Cognition, Language & Communication 2013

7: Evolution

Plan for today

- Theories of Language Evolution
- The structure of evolutionary explanations;
- Frequency-dependent selection & Evolutionary Game Theory;

Theories of the evolution of language

Nativist vs. empiricist vs. emergentist

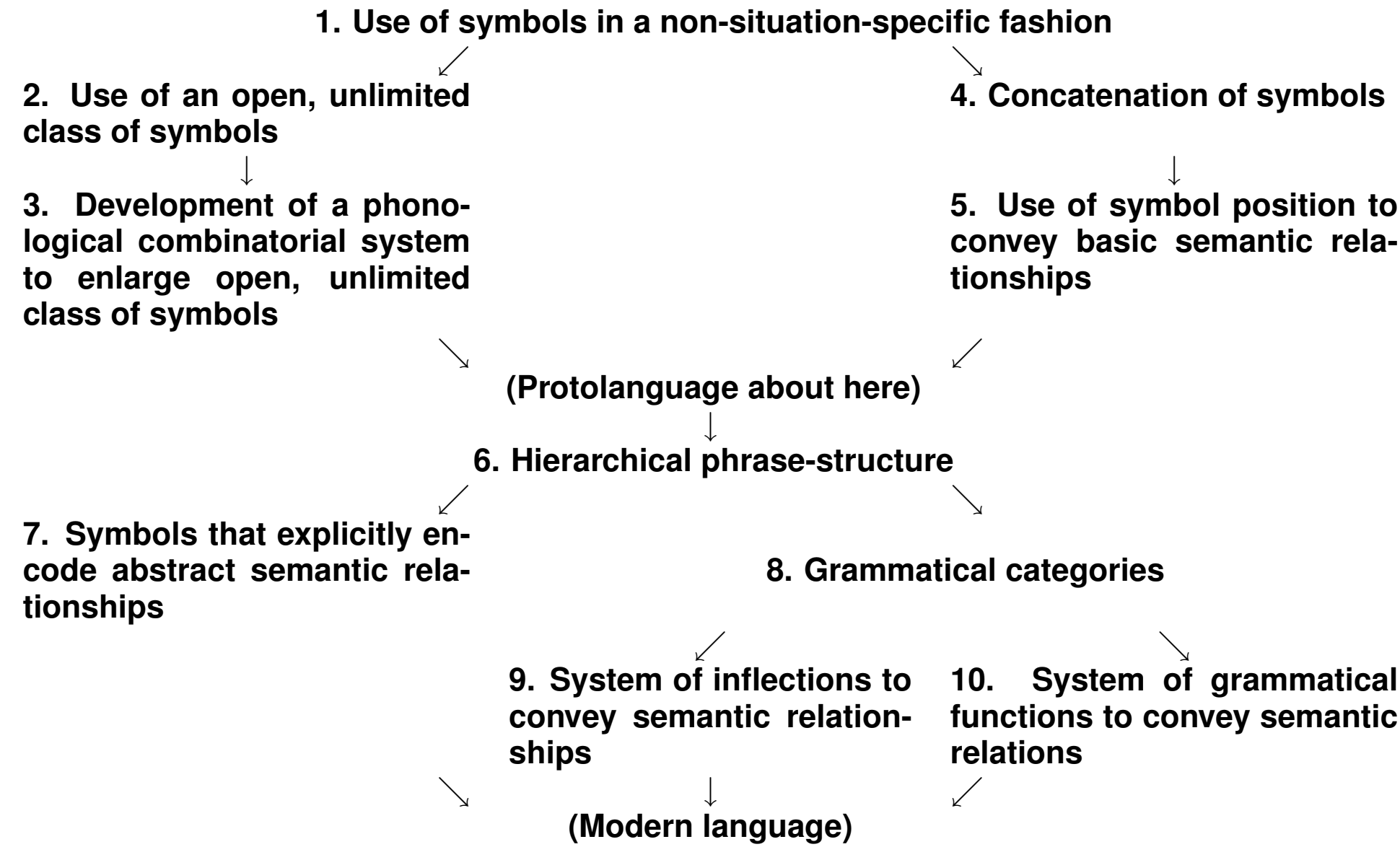
Adaptations vs. exaptations

Gradualist vs. saltationist

Communication vs. thought vs. contact:

Pinker & Bloom, 1990; Jackendoff, 2002: nativist, adaptationist, gradualist, communication-driven scenarios.

