

What are corvids?

ravens, crows, rooks, jackdaws, jays, magpies

- large songbirds
- broad spectrum of social organisations
- large variety of habitats

Why cooperation in corvids?

- advanced cognitive capacities
 - ▶ tool use
 - ▶ perspective taking
 - ▶ deception
- comparable to primates in many aspects
- ... but few studies of cooperative behaviour

COCOR strategy: primates – corvids comparison

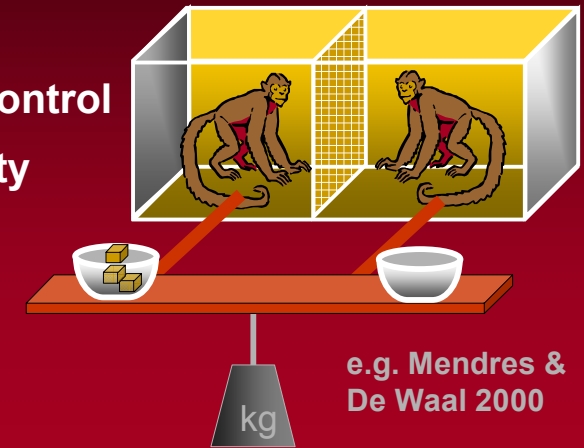
- repeat successful cooperation experiments done with primates
- analyse natural cooperative behaviour (e.g. coalition formation)



What has been done with primates?

■ mainly dyadic cooperation experiments

- ▶ partner control
- ▶ reciprocity

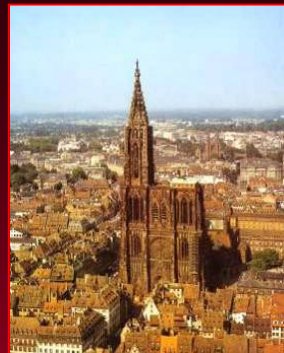


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Input from Strasbourg (team of Ronald Noë)

emphasis on:

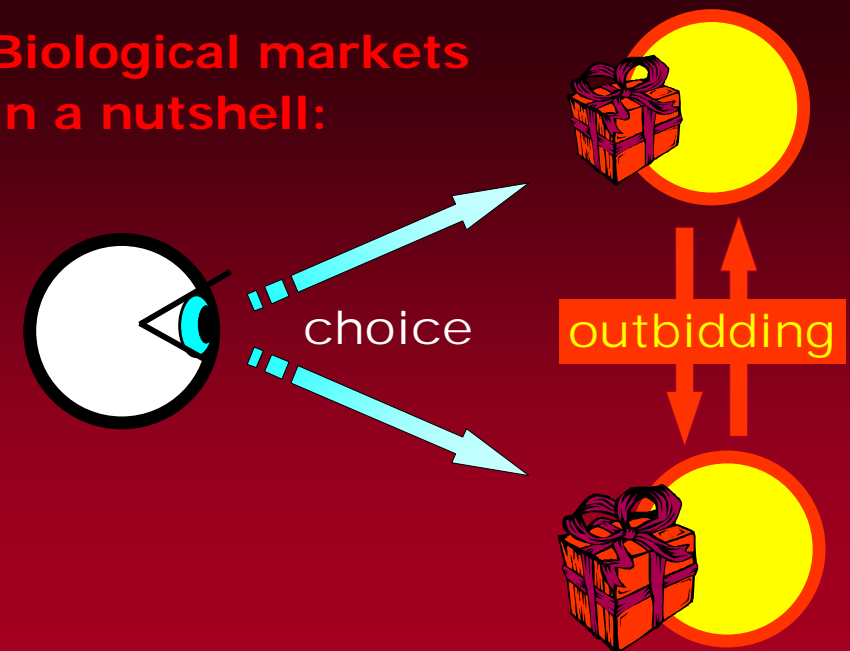
- ▣ partner choice
- ▣ exchange rates of commodities



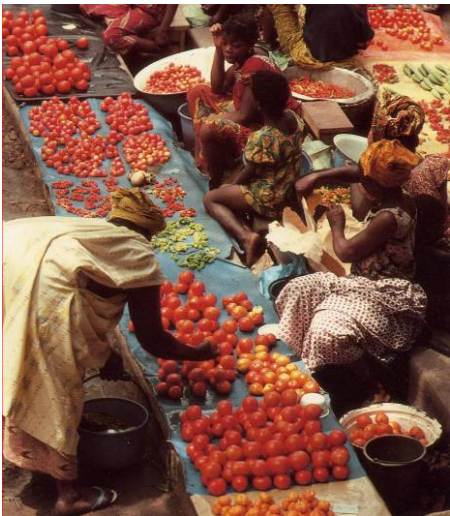
that is ... we test different aspects of the
biological market paradigm

