TECT Conference
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InTeLect Project

/ COOP project (submitted)

Project leader : Jean Gayon, Philosopher, Université Paris / Sorbonne / IHPST

Presentation*: Philippe Huneman, Full time researcher*

Philosophy of science, ***Institut d'Histoire et de Philosophie des Sciences et des Techniques***

(CNRS / Université Paris I Sorbonne)

InTeLect: Information transfer and levels of cooperation: testing analogies and models

People and teams

- Philosophy

Raimo Tuomela, Univ. Helsinski

Jean Gayon, Paris I Sorbonne IHPST

Philippe Huneman, IHPST

Marie Claude Lorne, IHPST

Gabriel Sandu, IHPST

IHPST – fields of expertise: history & philosophy of biology, logical modelling.

Daniel Andler, Paris 4

Paul Humphreys, University of Virginia, Frédéric Bouchard, Université de Montreal, Robert Brandon, Duke University

- Computer Science

Jean-Paul Delahaye, Lifl, CNRS, Lille

- Anthropology and psychology

Dan Sperber, IJN, Paris;

Simon Reader, Utrecht Un. , NL

- Evolutionary Biology

Finn Kjellberg, CNRS, Montpellier;

Regis Ferriere, Minus Van Baalen, Silvia di Monte, Eco-Evolution mathématique, Paris 6

Dan Mc Shea, Duke University

François Taddei, Inserm, Paris

James Bull, Sam Brown, Univ. Of Austin, texas.

- Human biology and genetics

Evelyne Heyer, Renaud Vitalis, Paris, Museum;

Michel Raymond, Charlotte Faurie, CNRS, Montpellier;

Other related partners : Mark Bedau, artifical ife, Venice; Miichale Chapuisat, evo bio, Lausanne.

Main themes

- *Levels of cooperation* : is a *general* study of cooperation possible (“from microbes to men”), what are the main concepts and their scopes, what is the ontology required ? (Levels and modes)
- *Testing models and analogies* : epistemological issues raised by the import models from different fields (interactions biology – economy at first place) : economical notions of cost, division of labour, etc: what is their status ?

- *Information transfer* : most of the cooperation studies have involved transfer of matter/energy, so that the "cooperator" gives up what he exchanges - the cost is the exchanged matter; whereas transfer of information entails that I keep the information I am sharing: how to apply the cost/benefit model ? Essential because information transfer is crucial for humans (learning, etc.), but also pervasive at all levels (bacteries exchanging genes)

->Refining the field of information-based cooperation studies

Specificity of the project

- The field of cooperation studies exponentially increased since the 70s; several fields (economy, evolutionary biology, microbiology sociology, psychology etc.) are involved, but no common language or set of concepts exist
- -> need for a **philosophical assessment of cooperation studies**: Philosophy of science, ethics, philosophy of action

- Evolutionary concepts (kin selection, reciprocal altruism, PD modeling) brought the promise of understanding why and how we humans cooperate: yet singularities do subsist, like large scale cooperation, clustering, prosocial behaviour in one-shot anonymous interaction, etc.

- Questioning the bases of a general theory of cooperation -> A framework for developing new models **to understand human cooperation and test its specificity.**
- Therefore information transfer, as a systematic extension of the cooperation studies, is a transversal dimension of the project.

Philosophy of science

IP 1 – "History and typology of cooperation studies"

Pr. *Jean Gayon, Philosopher of science,*

Dr. Philippe Huneman,

Dr. Marie Claude Lorne (IHPST (CNRS/ Université Paris I Sorbonne),

Pr. Finn Kjellberg (Centre d'écologie fonctionnelle et évolutive, CNRS, Montpellier).

-Understanding the *genealogy*, *foundations* and *limits* of current paradigms

- Determining whether the pervasiveness of cooperation concepts reflects a natural state of affairs, or is merely a useful methodological device.

Philosophy of science

IP 1 – "History and typology of cooperation studies"

a. study the different **levels of cooperation** = the hierarchy of entities and processes

b. **modes of cooperation** = is it possible to uncover very general rules or constraints, trans-level pattern, applying to cooperative phenomena at any level (*e.g.* Hamilton's rule or Iterated Prisoner's Dilemma)?