(Jackendoff, 2002)



Theories of the evolution of language

(Szamado & Szathmary, 2006)

Hunting theories: 'our intellect, interests, emotions, and basic social life all are evolutionary products of the success of the hunting adaptation.' (Washburn/Lancaster'68)use of language was to coordinate the hunting effort of the group.

Motherese: language evolved in the context of motherchild communication. Mothers had to put down their babies to collect food efficiently, and their only option to calm down babies was to use some form of vocal communication (Falk'04).

Group bonding and/or ritual: language evolved in the context of intergroup rituals, which first occurred as a kind of 'strike action' against non-provisioning males. Once such rituals were established, a 'safe' environment was created for further language evolution (Knight'98).

Gossip: menstrual ritual can be a costly signal of commitment; hence participating in such rituals can create female groups of shared interest in

which sharing information about the social life of others (i.e. gossiping) can be beneficial (Power'98).

Status for information: language evolved in the context of a so- called asymmetric cooperation, where information (that was beneficial to the group) was traded for status (Desalles'98).

Sexual selection: language is a costly ornament that enables females to assess the fitness of a male. According to this theory, language is more elaborate than a pure survival function would require (Miller'01).

Language as a mental tool: language evolved primarily for the function of thinking and was only later co-opted for the purpose of communication (Burling'93; also Chomsky's favourite just-so story).

Grooming hypothesis: language evolved as a substitution for physical grooming (Dunbar'98). The need for this substitution derived from the increasing size of the early hominid groups, which mean that physical grooming became more time consuming, whereas it was possible to 'groom' more than one individual simultaneously via vocal communication.

Mating contract and/or pair bonding: the increasing size of the early hominid groups and the need for male provisioning also necessi- tated 'social contract' between males and females (Deacon'97).

Song hypothesis: language evolved rapidly and only recently by a process of cultural evolution. The theory assumes two important sets of preadaptations; one is the ability to sing; the other is better representation abilities (i.e. thinking and mental syntax) (Vanneechoutes/Skoyles'98).

Tool making: assumes a double homology: 'a homologous neural substrate for early ontogeny of the hierarchical organisations shared by two domains language and manual object combination and a homologous neural substrate and behavioural organisation shared by human and non-human primates in phylogeny. (Greenfield'91)