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Biological markets in a nutshell:



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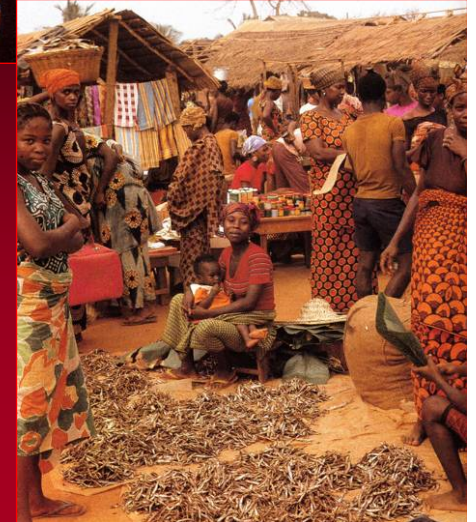
What are biological markets?



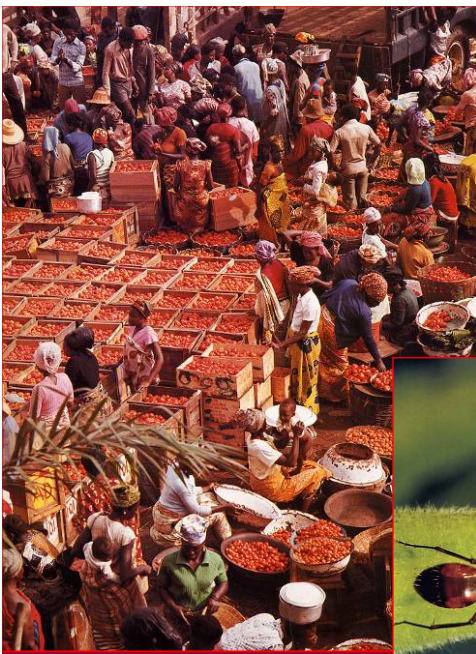
participants exchange goods or services ("commodities")



What are biological markets?



partner choice and outbidding are important mechanisms

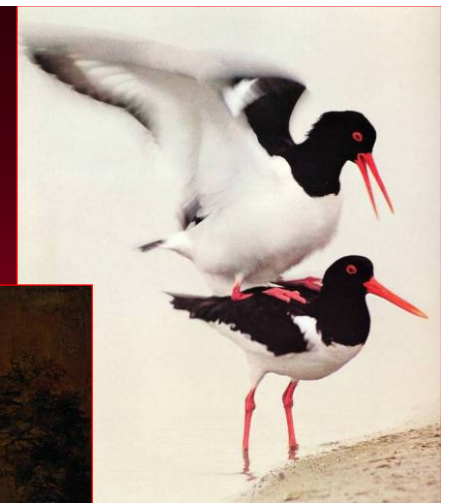


What are biological markets?

supply and demand determine the exchange rate of commodities



Another well-known market ...



mating
markets

ANALOGIES

economic
markets

biological
markets

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Baby markets

A natural market in primates:



sooty mangabey
(Florian Möllers)

access to infants in
exchange for grooming



yellow baboon holding twins

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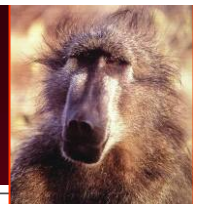
grooming for access to infants



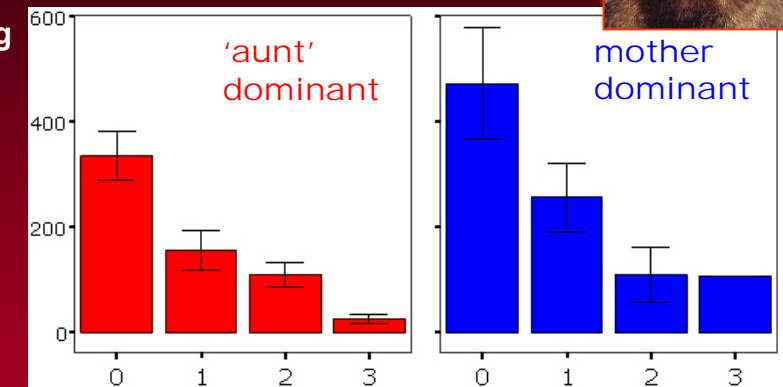
Photos: Peter Henzi

Baby markets • baboons

chacma baboons (South-Africa)



grooming
(sec)

