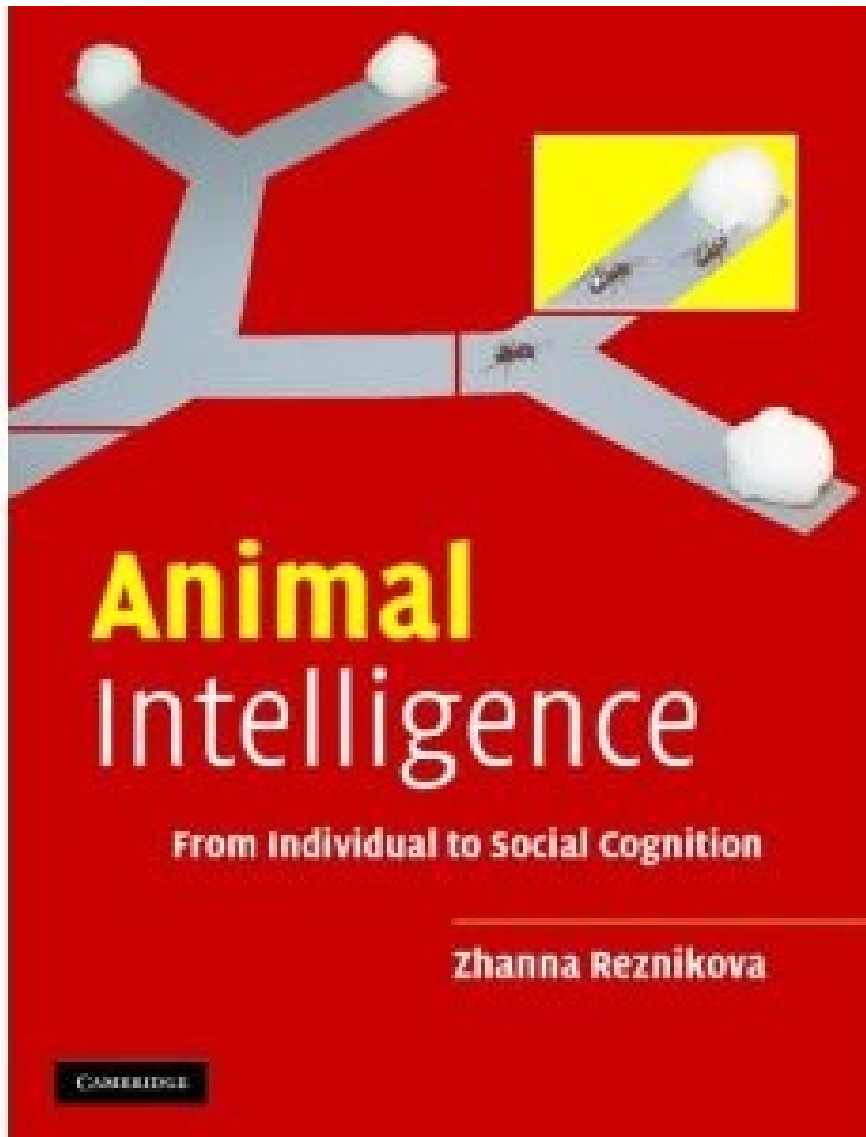


# **ANIMAL SOCIAL COGNITION**

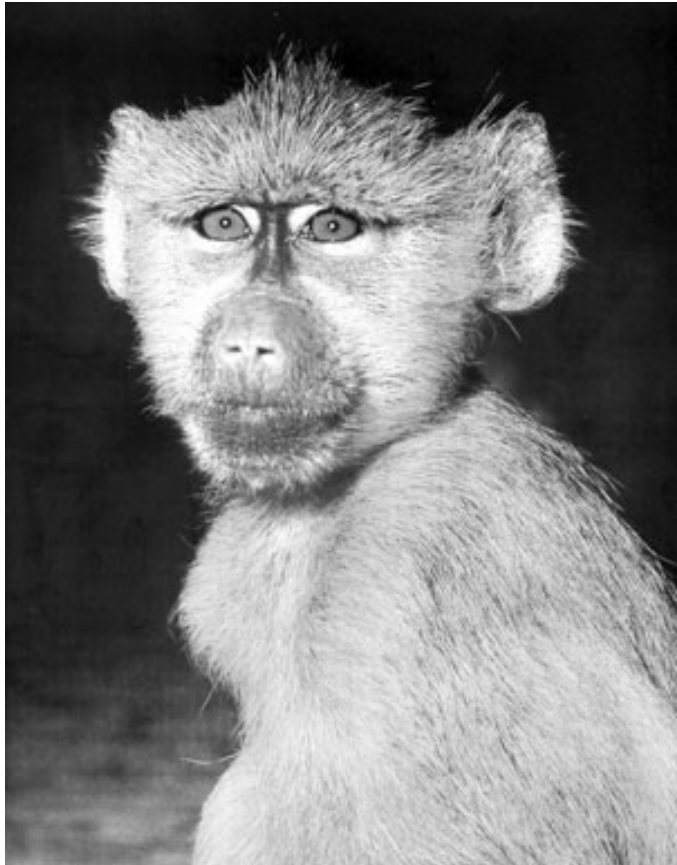
**Zhanna Reznikova**

**Institute of Systematics and Ecology of  
Animals, Novosibirsk**



**Animal social cognition is the study of how animals process and store social information and apply the gained experience to novel social situations.**

One of the highest manifestations of social cognition is **Machiavellian intelligence**: **the ability to manipulate with conspecifics as with “live tools”** (R. Byrne, A. Whiten, D. Maestriperi, and others)



**“Theory of mind”** : the ability to “read” other minds, that is, to attribute mental states to oneself and others

**“Theory of mind” requires sophisticated cognitive skills. However, these skills are restricted by characteristics of ecological niches and species-specific social relations**