Several criteria:

Sufficiency of the concept of cost to define modes of cooperation, mutualism, coordination, etc – especially, how to handle the case of information transfer

Equal or unequal partners in cooperation

Dyadic vs n-adic interactions

Small scale vs large scale cooperation

Topology and time-structure of interactions

Philosophy of science 2

Universal Principles of Biological Cooperatives

IP 3 –. Robert Brandon, Philosophy, Duke University;

Dan Mc Shea, Evolutionary biology, Duke

- What are the common features of all or most higher-level cooperatives, whenever they arise? What are the necessary correlates, if any, of their emergence?

Philosophy of science 2

Universal Principles of Biological Cooperatives

- Testing properties likely to be correlated to cooperatives, and their relations across phyla: level of connectedness, division of labor, intermediate structures (non-existing as former levels of selection, unlike cells or organisms)
- Correlate those properties with degree of individuality / autonomy of “cooperatives”
- Enquiry related to the investigation on major evolutionary transitions (Maynard-Smith, Szathmary 1995, Michod 1999)

Sample of correlations between candidate properties of correlates : connectedness, divison of labour

Connectedness	Division of labor (Y/N)
Unrestricted connection (shared body cavity)	
Bryozoa:Phylactolaemata	**N**
Restricted connection in 1 dimension (1D) only	
Cnidaria:Scleractinia	**N**
Bryozoa:Lichenoporidae	**N**
Restricted connection in 2D (connection via tubes)	
Cnidaria:Leptomedusae	**Y**
Cnidaria:Milliporina	**Y**
Cnidaria:Siphonophora	**Y**
Cnidaria:Gorgonacea	**N**
Cnidaria:Pennatulacea	**Y**
Bryozoa:Crisiidae	**Y**
Bryozoa:Diastoporidae	**Y**
Urochordata:Phlebobranchia	**N**
Restricted connection in 3D (closed tubes, with controlled flow)	
Bryozoa:Ctenostomata	**Y**
Bryozoa:Cheilostomata	**Y**
Urochordata:Doliolida	**Y**
Total restriction (no connection)	
Cnidaria:Actiniaria	**N**
Urochordata:Aplousobranchia	**N**
Urochordata:Stolidobranchia	**N**
Urochordata:Pyrosomatida	**N**

Correlated research : symbiosis and levels of selection

- AP. 2 Frédéric Bouchard (Philosophy of science, Université de Montreal)

Symbiosis as requiring new perspective on fitness and the units of selection;

What are the causally relevant individuals in symbiosis ?

Extending the cooperation studies

-> Models capable of dealing with information transfer

- IP 4. Pr. James Bull, Dr. Sam Brown (Section of Integrative Biology, University of Texas at Austin, Austin TX, USA), with coop. of Pr. François Taddei (Inserm, Hopital Necker, Paris):
  Microbiological studies on durable public goods.

- Idea : do not equate "public goods" with frequency of cooperators, but study public goods which have their *own temporal dynamics*
- Methodology : experiments on microbes/ Public goods = secreted substances like siderophore, bacteriocin, etc.
- *In humans too, such public goods dynamics are pervasive - especially, **information** and knowledge; like information transfer, the joint dynamics of public goods and cooperators is a trans-level pattern*

- Classic approaches to spatially-extended cooperative games: focus on the role of aggregation in cooperators
- Here : focus equally on the role of aggregation in public goods; track the degree of concordance between cooperators and aggregates of public goods

-> What conditions would favour aggregations (‘cities’) of public goods? How resistant are these ‘cities’ against invasion by defectors?

Ethics and Philosophy of action

Questions on the specificity of human cooperation

IP. 2. Pr. Raimo Tuomela, Department of Social and Moral Philosophy, University of Helsinki, Finland; collaborators, incl. Pr. Gabriel Sandu (IHPST)

Tuomela wrote the only monograph on cooperation in philosophy, on logical and ethical viewpoint (*Cooperation: A Philosophical Study*, *Philosophical Studies Series,* Kluwer Academic Publishers, Dordrecht and Boston, 2000).
Sandu is a logician (theory of games, theory of models, etc.)