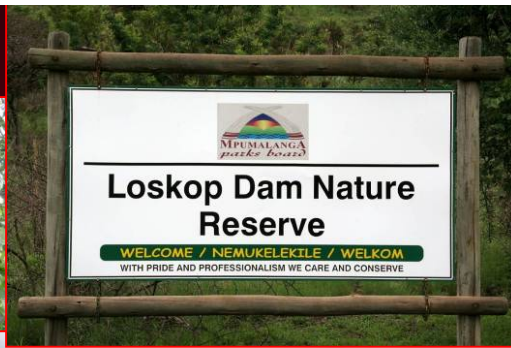


number of *other* babies in the group

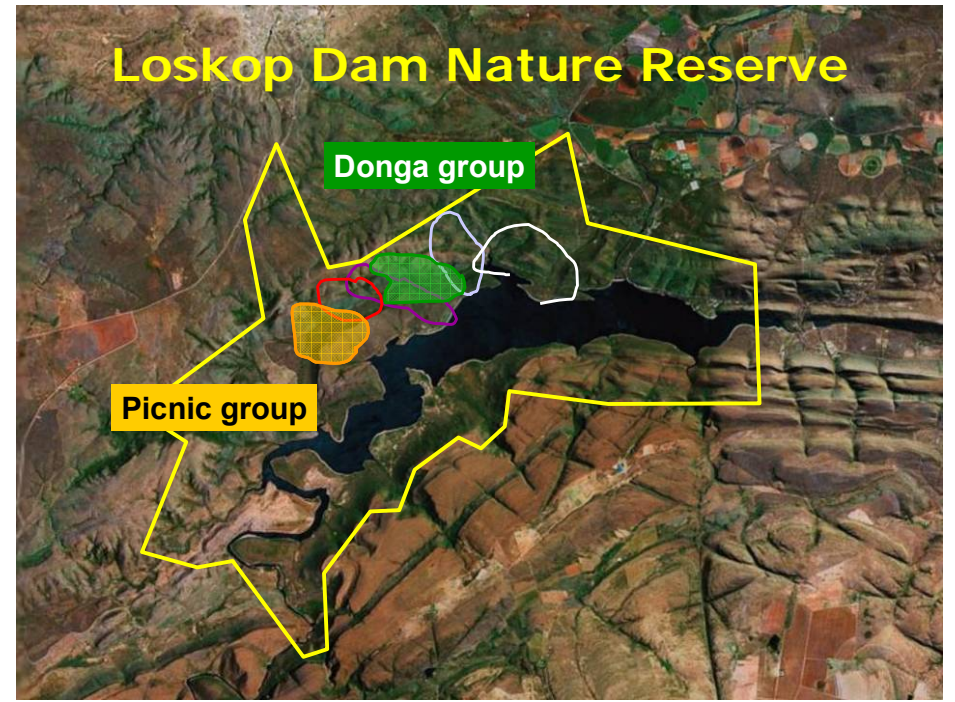
Barrett & Henzi 2006 (Kappeler & van Schaik ed)

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Free-ranging vervet monkeys



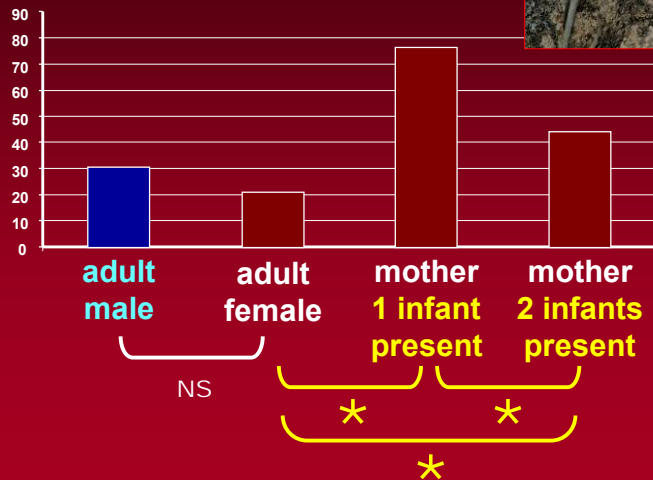
Loskop Dam Nature Reserve



The vervet baby market

data: Cécile Fruteau

mean time
(sec)
of being
groomed



An experimental approach

Phase 1: a single “producer”
(AF) in each group could open
a box with fruit for everyone
(7 apples in 24 pieces)



Cécile Fruteau
CentER for Economic Research
Univ. Tilburg (NL) &
Ethologie des Primates
Strasbourg (F)