**Examples.**

**“Can't trust anybody!”**

**I. “Theory of mind” in caching animals.**

**Deceptive caching in squirrels: they cover over empty cache sites, or alternatively move a few meters away from a cached acorn and perform covering behavior (Steele M. et al., *Animal Behaviour*, 2007).**



**Deceptive cashing can be interpreted in terms of cognition but it also might be analogous to a “broken wing” display in birds which is governed by a non-cognitive inherited program.**

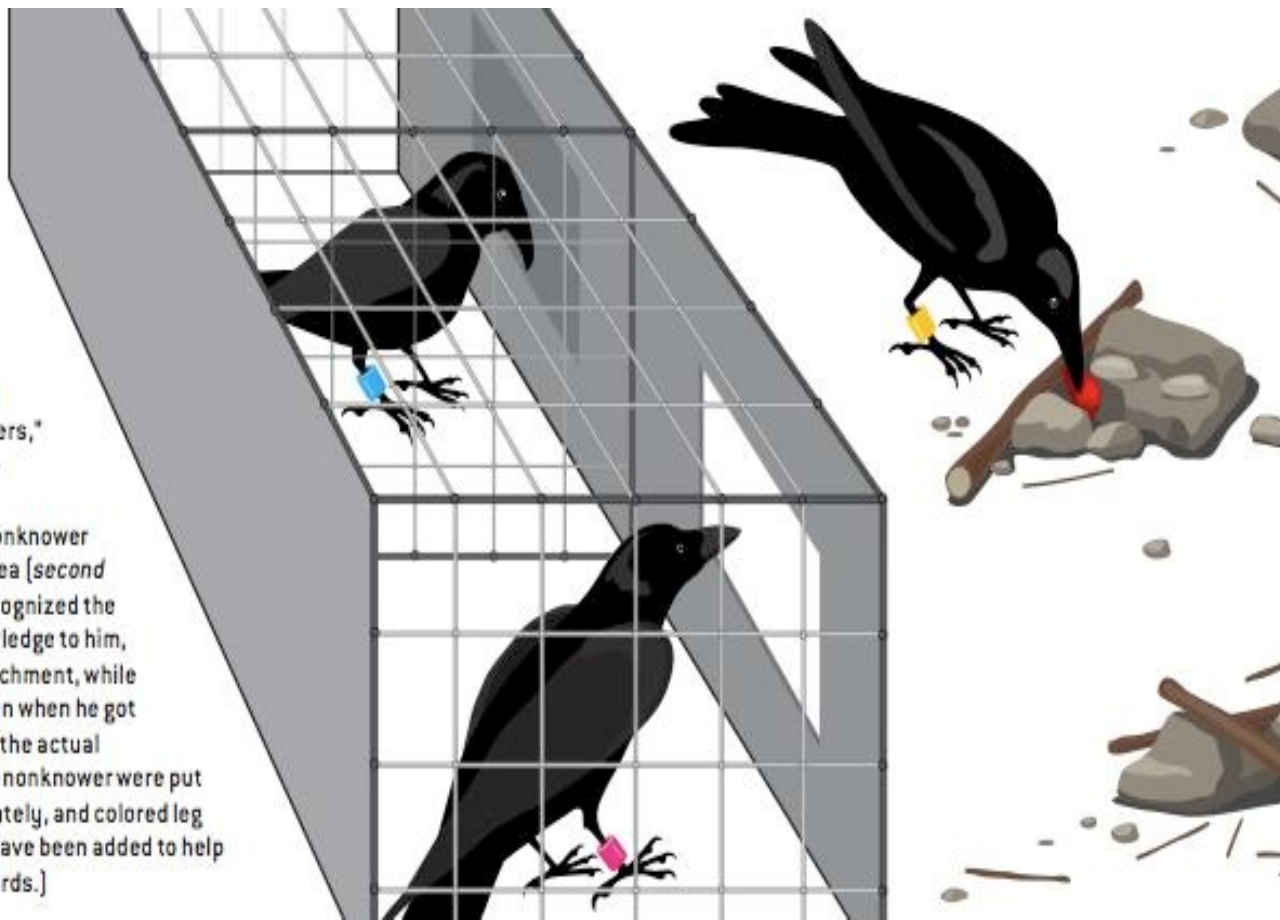
**In Corvids deceptive caching possibly includes elements of Theory of mind;**

**However, these cognitively demanding behaviours are likely to be a “top of an iceberg” basing on inherited programs.**

# Corvids display elements of “Theory of mind” (Emery N. & Clayton N., 2001, Nature; Heinrich, B. & Bugnyar, T.,2007, Scientific American).

AN ABILITY TO DISTINGUISH among individuals was demonstrated in an experiment involving the hiding of food. The authors created “knower” birds (such as the one at bottom in the first frame), who could observe the location of a cache made by another bird, and “nonknowers,” who could not see the cache location.

When the knower and nonknower were put into the caching area (second frame), the cache maker recognized the knower and attributed knowledge to him, guarding against his encroachment, while ignoring the nonknower, even when he got close to the hidden food. (In the actual experiment, the knower and nonknower were put into the caching area separately, and colored leg bands were not used; they have been added to help the reader distinguish the birds.)