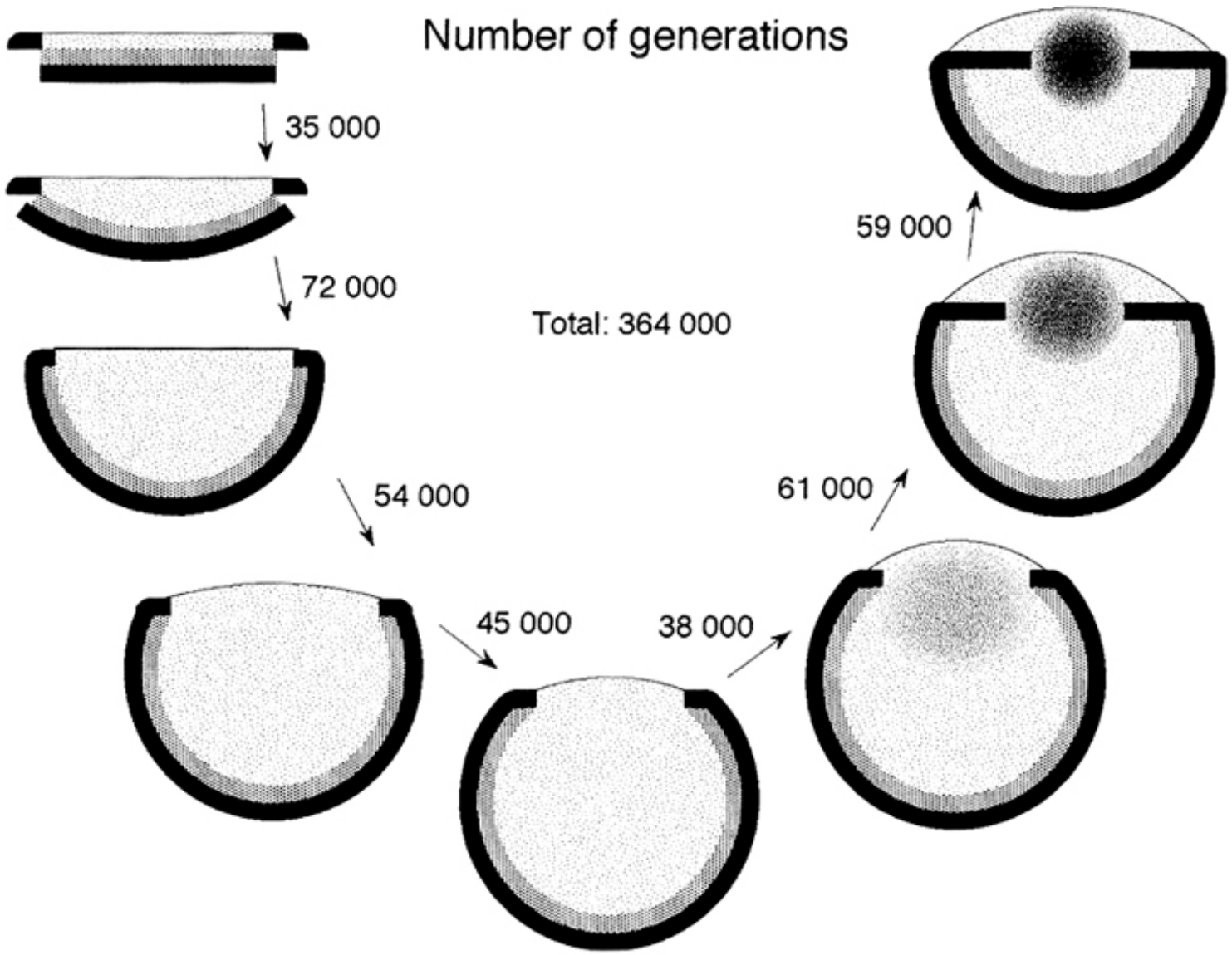


Fig. 1.6 A patch of light sensitive epithelium can be gradually turned into a perfectly focussed camera-type eye if there is a continuous selection for improved spatial vision. A theoretical model based on conservative assumptions about selection pressure and the amount of variation in natural populations suggest that the whole sequence can be accomplished amazingly fast, in less than 400 000 generations. The number of generations is also given between each of the consecutive intermediates that are drawn