An experimental approach



Phase 2: a second “producer” (also AF) could open a second box simultaneously with the first

The same amount of resource as used in phase 1 was divided over both boxes

boxes 2 m apart



Producer experiment – shifts in grooming investments

Preliminary conclusions:

1. After a ‘producer’ has opened a box, this female is groomed considerably more than during the control period
2. There is no significant change between periods for other dyads
3. The ‘value’ of a producer, measured as the amount the producer grooms relative to the amount she receives grooming after opening her box, diminishes considerably when a second producer is added

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Conclusion

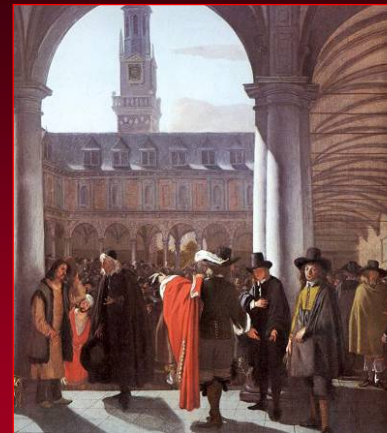
Monkeys trade:



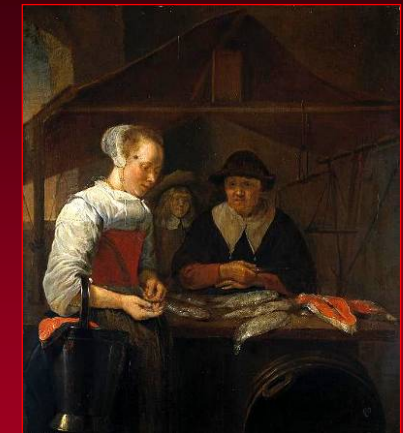
- ▶ they use a ‘currency’ (grooming)
- ▶ they react to changes in supply & demand
- ▶ they shop for the most profitable partner

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.. but do they trade like humans do?



Amsterdam stock market
Emanuel de Witte
1653



fish seller
Quiringh G. van Brekelenkam
1650 - 1670

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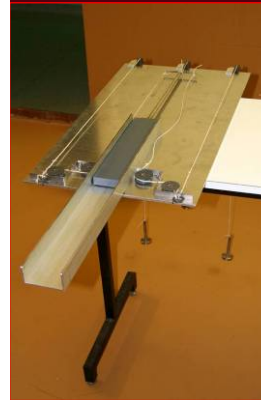
Back to the rooks ..

- ▣ breeds in large colonies
- ▣ common in the Alsace
- ▣ young birds can be easily obtained from the campus colony

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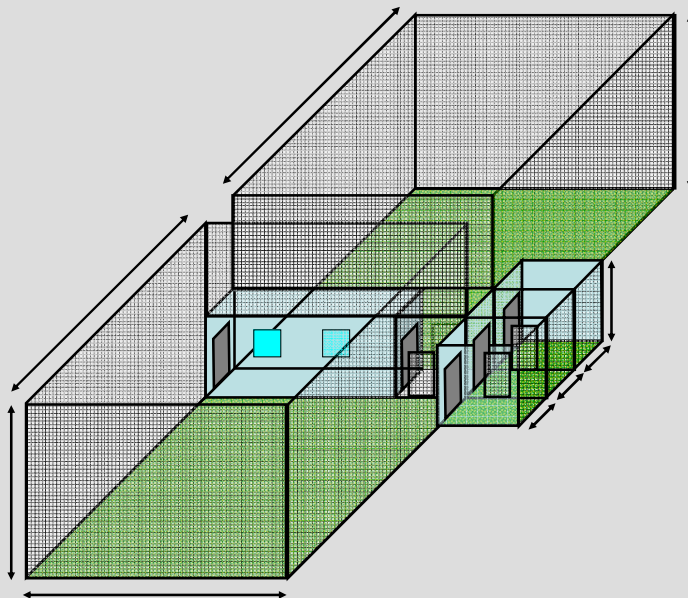
Back to the rooks

DEPE
Strasbourg



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Design aviaries rooks campus Cronenbourg (Strasbourg)



drawing: Thomas Hindelang

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Cooperation in Ravens

Thomas Bugnyar

K. L. Forschungsstelle,
University of Vienna
School of Psychology,
University of St. Andrews



University of St. Andrews



© Schloegl

From Rooks to Ravens

- ▣ Ecologically versatile
 - ▣ Large distribution
 - ▣ Broad diet, but preference for meat
 - ▣ Scavengers
- ▣ Socially flexible
 - ▣ Territorial pairs
 - ▣ Vagrant non-breeder groups