**A caching bird was able to identify which bird had observed it making its caches and was able to discriminate between it and a "non-knower" bird; a knower birds did not go to the caches when the caching birds were nearby.**

# It takes a thief to know a thief. Cache protection at recovery when observers have left the scene

(Clayton, Emery, Dickinson, 2006)



## Conditions at Recovery



Cacher recovers from both trays in front of Observer A



Cacher recovers from both trays in front of Observer B



Cacher recovers from both trays in front of a naïve individual



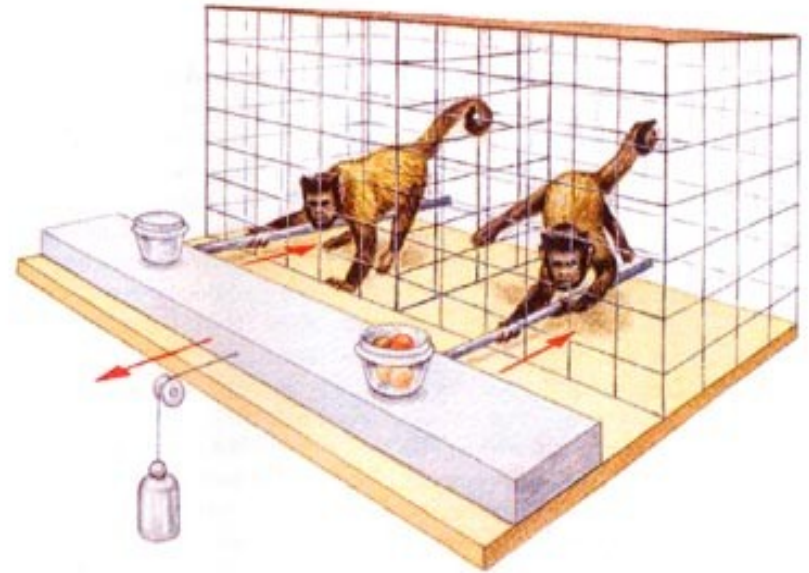
Cacher recovers from both trays in private

scrub jays use their own experience of having been a thief to predict the behavior of a pilferer. Whereas experienced thieves engaged in high levels of re-caching at recovery when they were observed during the previous caching episode, control birds, who had not been thieves in the past and therefore had no prior experience of stealing other birds' caches, showed hardly any re-caching at all

**Misleading behaviour can be attributed, at least partially, to the following phenomenon known in behavioural ecology : the frequency of re-caching depends on the frequency of encounters with conspecifics.**

**So, re-caching may be based on the behavioural tactic common to pilfering species rather than on their capacities to “read” other minds.**

## II. Cooperation in solving problems: species-specific limitations in understanding of partner's value



**Rooks (Seed AM, Clayton NS, Emery NJ 2008) and capuchin monkeys (Chalmeau, Visalberghi, Gallo, A., 1997; deWaal, 2005) succeed in the cooperative task with a limited understanding of the requirement of the task and without taking into account the partner's role.**

**In a separate experiment one rook was presented with an out-of-reach tray, and the second rook had to scabble through a hatch before getting into a position where it could pull on the string.**

**However, the first rook pulled its own end of string instead of waiting for its partner to arrive.**

**Similar studies have shown that chimps would wait for their partner before acting.**

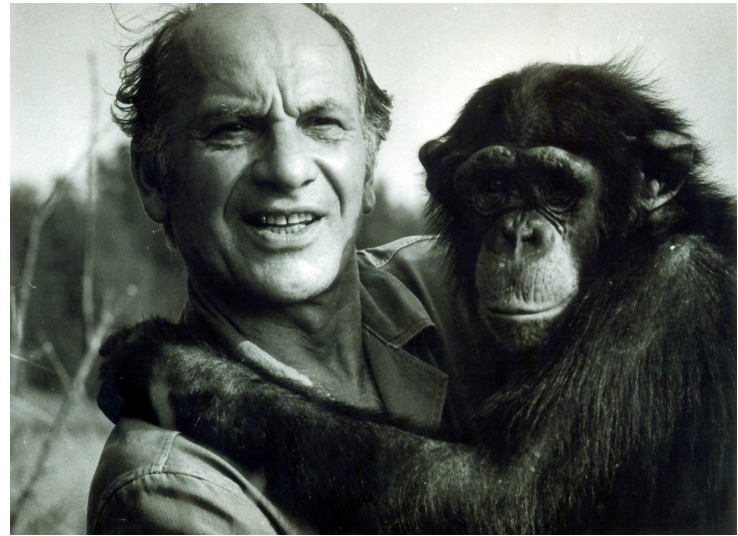
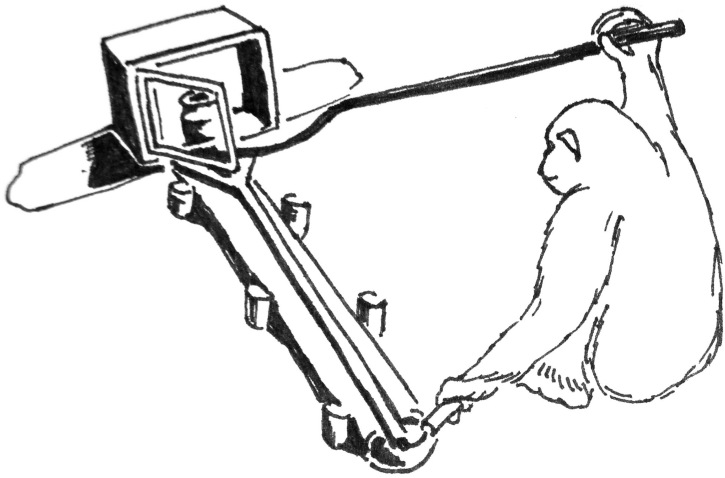
**So, they have cognitive resources to understand the value of partnership; however, they rarely apply this understanding.**



**Observations in the wild and captivity have reported evidence of cooperation in chimpanzees, such as food sharing, grooming, coalition formation, consolation and cooperative hunting. However, in general, they are not “other-regarding”.**

**S. Yamamoto, T. Humle, M. Tanaka; PloS One 2009. Chimpanzee help each other upon request .**

**Are chimpanzees really good partners?**



**In experiments of Leonid Firsov (70-th) semi-free chimpanzees (housed on an island in a lake) displayed cooperative behaviour being presented with problems that were difficult to solve by a single ape. However, their relations balanced between cooperation and parasitism, that is “exploitation” of a subordinate individual by a dominated one.**

