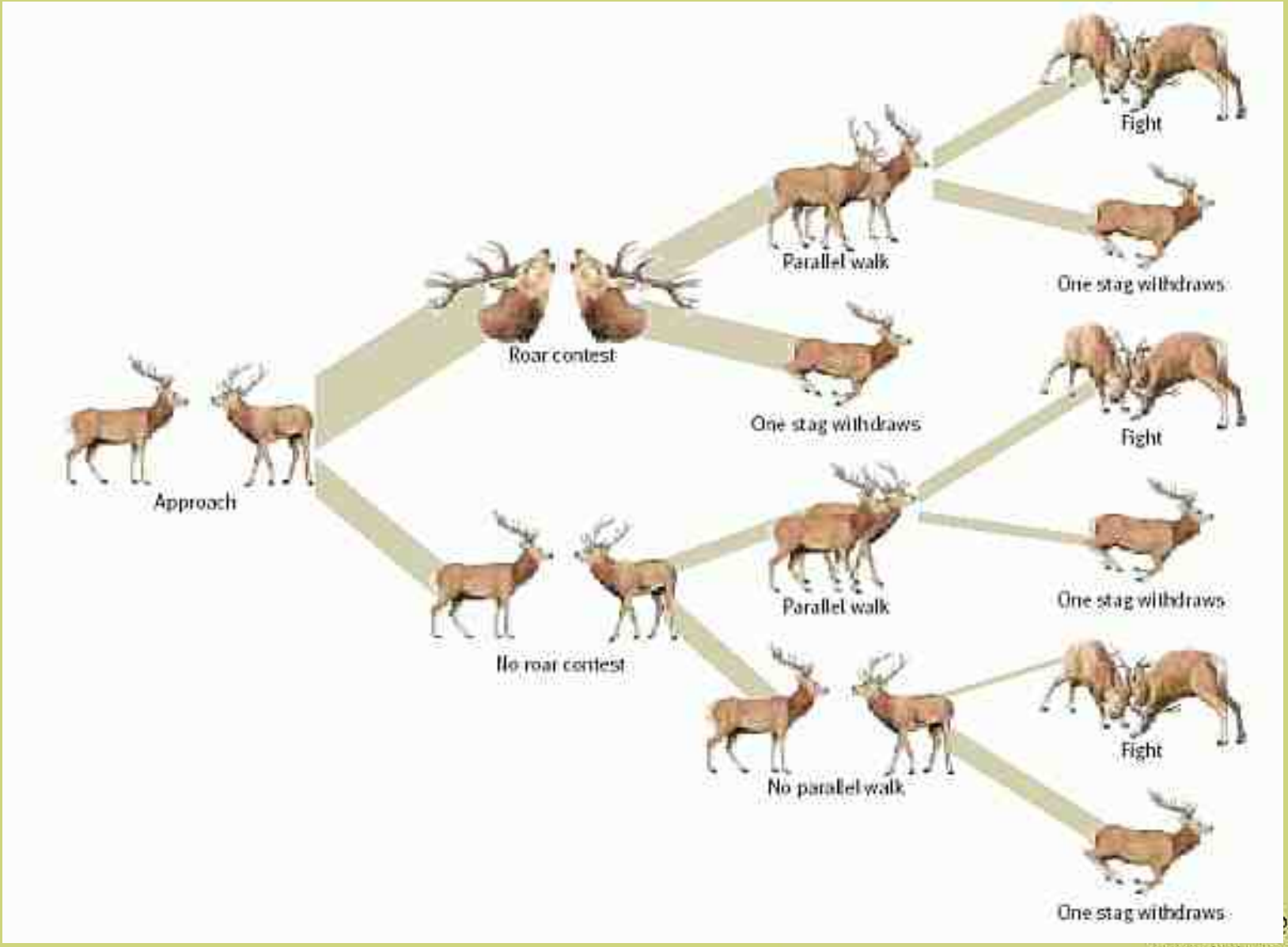
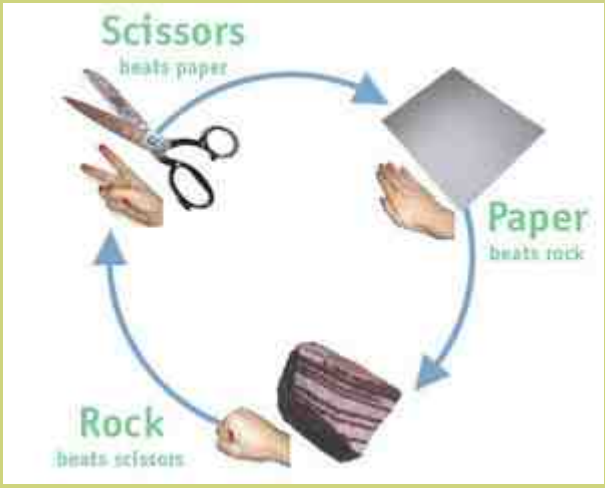
Signalling quality reduces injuries



Evolutionary game theory

Rock – paper – scissors



scissors > paper > rock > scissor > paper…

	R	P	S
R	**-ε**	**-1**	**1**
P	**1**	**-ε**	**-1**
S	**-1**	**1**	**-ε**

If their benefits are equal the three genotypes can coegsist

Rare in nature?