Machiavellian Players

- ▣ Active recruitment of non-kin to monopolized food sources
- ▣ Scrounging
- ▣ Food caching and pilfering of caches

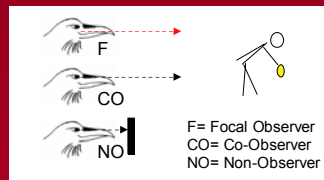
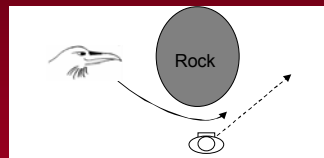
Make use of others as source of knowledge and as means to gain food



Machiavellian Mind

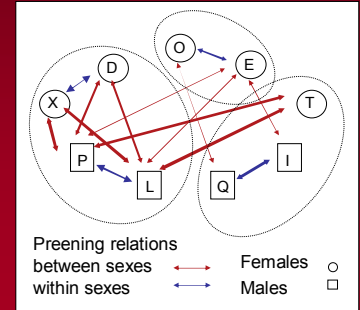
- ▣ Tactical deception by withholding information and misleading
- ▣ Follow other's gaze behind visual barriers
- ▣ Differentiate between 'knowers' and 'guessers'

Sophisticated mental skills to outwit others



Context-specific or General Knowledge?

- Food-caching
 - Storer-pilferer interactions
- Social complexity
 - Captive groups structured by dominance, kinship, friendships
 - Social bonds characterized by mutual preening, play, proximity
 - Support in agonistic interactions (coalitions, alliances)
 - Post-conflict third-party interventions (consolation)



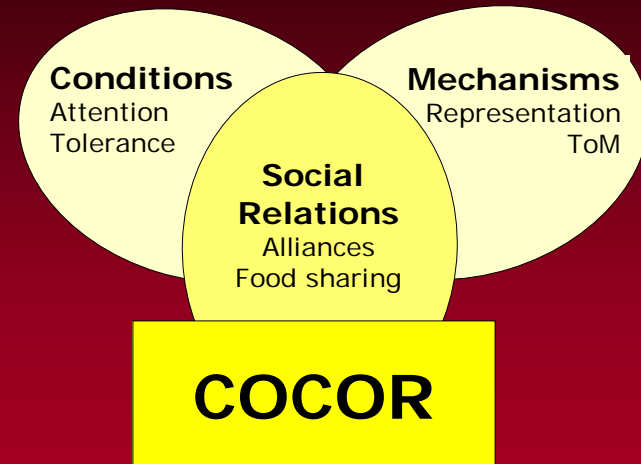
Effects of Valuable Social Relations

- Exploration of novel objects
- Attention to conspecifics
- Social learning
- Food sharing, scrounging
- Profound differences between ravens and jackdaws in use of social relations



Selective Use of Cooperative Skills?

Cooperation in Ravens



Groups Austria and USA



Input from KLF/Austria

- ▣ Analyse coalitions, alliances
- ▣ Manipulate partner's availability and reliability
- ▣ Partner control/choice

Input from UVM/USA

- ▣ Recruitment, tolerance at food
- ▣ Manipulate (sub)group composition
- ▣ Public good

Partner Control and/or Choice?

- ▣ Individuals invest in affiliate relations
- ▣ Affiliated birds support each other in fights
- ▣ System of dependent ranks



If and how ravens maintain alliances when partner prevented from providing support?

Effects across domains?

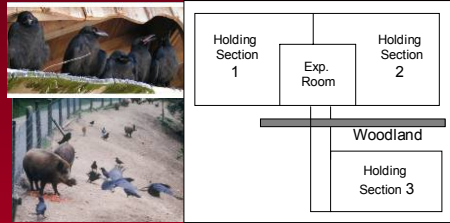


Where, How & With Whom?

- Konrad Lorenz
Forschungsstelle,
University of Vienna



- Captive colony
 - 6 breeding pairs
 - 20 offspring/year



- Habituated wild population

- Collaborations: Kurt Kotrschal, Redouan Bshary (CH)
Ronald Noë (F), Paolo Zucca (I), Vittorio Baglione (E)



Cooperation and cognition in a variable social system



Vittorio Baglione
University of Valladolid
Daniela Canestrari
University of Granada

Cooperative breeding: when more than two individuals contribute to raise the young