**In fact, many of the cooperative interactions among chimps take place to outwit others.**

**Look, who champion the cooperative task!**

## **Cooperatively hunting carnivores are more hard-wired for social cooperation than chimpanzees**



**Pairs of spotted hyena that needed to tug two ropes in unison to earn a food reward cooperated successfully with no training (C. M. Drea, A.N. Carter; *Animal Behaviour*, 2009). Hyenas self-adjust their behaviour based upon social context.**

**When a naïve animal unfamiliar with the feeding platforms was paired with a dominant, experienced animal, the dominant animals switched social roles and submissively followed the lower-ranking, naïve animal. Once the naïve animal became experienced, they switched back.**

**It is likely that processing social information, even being based on sophisticated cognitive skills, is strongly limited by specific ecological traits.**

**Let us consider important aspects of social cognition which are based on automatic processes in populations :**

- (1) Cognitive specialization and altruistic behaviour: knowledge is power but...not for all.**
- (2) “ Distributed cognition”:** born carriers of complex behaviours can serve as catalists for spreading these patterns within groups; in many cases this is an alternative way to explain culture in animal societies

**We will see that *preparedness* is the basic part of the “iceberg” which is named “animal social cognition”**

## (1) COGNITIVE SPECIALIZATION AND ALTRUISTIC BEHAVIOUR

In contemporary evolutionary biology, an organism is said to behave altruistically when its behaviour benefits other organisms, at a cost to itself. The costs and benefits are measured in terms of reproductive fitness, or expected number of offspring.

So by behaving altruistically, an individual reduces the number of offspring it is likely to produce itself, but increases the number that other individuals are likely to produce.



**Eusociality can be considered an extreme form of altruism in animal communities**

## Kin – altruism; Hamilton, 1964



**“drumming rabbits” as a folk model: By warning its relatives of an approaching predator, the rabbit draws attention to itself and risks its life.**

## Reciprocal altruism; Trivers, 1971



**vampire bats share blood with non-kins basing on partner fidelity (Wilkinson, 1984, Nature)**

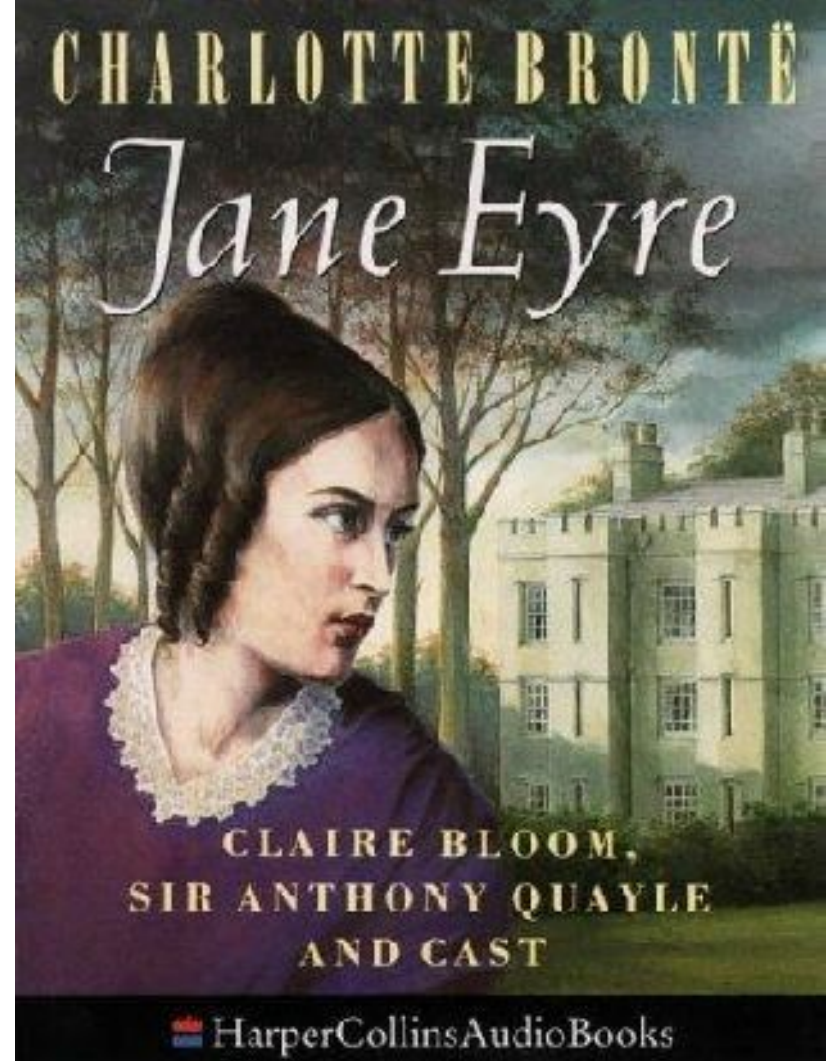
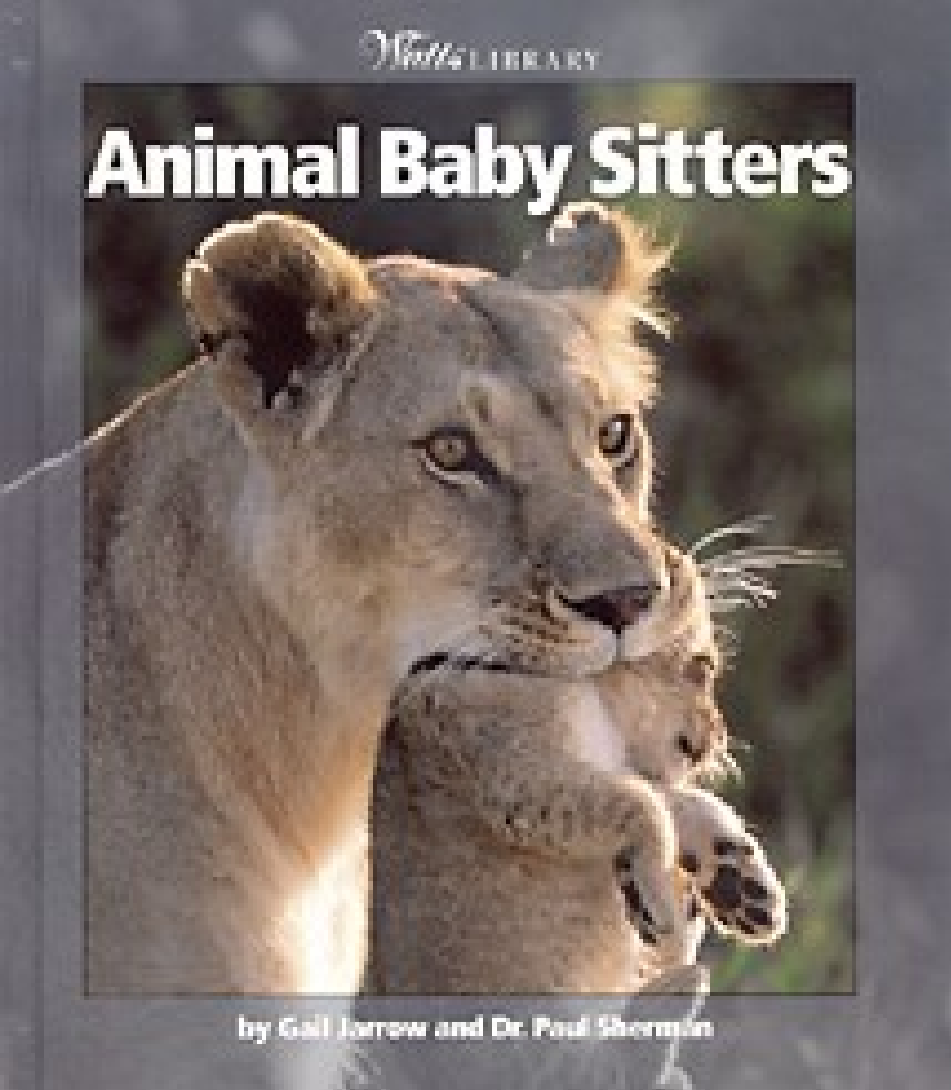


