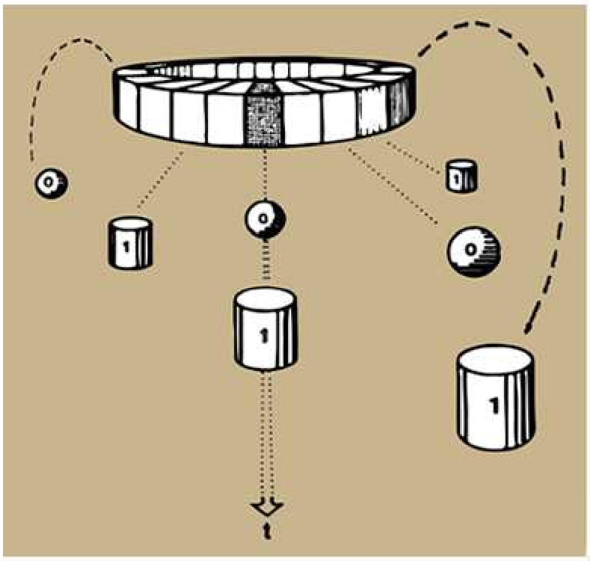

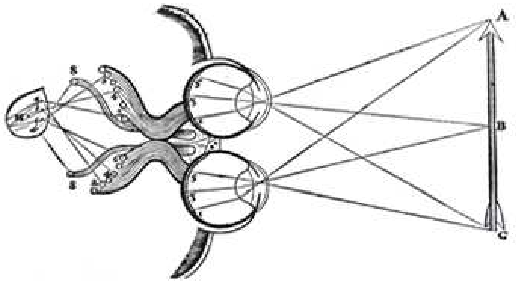

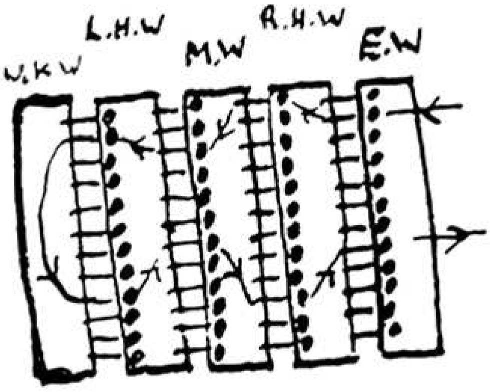

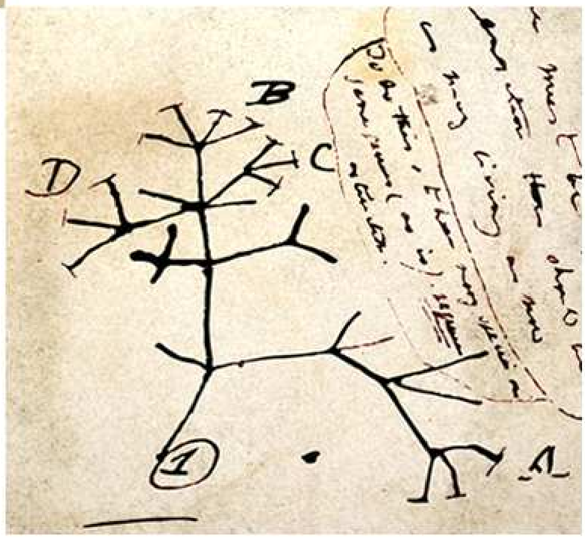

II Workshop ReteCog
INTERACTION

University of Zaragoza
17 - 18 January 2013

ABSTRACT BOOKLET

Invited Speakers

Plenary Talks

Evolution and Analysis of Brain-Body-Environment Systems

Randall D. Beer
Cognitive Science Program, Informatics and Computing,
Indiana University

Abstract: Interest in situated, embodied, and dynamical approaches to behavior and cognition has been growing steadily for many years. However, both the conceptual foundations of this approach and the theoretical tools necessary to understand the resulting brain-body-environment systems are still in their infancy. In order to advance these aspects of the approach, we study simple model agents that have been evolved to exhibit minimally cognitive behavior and, using the tools of dynamical systems theory, we analyze how the behavior of these evolved agents arises from the interaction between their nervous systems, bodies and environments. After a brief overview of this research program, it will be illustrated using a recent model of embodied relational categorization. In this model, an agent presented with two falling objects of different sizes in sequence must catch the second object if it is smaller than the first and avoid it otherwise. Interestingly, both largely disembodied and strongly embodied strategies evolve to make this relational judgement. A dynamical analysis of one of the best agents reveals the mechanisms by which its relational discrimination is made.

Behavioral Dynamics: From Individual to Collective Behavior

William H. Warren
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Brown University

Abstract: Where does the organization in behavior come from? *Behavioral dynamics* argues that stable, adaptive behavior emerges from the dynamics of the interaction between agents and their environments, exploiting physical, ecological, and informational constraints. Two case studies illustrate this approach at the individual and collective levels. First, rhythmic ball bouncing offers a model system for studying the dynamics of agent-environment interaction. Experiments reveal that agents aren't simply captured by the passive dynamics, but use information to adaptively modulate them. This *mixed control* mode may be characteristic of agent-environment interactions. Second, the collective behavior of human crowds is thought to emerge from local interactions between individual agents. We have built a dynamical *pedestrian model* based on human experiments, including steering, obstacle avoidance, interception, and following. We are now using multi-agent simulations to test whether such local interactions can generate global patterns of behavior we measure in human "swarm" scenarios. In each case, stable individual and collective behavior emerges from agent-environment interactions, making internal models and plans unnecessary.