Meerkats



Bee-eater

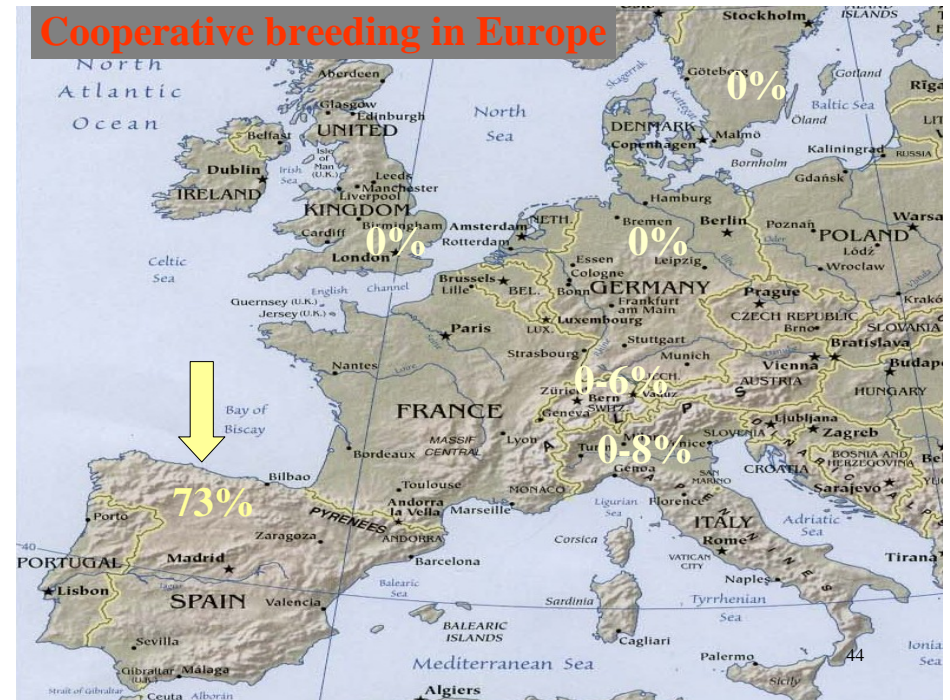


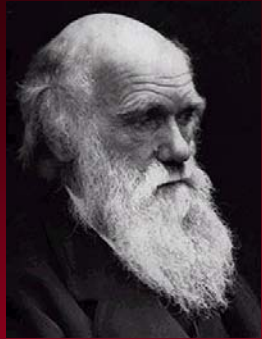
Dunnock

Carrion crow *Corvus corone corone*



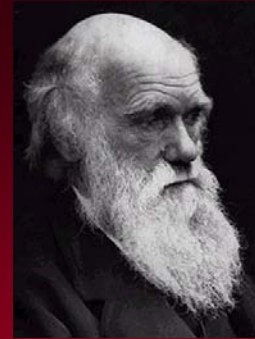
Cooperative breeding in Europe





Evolutionary paradox

Kin selection:
Individuals maximise inclusive fitness by increasing reproductive success of relatives



Key prediction of kin selection:
cooperation arises among kin



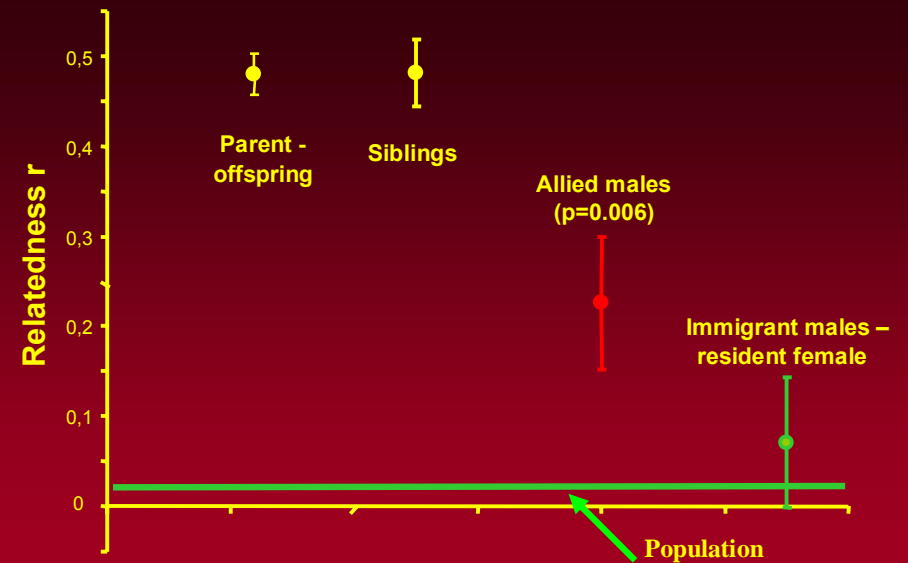
Spain

- Cooperation at the nest in 73% of territories
- Average group size = 3.2
- Up to three helpers at the nest