**‘Kin altruism’ is based on animals’ ability to recognise relatives and to adjust their behaviour on the basis of kinship; reciprocal altruism requires certain cognitive prerequisites.**

**In primates reciprocal altruism relies on sophisticated cognitive abilities that make current behaviour contingent upon a history of interaction and calculation of mutual rewards and punishments (deWaal, 2000).**

**Both kin- and non-kin-altruism in animal societies are based on the division of roles and thus on great individual variability which includes **behavioural, cognitive and social specialization****

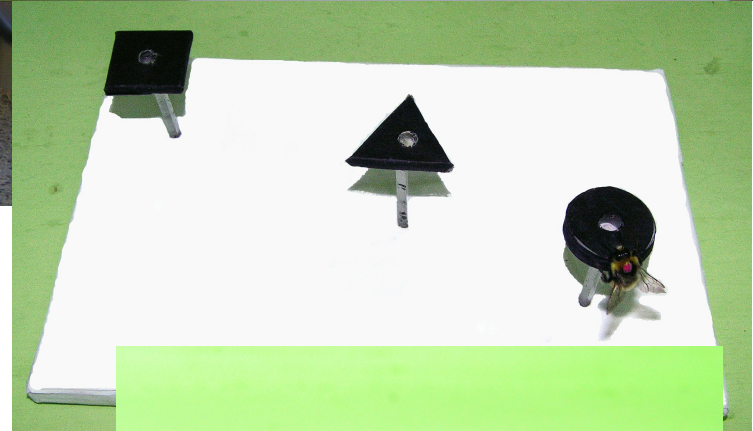
**Let us consider these three components of division of roles.**



**Social specialization**: if one must be sacrificed, why me?  
Subordinate members of cooperatively breeding communities sacrifice their energy and possibly cognitive skills to dominating individuals serving as helpers or even as sterile workers.



**Social specialization:**  
**Patriotic duties**  
**usually come into**  
**conflict with**  
**intellectual**  
**meditation**



## **Behavioural specialisation**

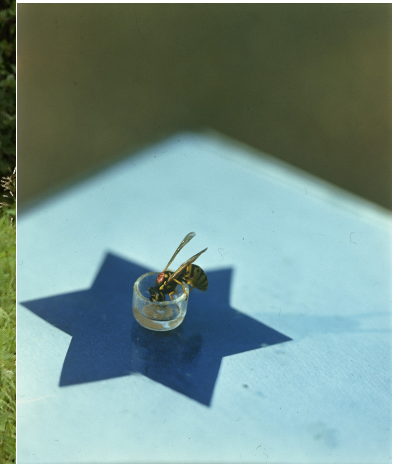
**(an example from our lab):  
Naive bumblebees display  
inherited preference for artificial  
flowers of different shape and  
size.**



**Cognitive specialization** is based on the ability of some individuals to learn faster within specific domains, that is. to form associations between some stimuli easier than between other stimuli and thus learn more readily certain behaviours.

The presence of ‘cognitive specialists’ facilitates tuning of integrative reactions of a whole animal community to unpredictable influences in its changeable environment.