Continuation : new project submitted to Finland's national agency: « *Cooperation and its evolution* ».

Ethics and Philosophy of action
Questions on the specificity of human cooperation

- I-mode : think of the outcome of the group action as a way to achieve one's aim
- We-mode : think of one's interests as part of interest of the group

- Human cooperation requires both I-mode and We-mode
- By contrast most of evolutionary theorizing, e.g. use of Prisoner's Dilemma model, relies on I-mode

-> a. gap between biological studies and sociological/theory of action studies of cooperation; fill this gap;

b. theorize the rationality proper to we-mode action

Specificity of Human cooperation, 1

- 1. IP 4. Simon Reader, Psychology, Utrecht University

“Cultural Transmission as Cooperation”

Experiments with adult human participants to investigate (1) cultural transmission as cooperation, (2) the efficacy and stability of cooperative versus non-cooperative information transfer, (3) the factors promoting cooperative information transfer, and (4) the social transmission of cooperative norms and tendencies.

Hypothesis : The conditions that favour cooperation may favour active instruction, while within-group competition may favour passive information transfer or even active hindrance of information transfer by knowledgeable individuals.

Specificity of Human cooperation, 2

- AP 1: Paul Humphreys (Philosophy, Charlottesville, University of Virginia):

Cooperation and Coordination Between Constrained Agents

- First, how induced coordination emerges between agents and the extent to which this induced coordination achieves results that are similar to deliberate cooperation. Secondly, to identify which mixture of search strategies in a population results in maximal population level benefits as measured by a number of different criteria such as mean population fitness, total gain, Gini coefficient, and net present value.

Specificity of Human cooperation, 2

- Former results : populations using search procedures such as `identify the set of all available options that improve your current fitness level and then select one of those at random' can achieve higher mean population fitness values than populations of agents searching according to the rule that simply chooses from the available options the one with highest fitness.

- Method : using agent-based models on fitness landscapes in order to evolve the most reliable/efficient rules

From Intelect To COOP (subm. French ANR)

“Biological and philosophical perspectives on human cooperation”

Re-focusing on the interplay between philosophy and biology; re-emphasize the issues raised by human cooperation

From Intelect To COOP

A. *Philosophical framework for cooperation studies* (Gayon, Huneman, Lorne, Daniel Andler (Paris 4/IHPST))

B. *Mathematical modeling of new general features of cooperation : coevolution of social networking and cooperation* (Pr. Régis Ferrière, Pr. Minus Van Baalen, Dr. Silvia di Monte (Eco-evolution mathématique, ENS Paris 5, Paris)Pr. J.P. Delahaye (Computer Science, Lifl, Lille)

-> C. *New tools for addressing the specificity of human cooperation* (Pr. Dan Sperber, IJN, paris; Pr. Evelyne Heyer, Museum, Paris)

C. *New tools for evaluating the specificity of human cooperation*

- 1. Cognitive bases of cooperation : *mutualism through* ***metarepresentation*** *vs cooperative perspective* (Dan Sperber, Institut Jean Nicod, CNRS, Paris)
- 2. Behavioural bases of human cooperation : ***Punishment*** *and Cooperation in Human Groups* (Evelyne Heyer, Jean-Baptiste André and Renaud Vitalis, Muséum national d'histoire naturelle, laboratoire de génétique des populations humaines, CNRS, Paris; Charlotte Faurie) :
- 3. **Familial ecology** (Michel Raymond, Human evolutionary biology, CNRS, Montpellier; with Charlotte Faurie) : does birth order influence cooperative dispositions ? What are the hormonal predispositions for prosocial behaviours ?