3 key elements in an evolutionary scenario

1. What is the scope of phenotypes that are “available” for evolution?
   . . . . . strategy set
2.
3.

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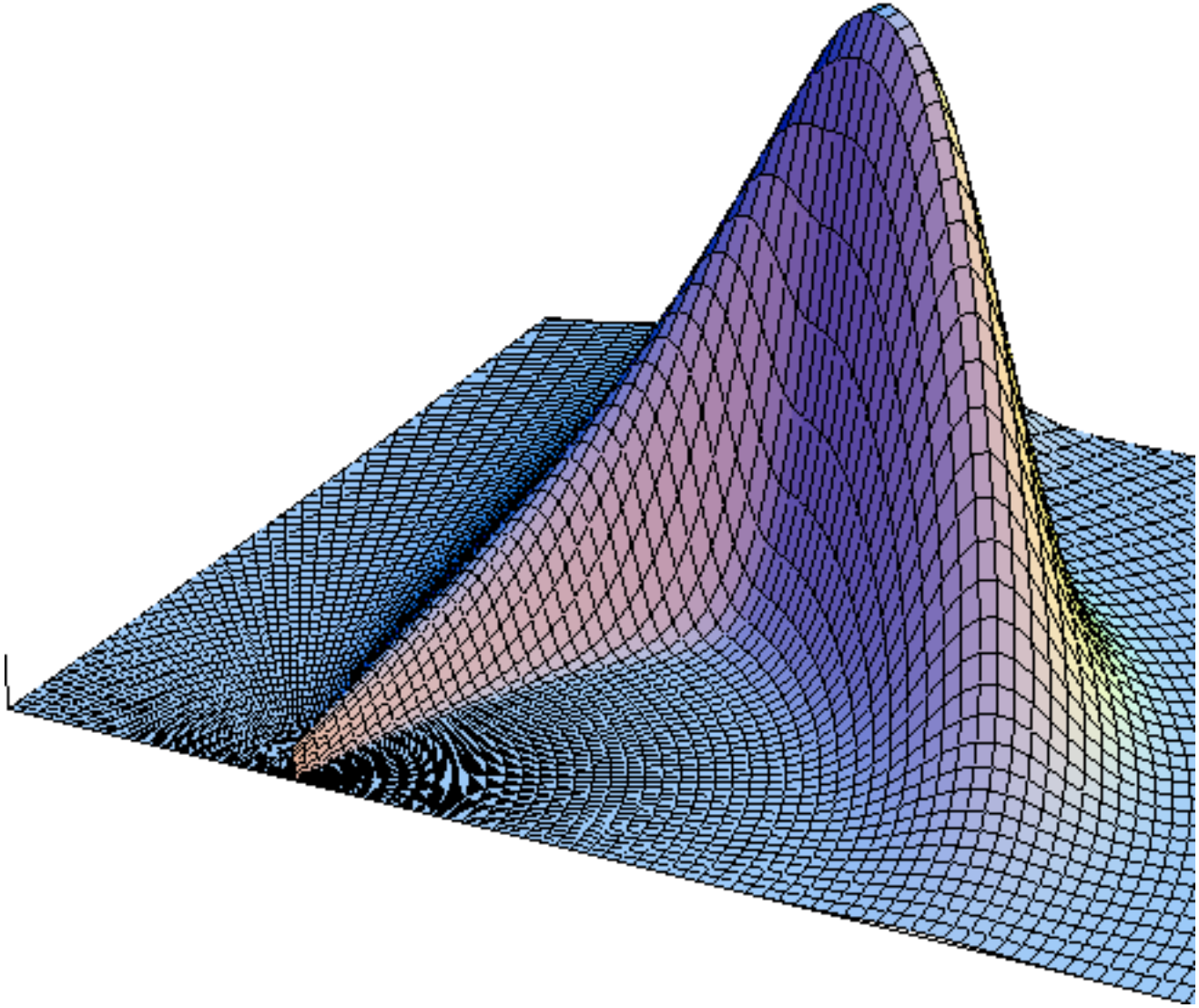