- Delayed dispersal of offspring
- Immigration (male biased)

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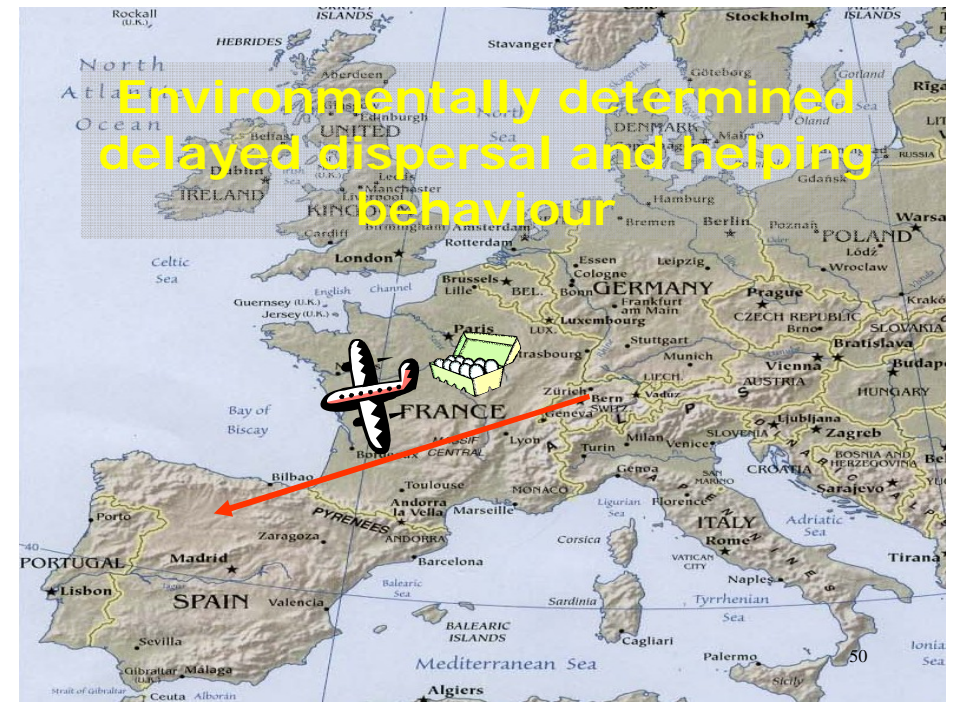
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Cooperative groups are extended families

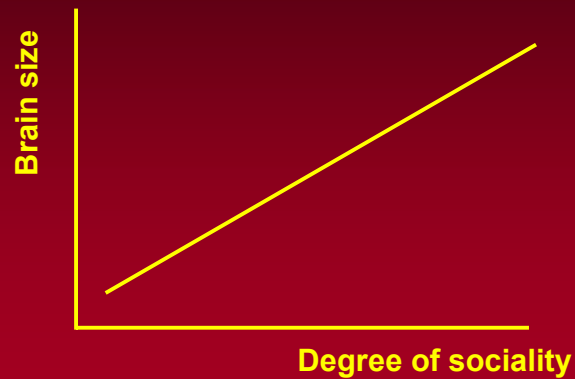
Kin based cooperation in the carrion crow



Environmentally determined delayed dispersal and helping behaviour



Cooperative social organization and cognition



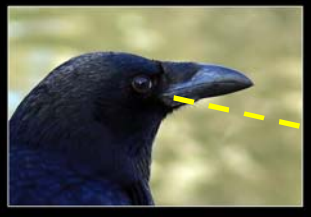
In social species, evolution favours “clever” individuals that, through social manipulation, deception and cooperation can obtain the highest benefits from living in group.



A Machiavellian mind



A "social mind"



Social learning



Spread of knowledge
("social culture")



Innovations

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Hypotheses

- 1) Does family living promotes social learning?
- 2) Are individuals that grew up in a social environment better able to solve problems?
- 3) Are individuals from cooperative populations genetically "smarter"?