**Let us consider several examples of cognitive specialization.**



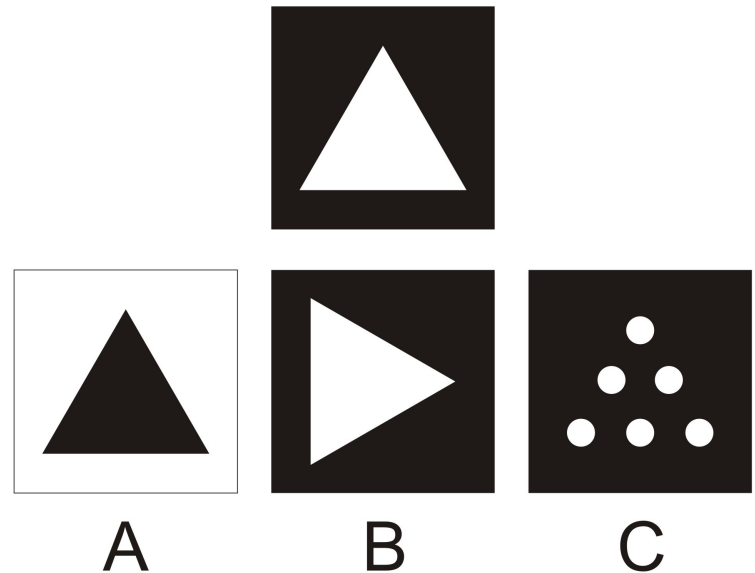
## Cognitive specialization

**Mazokhin-Porshnyakov's lab in Moscow:  
abstraction and categorization in honey bees  
and wasps**

# KNOWLEDGE IS POWER?...NOT FOR ALL



all members of the hive successfully learn simple problems of discrimination. Tasks that require concept formation are solved by a few “gifted” bees only.





**In highly social group-retrieving ant species (such as red wood ants) not all members of a colony can cope with maze problems. Instead, there are “top ten” individuals (less than 10%), which successfully navigate mazes (see: Reznikova, 1982, Behaviour).**

**In cooperatively breeding meerkats there is a high variation between helpers in provisioning rates. Helpers bring scorpions to babies. Meerkats exhibit teaching of prey-handling skills and social learning of the use of new landmarks, so individual variability in learning capacities of helpers influence the prosperity of a group (Clutton-Brock, 2002; Thornton and Malapert, 2009).**



In some situations **behavioural, social, and cognitive specialisation can be congruent.**

Perhaps in such situations individuals are lucky to be in harmony with their mentality and environment.

May be this is **the formula of happiness.**



## 2) Distributed cognition”: an alternative way to explain the phenomenon of culture in animal societies

(the second aspect of social cognition which is possibly based on automatic processes in populations)

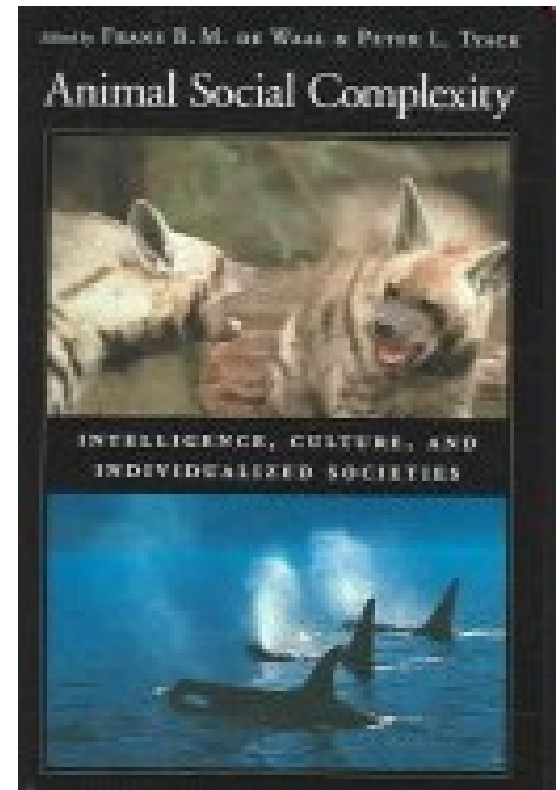
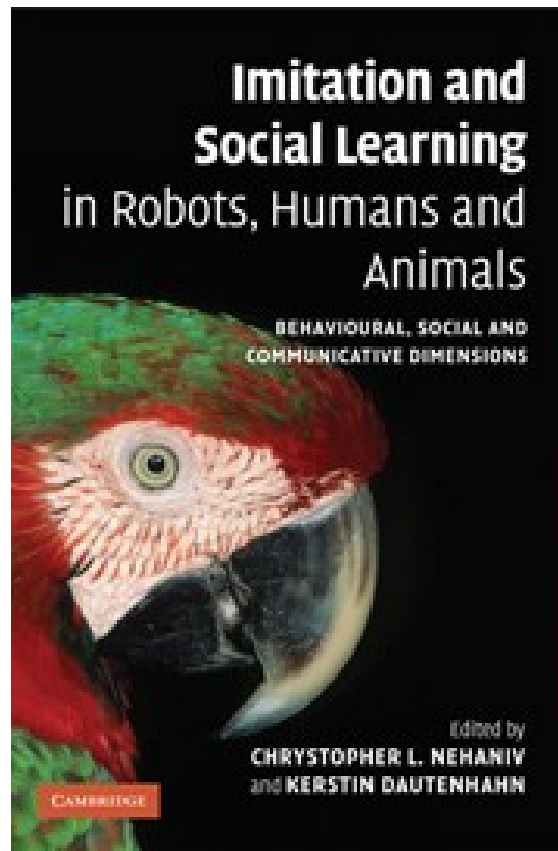
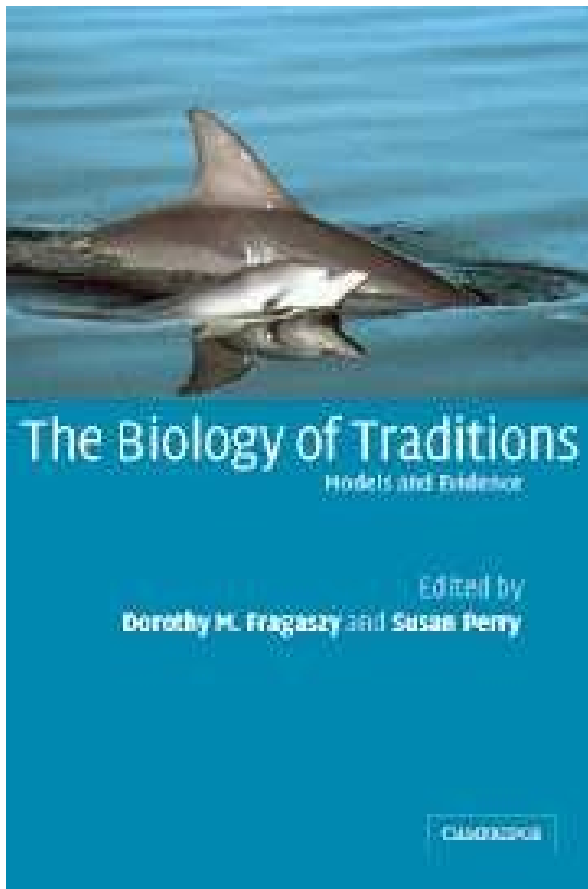