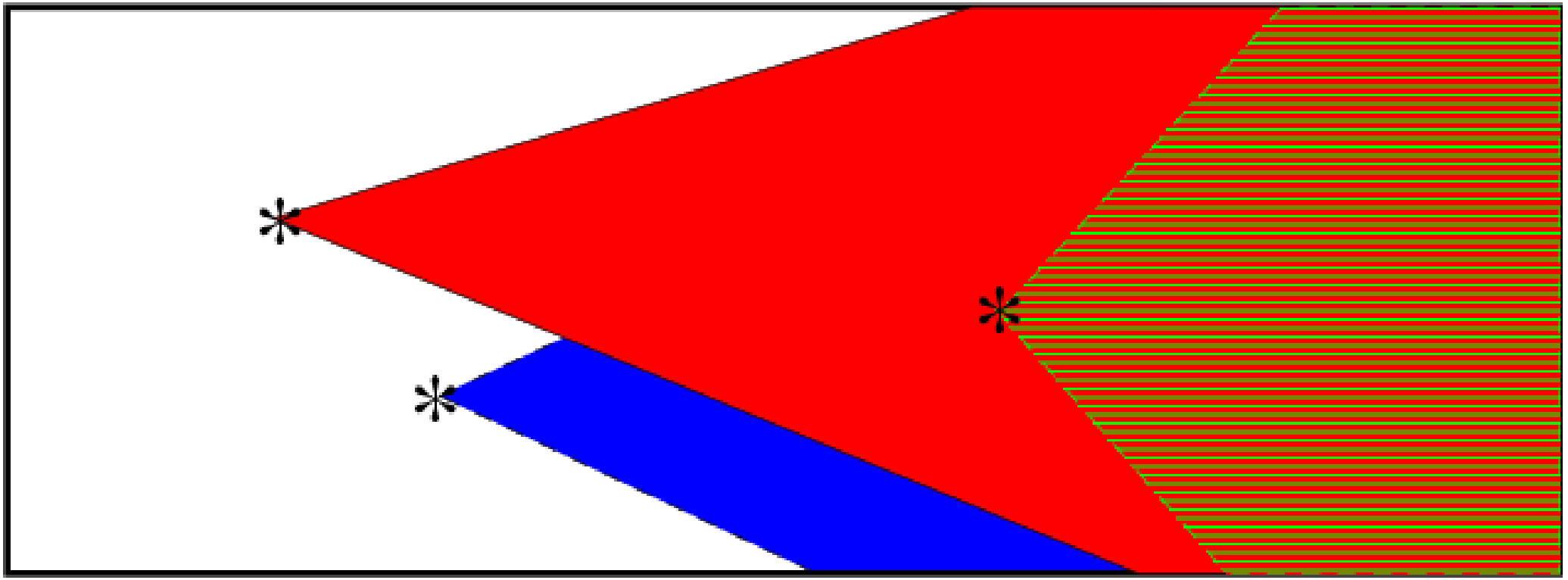
3. Is there a sequence of possible phenotypes, each next one fitter than the previous, such that in can invade? . . . . . fit intermediates