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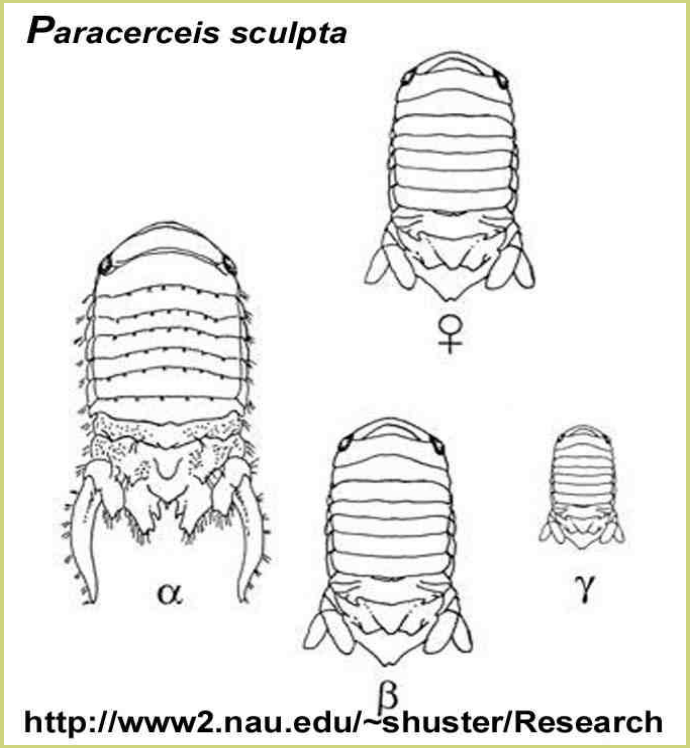
Marine sponge isopods

- 3 male morphs
  - Territorial, female imitator, sneaker
- Genetically distinct
- One locus, 3 allels



Reproductive success

Alpha: 1,51; Beta: 1,35; Gamma: 1,37 female / male

ESS!

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Prisoner's Dilemma

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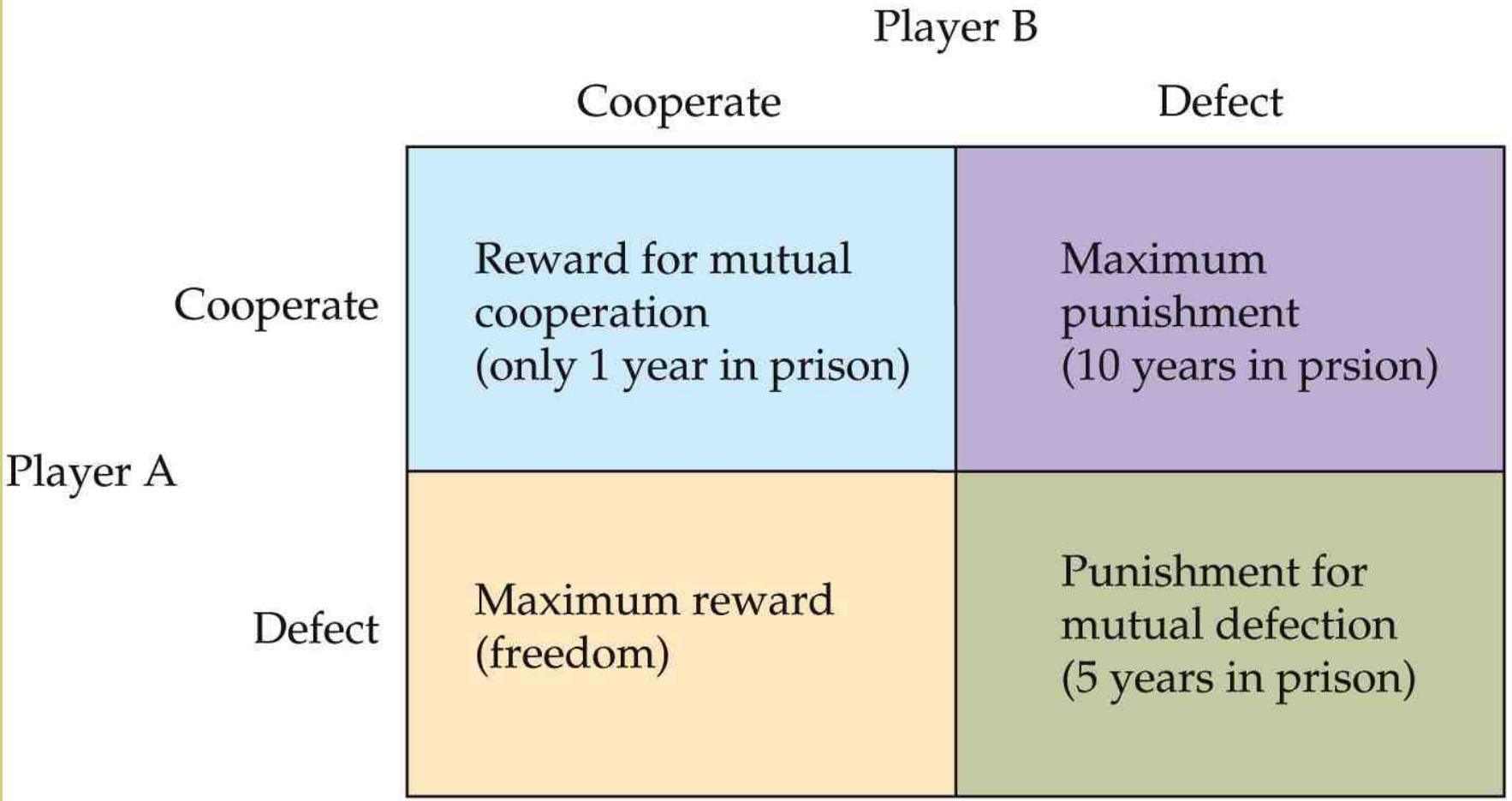

***ANIMAL BEHAVIOR* 9e, Figure 13.14**

Prisoner's dilemma

- Single game without information about the action of partner? Defect is ESS (Trivers, 1971)
- Information is not reliable
- Many games? tit for tat!

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