**The ant says to its nestmates: Chimps have culture?! Nonsense! We build domes, and they still sit naked in the rain!**



**A classic example of “animal culture”: “potato washing” by Japanese macaques**

**Social learning is one of the main mechanisms of “cultural transmission” of behavioural patterns in animal communities.**



**There are many excellent results concerning animal culture, traditions, and abilities of members of many species to gain experience by social learning.**



**However, in many cases animals simply “do not want” to learn from their peers.**

**There are many examples demonstrating that members of highly social and intelligent species badly teach and poorly learn (may be this is the reason why they are still sitting naked in the rain).**

**-What is it like to be an innovator?**

**-Is it like to be a “cognitive specialist”?**

**-How behavioural and cognitive flexibility interacts with inherited propensities of community members ?**



**Let us consider examples (some from many) where alternative explanations of “culture” are possible.**



**(1) That this custom died with its carriers could be explained by that it was not supported by the inherited predisposition in this troop**

**As J. Goodall notes, of the many innovative behaviours observed, only a few will be passed to other individuals, and seldom will they spread through the whole troop.**

**For example, Goodall (1986) observed two instances of the use of stones by adolescent chimpanzees to kill dangerous insects.**

**She supposed that this usage of stones would become customary in that reference group.**

**But this had not happened in the following 30 years, and the innovation faded away.**



**(2)**

**In “sponging dolphins” only females learn from their mothers how**

**to use a sponge as a tool.**

**Why only females?**

**The authors suggest that males simply do not want to learn, and they have many interesting things to do above sponging.**

**They also suggest that “ In terms of evolutionary pressures, selection to learn socially or to develop foraging skills may be stronger for females than for males because food resources generally limit female reproduction in this species”  
(Krützen et al., 2005; Sargeant et al., 2005).**

**But...(I think) that it is also possible that there are sex-linked genes here.**

**It might be that preparedness is often the most significant factor of spreading habits in the wild, even against the background of social learning.**

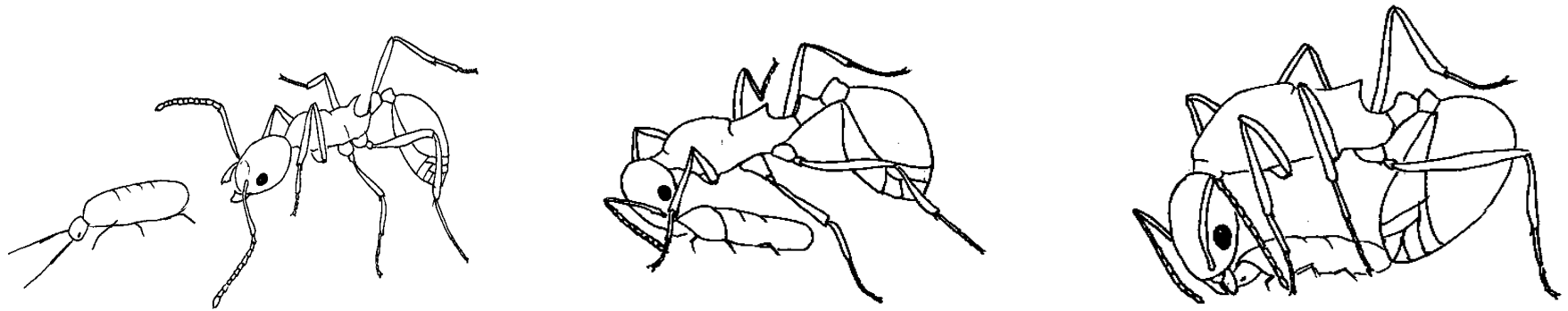
**Studying ants' hunting behaviour, we found a relatively simple and universal way of propagation of new behaviours within populations that we call “triggering of dormant incomplete behavioural patterns” (Reznikova & Panteleeva, 2008, Acta Ethologica).**

**It could be adaptive for members of different species to have dormant “sketches” of complex behavioural patterns being implemented on several carriers and then distributed by means of social learning.**

**“triggering of dormant incomplete behavioural patterns”  
is based on “distributed social learning”**

**We call this “distributed” because we assume that fragments  
of useful behavioural programs are distributed among  
members of a population and remain cryptic until appropriate  
changes in the environment occur**

ng behavioural pattern in *Myrmica rubra*: **tip-and- run attack**



**In naïve laboratory reared ants only about **7%** of a  
colony display “at once and entirely” hunting stereotype  
(see “Ant communication and cognition” lecture)**