Limits to Optimality

"Natural selection tends only to make each organic being as perfect as, or slightly more perfect than, the other inhabitants of the same country with which it comes into competition. And we see that this is the standard of perfection attained under nature" (Darwin, 1872, p 163)

- biophysical and genetic constraints
- the speed of evolution
- mutational load
- fluctuating fitness
- frequency-dependent fitness
- correlation, levels of selection



Language is not an eye!

Often, the fitness of an individual with a given phenotype does not only depend on the phenotype and environment (including other species), but also on the *f*requency of the phenotype in the population.

This is called: *F*requency-dependent Selection

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Sight Communication

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individual ↓	population	
	bad eyes	good eyes
bad eyes	low	low
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Communication

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	population	
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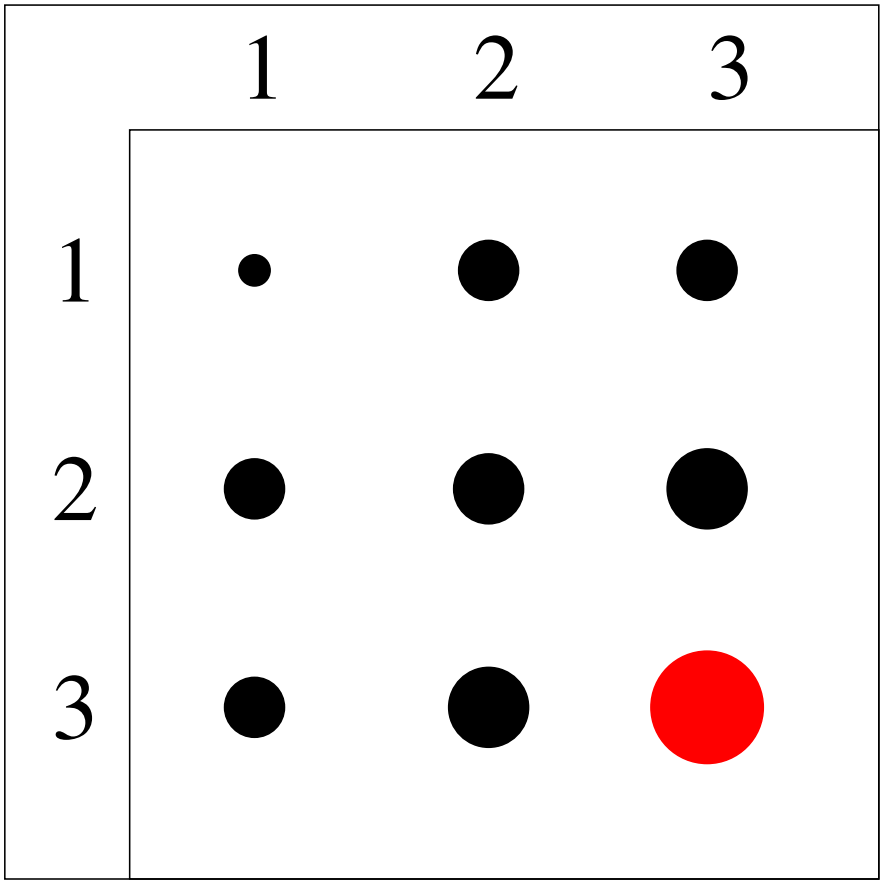
Communication

	population	
individual ↓	code A	code B
code A	high	low
code B	low	high

Evolutionary Game Theory



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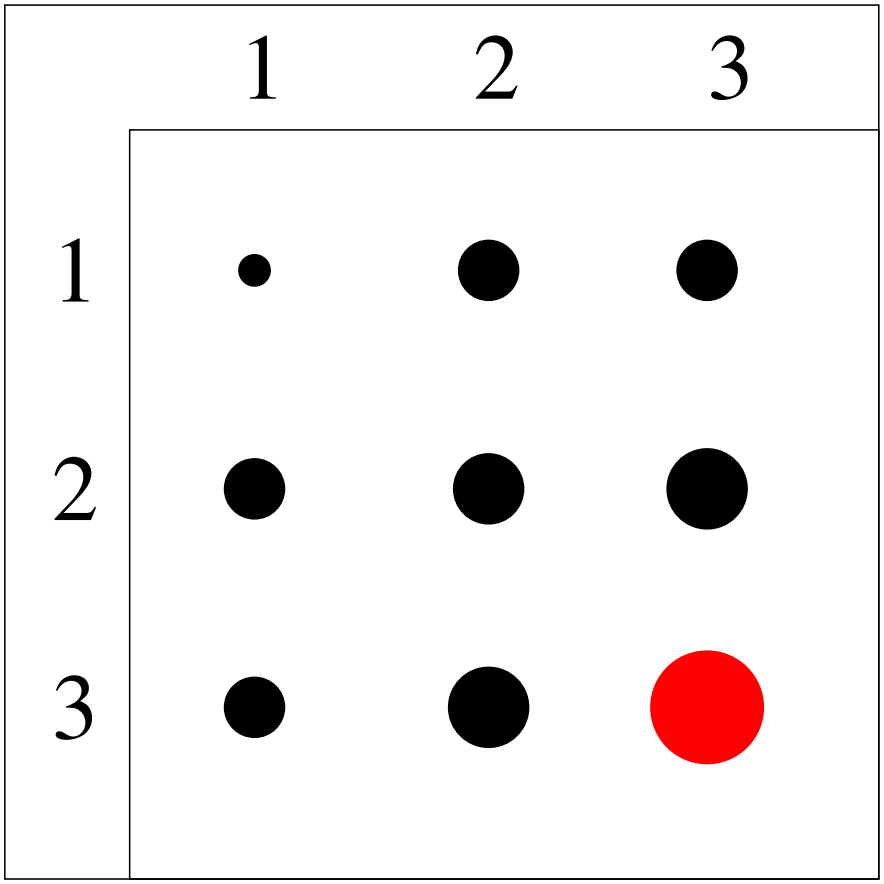