A. A philosophical framework to assess the possibility of a general study of cooperation

(partnership with Mc Shea- Brandon, Duke):

a. Levels and modes of cooperation;

b. History of cooperation studies : from symbiosis botany and non-darwinian approaches to evolutionary theory of games and current neo-darwinian approaches

B. Mathematical modeling of coevolution between cooperation and social networking (Ferrière, Van Baalen, Di Monte, Delahaye)

Presumably cooperative interactions are conditioned by the network of relations between individuals; but this network is also molded by the individual choices and their cooperative / uncooperative decisions. Thus *: How do network structures and the cooperative actions they might support evolve together?*

(Delahaye Research project, LIFL : Modeling small world topologies and the enhancement of cooperation)

B. Mathematical modeling of co-evolution between cooperation and social networking

- In previous studies that acknowledged the importance of network structures (van Baalen and Rand, 1998, Le Gaillard et al., 2003, Le Gaillard et al., 2005, Liberman et al., 2005, Nowak, 2006) the set of cooperation behavioral options is fixed and small (typically, the population assumes a mixture of 'cooperators' and 'defectors' engaged in a simple game), and the networking rule is given a priori.

B. Mathematical modeling of co-evolution between cooperation and social networking

Instead of assuming that individuals respond in an all-or-nothing manner to an a priori set of cues, we will let the population evolve by random variation and selection in a high-dimensional space of possible cues and possible response rules (McNamara and Gasson, 2001). More precisely, cues will include information about current and past interactions, and responses will be expressed in terms of cooperative and networking ‘efforts’.

B. Mathematical modeling of co-evolution between cooperation and social networking

- *Ultimate goal* : identifying the patterns of cooperation and social networking that are expected to have evolved gradually in human communities, under the sole action of biological processes of heritable variation and selection.

-> The project assesses the extent to which more realistic assumptions in evolutionary models can account for the specificities of human cooperation.

C. 2. Behavioural bases.Punishment and Cooperation in Human Groups

(Heyer, Vitalis, André, Faurie)

- *Hypothesis :* punishment is not altruistic and may actually be indirectly beneficial to the punisher, thanks to better group performances.
- *Test*: consider the effects of punishment on the behavior of individuals involved into a collective action, and measure the associated long-term gain that the punishers may incur.
- *Prediction:* the **gain lies in the perception of punishment as a threat in future interactions**
- *Principle of the experiment: measuring the Effects of Punishment in the Public Good Game*

C. 2. Behavioural bases. Punishment and Cooperation in Human Groups

- *Associated experiment* : levels of hormones and cooperation:

High levels of testosterone are associated with dominance and aggressive behaviours (Dabbs et al. 1988; Gladue et al. 1989; Mazur and Booth 1998), whereas high levels of cortisol are involved in the response to stress (Flinn and England, 1997, Wagner et al., 2002).

Changes in the blood concentrations of these two hormones may be involved in the behavioural changes occurring under the threat of punishment.

(C. Faurie)

C. 1. The cognitive bases of human cooperation

(Sperber, IJN, Paris)

- ***Hypothesis* : A cognitively grounded mutualistic alternative to group-selectionist approaches**
- *Research:* Investigate the role that the specifically human ability to construct and use complex higher-order representations (or "meta-representations") plays in the development of moral norms and institutions.
- Shared intentionality seems to be uniquely human (Tomasello et al., 2005). Great apes never perform actions coordinated by shared intentionality unlike human infants (e.g. building a block tower with an adult)

C. 1. The cognitive bases of human cooperation

- Evolutionary approaches : cases where collective and individual interests are conflicting.
- But collective actions require, to begin with, the *ability to share intentions*

-> investigate in which ways the high cognitive ability to meta-represent plays a central role in collective action

C. 1. The cognitive bases of human cooperation

- Current theories of group selection (e g Gintis, 2000) predict a human tendency to altruism that does not depend on higher cognitive abilities.
- Alternative hypothesis : human cooperation is based on a moral sense of *justice* that *does depend* on such higher abilities.
- *Experiments*: test the hypothesis that humans' moral intuitions are driven by a sense of fairness or justice – through moral dilemmas and cross cultural comparisons.
- Hence mutualism (coordinated action through shared intentions based on meta-representational abilities) and not evolutionary altruism would be the specific basis of human cooperation.