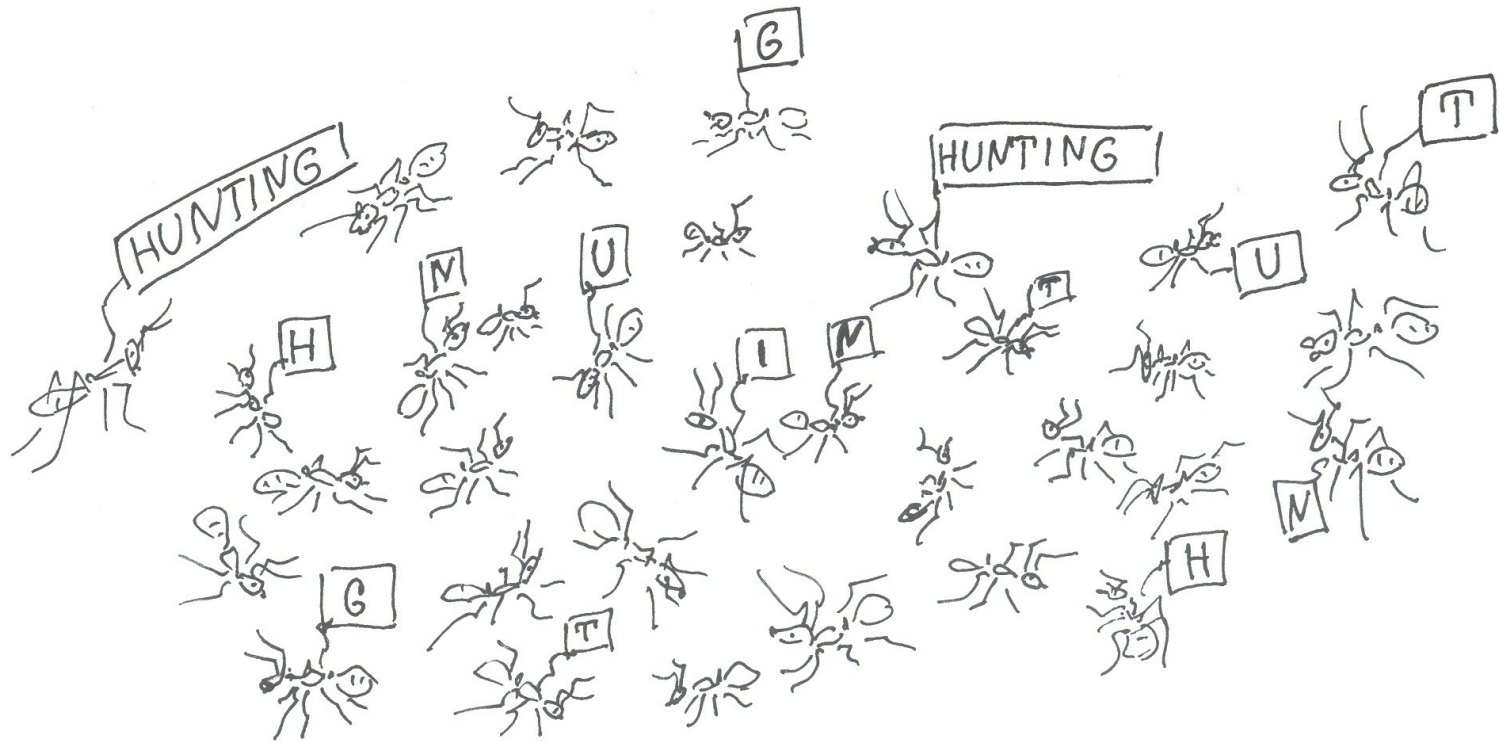


**A “born hunter” catches a jumping springtail from the first encounter**



**This individual (of the same age) has to learn**

# “dormant incomplete behavioural patterns”



- Carriers of whole patterns to be spread serve as catalysts of social
- learning. Triggering of dormant behavioural patterns can be based on
- a cumulative effect and then tuned by individual experience
- of observers.

## Supportive examples



**(1) Tool use in New Caledonian Crows has been considered a phenomenon of cultural tradition. However, one from four hand-reared chicks of this species displayed "at once and entirely" tool-use behaviour (Kenward et al., 2005; Bluff et al., 2007).**

**It is possible that this luckily found chick belongs to the same club of carriers of "at once and entirely" behavioural patterns as our ants - springtail hunters, and propagation of these behaviours in populations is based on very simple forms of social learning such as social facilitation**

**(social facilitation is an increase in the frequency of a behavioural pattern in the presence of others displaying the same behavioural pattern at the same time).**

William McGrew

# The Cultured Chimpanzee

Reflections  
on Cultural  
Primateology



CAMBRIDGE

**(2) “Grooming hand-clasp” has been considered one of classic examples of cultural traditions. DeWaal and Seres (1997) found the grooming hand-clasp developed spontaneously in a captive group of chimpanzees. In the beginning, hand-clasps were initiated by one adult female. Over the years the posture spread to the majority of adults and to a few young individuals. The authors suggest that learning is the most likely mechanism here.**

**And I assume that if there is a carrier of a specific behavioural pattern within a social group, then performance of such a pattern can trigger dormant behavioural patterns in some members of the group by means of social facilitation.**

**Indeed, it could be rather costly for animal brains to be equipped with complex stereotypes for all possible vital situations.**

**Propagation of complex stereotypes, new for certain populations, can be based on simple forms of social learning (social facilitation) which underlies species' predisposition to learn certain behaviours and does not require feats of intelligence from animals.**

**In the absence of such predisposition in "pupils", new behaviours can die with the death of "tutors".**

**The alternative for the animals is to be intelligent enough to quickly grasp and spread innovations. It might be that this option is implemented in some populations of primates and dolphins but it also might be that we meet a combination of innovative and preconditioned behaviour.**

**We can suggest that preparedness is the best teacher for animals, at least, for some of them.**

**Even such sophisticated phenomena as social cognition and cognitive specialization can be based on automatic processes in populations.**



**The laboratory of Community Ethology, Inst. of Systematics and Ecology of Animals, Siberian Branch RAS, Novosibirsk.  
The study was supported by the Russian Fund for Basic Research.**