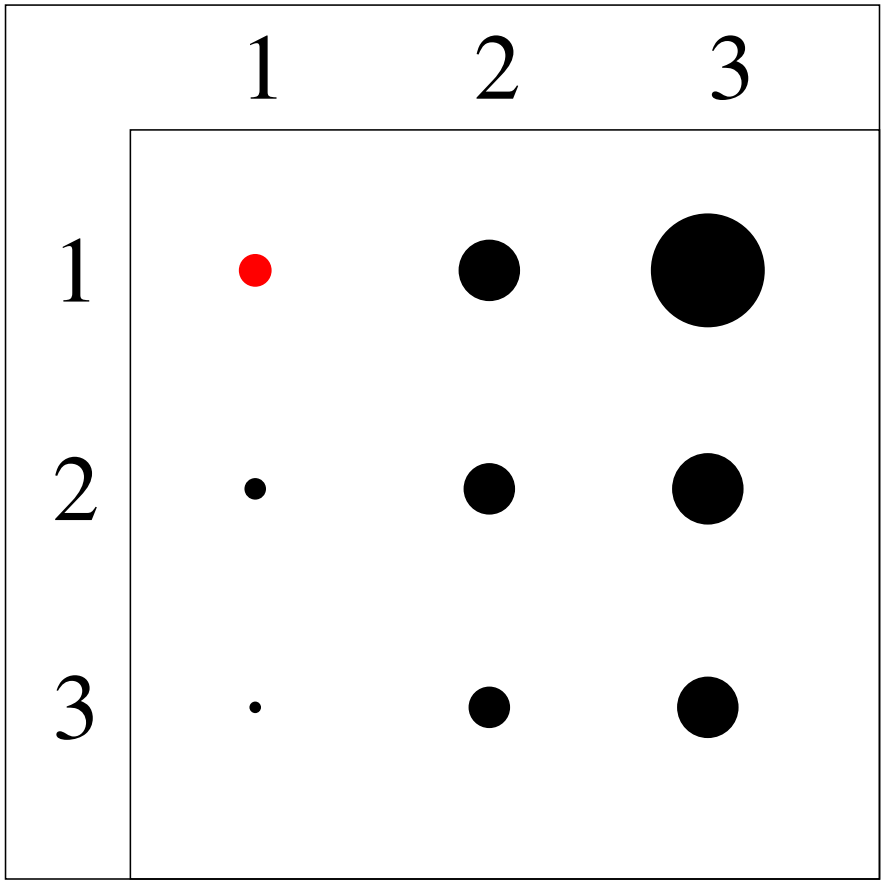

Evolutionary Game Theory (Maynard Smith & Price, 1973)

An Evolutionary Stable Strategy (ESS) is a strategy that cannot be *i*nvaded by any other strategy, because all other strategies have either a lower fitness when playing against the ESS, or if their fitness is equal, they have a lower fitness when playing against themselves.

That is, if $W(i, j)$ gives the fitness for a player playing strategy i against an opponent playing strategy j, then i is an ESS iff:

$$\forall j \, (W(i,i) > W(j,i) \vee W(i,i) = W(j,i) > W(j,j))$$

Problem of cooperation Why would senders be willing to send honest signals, and hearers be willing to receive and believe the signal?

Honest signaling theory (Zahavi, Maynard Smith, Grafen, Bergstrom)

Problem of coordination How is, after each innovation, a shared code established and maintained? And which code?

Coordination games (Lewis, Skyrms, Nowak, Hurford)