IV BORDEAUX-SAN SEBASTIAN WORKSHOP ON PHILOSOPHY OF BIOLOGY, MEDICINE, AND COGNITIVE SCIENCE

Abstracts

Non-Human Primates Models in Cognitive and Behavioral Neuroscience: Issues for Neuroeconomics

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Neuroeconomics is torn between its behavioral economic and neuroscientific (esp. neurophysiology) historical and disciplinary roots. If many aspects of neuroeconomics have been discussed by philosophers (notably, the usefulness of neuroeconomics regarding the assessment of economic theories) and by philosophers of science (Craver and Alexandrova 2008), one issue seems not having attracted much attention: the use of non-human primates models (esp. Macaques and Capuchin Monkey). This use is quite common in the field of cognitive and behavioral neuroscience and is a well-known constraint on neuroscientific practice. However, when these models are used to probe the presence and categorization of some non-human primates cognitive and behavioral patterns under a common label of (human) economic behavior, there are strong possibilities that the model imposes a veil between the target behavior and the theoretical results. I'll argue that this sets some theoretical constraints on the understanding of such abilities as probabilistic reasoning, optimal or biased decision-making, strategic interactions, Pareto-optimal cooperation, exchanges, trade, token-uses, etc. These theoretical constraints need to be clearly identified if one wants really to draw economic conclusions from cognitive and behavioral studies on non-human primates.

Revising the superorganism: A multilevel organizational approach to complex eusociality

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Eusociality has been at the centre of many debates in philosophy and biology for decades. It is characterized by colonial groups and broadly defined as: colonies consisting of overlapping generations (more than one), cooperative brood care, and a reproductive division of labour where sterile (or less reproductive) workers help the reproductive members. More complex colonies — those with large colony sizes, polymorphism, and complex communication and interaction networks — have also long been at the centre of debates over multilevel selection, biological individuality, major transitions, etc. There is increasing evidence that complex eusocial colonies are qualitatively different to simple ones. For example, it has been shown that (as predicted by metabolic scaling theory for unitary organisms) the increase to a larger colony size (and therefore mass) causes lower mass-specific energy use in complex eusocial colonies. Moreover, polymorphism and the loss of worker reproductive potential is associated with large colonies only. However, current diachronic and synchronic explanatory approaches to complex eusocial colonies are insufficient. Current evolutionary (diachronic) explanatory approaches are based on the notion of the superorganism concept. Today this concept denotes a group as an evolutionary individual, if intergroup selection is greater than intra-group selection. However, this notion of the superorganism concept is not fine-grained enough and does not explain the actual organization within colonies and their differences. This makes it unclear whether the concept actually picks out anything special from the vast array of biological systems found in nature. Other evolutionary explanations, such as kin selection, do not take into account the higher-level organization within colonies.

Due to this, more synchronic explanatory approaches have been developed in order to provide more fine-grained explanations of complex eusociality. The mainstream explanation of is the self-organization approach. In this approach, colony level phenomena are explained as emerging from the distributed interactions of the insects within the colony. But there is little focus on whether self-organization occurs in the whole organization of the colony or just sub-sets. The self-organization approach does not focus on the complex hierarchical (or multilevel) organization within complex eusocial colonies.

In this paper I propose a novel synchronic explanatory approach to complex eusocial colonies, the multilevel organizational approach, derived from the Autonomous Perspective (IAS Research group). Using the example of the honey bee (*Apis mellifera*) and others, I aim to show that complex eusocial colonies exhibit self-maintaining hierarchical organizations that are more than just the result of the emergent self-organization of the insects within the colony. And moreover, that this higher-level organization is in "control" of the colony, i.e. the higher-level organization constrains the lower-level "parts". Therefore, I show that the self-organization approach, or indeed the evolutionary approaches, cannot provide full explanations of complex eusocial colonies.

The dialectics of embodiment and the enactive conception of life

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Among dynamical and nondualistic approaches in cognitive science, the enactive perspective offers research in embodied cognition an alternative to functionalism. It does so by theorizing the individuation of organic, sensorimotor, and social bodies in their material precariousness. In this talk, I discuss the concepts of autonomy, agency, and sense-making as they emerge from a dialectical analysis of the notion of autopoiesis. Each of the requirements of self-production and self-distinction in this notion—requirements that an organism must satisfy simultaneously to stay alive—are shown to involve potentialities and tendencies that contradict each other. The dialectical overcoming of these tensions is the passage toward a more concrete concept of self-individuation as an open, unfinished operation that extends over time. This is the enactive concept of agency. The implication of this naturalization of the mind is that concrete, material self-individuation is always-already, from the simplest life-forms to human bodies in all their dimensions, the self-individuation of agents that enact a world, a world that brings forth communities of agents.