Field experiments
Cross-fostering experiments

Aviaries



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Thanks to

Jan Ekman
José Manuel Marcos
Giuseppe Bogliani
Michael Griesser
Rubén Vera
Elisa Chiarati
Guido Andreotti
Gloria Robles



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Modelling cooperation with robots



Laboratory of Autonomous Robotics and
Artificial Life



Institute of Cognitive Sciences and Technologies

National Research Council, Italy

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Modelling cooperation with robots

Emergence and evolution of cooperation in teams of autonomous robots

- social feeding behaviours
- collective hunting behaviours

The role of functional lateralization in social behaviour

- several avian species have a dominance of the **right hemisphere** for social recognition (Vallortigara & Rogers, 2005)
- functional specialization of neural modules

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Modelling cooperation with robots

Emergence and evolution of cooperation in teams of autonomous robots

Robots are new kind of animals

The role of functional lateralization in social behaviour

Robots are models of existing animals

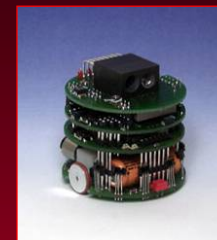
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Modelling cooperation with robots



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The Robots



Khepera



Khepera II



E-puck



Small Blimp

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Evolutionary robotics

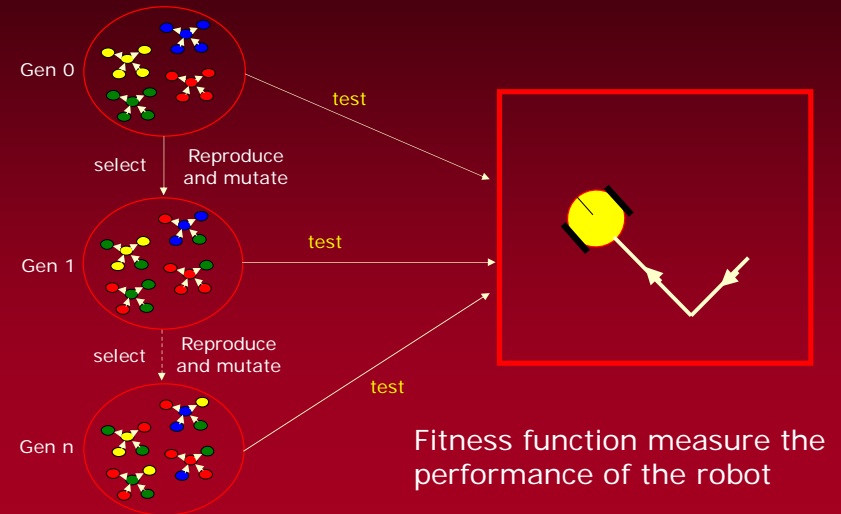
Evolutionary Robotics is a technique for the automatic creation of autonomous robots

It is inspired on the Darwinian principle of selective reproduction of the fittest

Robots develop their own skills in close interaction with the environment without human intervention

Neural Networks Genetic Algorithm

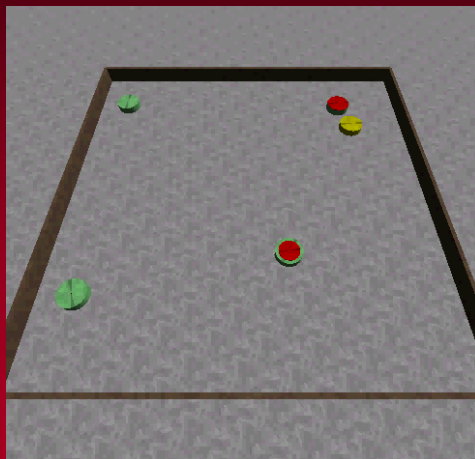
Evolutionary robotics



Emergence of cooperation

Cooperation in hunting

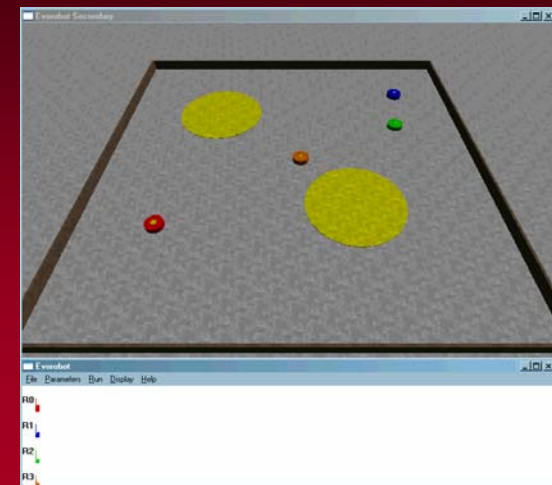
ECAgents
EU Project



Emergence of cooperation

Cooperation in navigation

ECAgents
EU Project



Emergence of cooperation

Cooperation in navigation



Thanks to Vito Trianni

Swarm-bot
EU Project