Internal(ized) biological barriers, between possible speculative safeguards and epistemic obstacles

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Organisms are bounded, yet boundaries do not simply mark the edges of their spatial extension across which selective exchange with the environment occurs. Boundaries in biology are thus functional entities necessary for an organism to maintain its existence. In addition to the interfacing boundaries between the organism and the world, there are also internal "barriers" that separate organelles from the cytoplasm and organs from systemic circulation (e.g., the blood-brain barrier) or enclose internalized "environments" or cavities (e.g., the gastrointestinal barrier). However, while theories of boundaries have addressed the roles of external envelopes in maintaining the internal conditions of the organism, little theoretical work has been done on the implications of internal barriers for the whole organism qua barriers. The presence of specialized internal barriers in multicellular organisms raises the following question: what are they and what kind of role do they play in the organization of the multicellular organism?

The term "barrier" may seem to indicate that no molecules can cross the epithelial or endothelial cells constituting them. An internal barrier, seen this way, is merely a concrete structure that marks when one specific part ends and another begins. It is, however, clear to the workers in the field that they should be considered selective barriers or borders through which nutrients can be taken up and across which peptides may signal, but that prevent passive crossing of water-soluble molecules and microorganisms. It is thus clear to those specialized life scientists that these interfaces are essential for the biological function of the tissue or organ they are studying, yet they rarely address the implications of them for the whole organism. We propose that these internal epithelial or endothelial barriers create several internal milieus and allow, for example, efficient signaling between neurons in the nervous system.

Recently, however, other life scientists have made claims connecting the gut microbiome and brain function that pertain to the overall mental health of the organism without fully taking into account in the possible constraints of biological barriers. Here, we propose to address different ways in which the so-called gut-brain axis can be decomposed and recomposed taking into account at least two biological barriers namely the gut and blood-brain barrier. We will focus on these cases and argue that the part-whole relation in these systems do not fit traditional accounts of part-whole relations in organisms.

Developmental mechanism of a major evolutionary transition in ants

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Major transitions in evolution occur through integration of independently replicating units into a single, higher-level, replicating unit. Despite the importance of major transitions for understanding increases in biological complexity, the evolutionary developmental steps towards integration remain unknown. Here we use gene expression, RNAi, antibiotic treatment, and comparative phylogenetic analysis to reconstruct five evolutionary developmental steps underlying the major transition to obligate endosymbiosis between the hyperdiverse genus Camponotus (carpenter ants) and the bacteria Blochmannia – Camponotus ensures vertical transmission through its germplasm while Blochmannia provides nutrition and immunity. This integration evolved through two successive rounds of duplication and divergence of a single ancestral germplasm, giving rise to three germplasms with a functional division of labor between them. Blochmannia induced these duplication and divergence events through its pre-adaptive relationship with the Hox genes Ultrabithorax and Abdominal-A, while Camponotus underwent radical alterations in its early development. We predict that the general pathway to major evolutionary transitions, including to multicelluarity and eusociality, occurs by environmentally-induced duplication and divergence of pre-existing traits, allowing each duplicate to take on novel functions and divide labor.

From integrated individuals to multi-species communities - identifying the spectrum of holobiont interactions and why it matters.

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In the last few decades, biologists and philosophers of biology have worked towards finding biological criteria for the individuation of biological entities, as opposed to earlier approaches based on the "phenomenal individuation" of organisms using categories derived from more familiar things, such as vertebrate animals and large plants. This has resulted in some of the most active debates within philosophy of biology, and these debates have intensified given recent confirmation of the ubiquity of holobionts across all multicellular life. All macroscopic animals, plants and fungi can be redescribed as holobionts—defined as an organismal host and all its associated microbiota. Holobionts are an interesting case study for individuality because most of them share features with organisms, communities, and ecosystems. The interactions between holobiont partners span the continuum between converged individuals, functionally integrated wholes, and ecological relations. I will explore some of the details of holobiont biology and use them to interrogate a range of alternative conceptions of

biological individuality. I will argue that multiple conceptions of individuality are needed to make sense of holobiont behavior and evolution. I will conclude by suggesting how we should understand the problem of individuality more generally, given the ubiquity of holobionts, and the fact that they are the default state of macroorganismal life.