Robot embodiment and adaptation in affective interaction

Lola Cañamero
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University of Hertfordshire, UK

Abstract: "Affective" and "social" robots that can display and recognize simple forms of emotions and interact with people in a "human-friendly" way are becoming an increasingly popular subject, not only in research but also in the media as well as among the general public. Humanoid robots are deemed particularly appropriate for this. They are often regarded as "cool" (and sometimes feared) gadgets reminiscent of characters in science fiction stories. However, besides their entertainment potential, robots and other artificial life models are also very special and unique research tools that can provide valuable insights to scientists trying to understand the nature, functions, origins, development, and adaptive value of emotions and other affective phenomena. In this talk I will provide simple examples of robotics and artificial life research we are carrying in my group to illustrate how these "virtual laboratories" can be used to build models of these different aspects of emotions and their role in interaction with the physical and social environment. In this context, I will discuss the role of embodiment and the potential advantages and drawbacks of humanoid and non-humanoid embodiments.

Participatory sense-making and social interaction.

Hanne De Jaegher
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Dept. of Logic and Philosophy of Science,
University of the Basque Country - UPV/EHU,
San Sebastian, Spain

Abstract: My presentation has three parts: 1) An introduction to the concept and theory of *participatory sense-making*, 2) defining *social interaction*, and discussing its roles in social understanding, 3) and a brief elaboration of the *interactive brain hypothesis*, about how interactive processes relate to neural mechanisms involved in social understanding. 1) *Participatory sense-making*, the enactive approach to social understanding, extends the enactive concept of *sense-making* into the social domain. It starts from the process of *interaction* between individuals in a social encounter. It is a well-established finding that individuals can and generally do coordinate their movements and utterances in such situations. We argue that the interaction process can take on a form of autonomy. This allows us to reframe the problem of social cognition as that of how meaning is generated and transformed in the interplay between the unfolding interaction process and the individuals engaged in it. The notion of sense-making in this realm becomes participatory sense-making. The onus of social understanding thus moves away from strictly the individual only. [1] 2) But what is the precise role of the interaction in making sense of each other and of the world together? We have proposed that the roles of both the social interaction and individual mechanism range from contextual to constitutive. [2] 3) How do social interactive processes relate to neural mechanisms involved in social understanding? I briefly introduce the Interactive Brain Hypothesis (IBH), which helps map the spectrum of possible relations between social interaction and neural processes. The hypothesis states that interactive experience and skills play enabling roles in both the development and current function of social brain mechanisms, even in cases where social understanding happens in the absence of immediate interaction. I will describe some elements of social interaction that bear most directly on this hypothesis and discuss some empirical possibilities open to social neuroscience. We propose that the link between coordination dynamics and social understanding can be best grasped by studying transitions between states of coordination. These transitions form part of the self-organization of interaction processes that characterize the dynamics of social engagement. The patterns and synergies of this self-organization help explain how individuals understand each other. Various possibilities for role-taking emerge during interaction, determining a spectrum of participation. Finally, I introduce the concept of readiness to interact, which serves to grasp the practices and dispositions that are summoned in situations of social significance (even if not interactive). This latter idea links interactive factors to more classical observational scenarios. [3]

[1] De Jaegher, H., & Di Paolo, E. (2007). Participatory Sense-Making: An enactive approach to social cognition. *Phenomenology and the Cognitive Sciences*, 6(4), 485-507. Key parts: the introduction to the enactive approach, the section on participatory sense-making, including the definition of social interaction

[2] De Jaegher, H., Di Paolo, E. A., & Gallagher, S. (2010). Can social interaction constitute social cognition? *Trends in Cognitive Sciences*, 14(10), 441-447

[3] Di Paolo, E. A., & De Jaegher, H. (2012). The Interactive Brain Hypothesis. *Frontiers in Human Neuroscience*, 6(163). Key parts: the introduction, the section introducing the interactive brain hypothesis, and the section 'toward a neuroscience of social interaction'

Not one, not two (reloaded)

Ezequiel Di Paolo
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University of the Basque Country - UPV/EHU,
San Sebastian, Spain

Abstract: Dualisms have a way of creeping up on us. One particular form of dualism has found its way into theories of biological organisation. It is similar to that found in transcendental phenomenology and various other disciplines. It is the dualism that radically separates the constitutive and interactive domains of an agent. On the one hand we have the sphere of constructive processes that make up a living system (or analogously in phenomenology, the sphere of immanence) and on the other the relational domain of the agent's interactions with the world, the domain of cognition proper (phenomenologically the domain of intentionality). It is not the drawing of this distinction that is problematic, but its radical interpretation. What an agent is and what it does are phenomena that must indeed be spoken about with different vocabulary (the subpersonal and personal domains). Otherwise, we fall back into the non-distinction of functionalism and its inexhaustible wellspring of mereological fallacies and homuncular variations. Unlike functionalism, enactivism follows the conceptual boundary between constitution and interaction, in order to be able to clearly define such terms as agency, behaviour, sense-making, interaction and mind. So where is the dualism? It is in how we conceive of the epistemic traffic across this conceptual boundary. Traditional autopoiesis, like Husserlian phenomenology, has seen the two domains as non-communicating: a closed borders policy that invites a myriad of paradoxes. This is the anti-thesis of functionalist non-distinction. Enactivism see the domains as non-reducible to each other, but not as explanatorily disconnected. As dynamical systems analyses allow for a wide range of explanatory and conditioning relations between dynamical phenomena (contextual interventionist causality, lawful co-variations, dynamical constraints, enabling relations, etc.) it has become clear that the interactive and constitutive domains of an organism can indeed relate in complex ways while remaining under-determined by each other. There is a border, and there's traffic through it. The enactive body is not merely the autopoietic organism but the history of incorporation of its relational habits back into itself. This allows constitutive process (e.g., physiology, neural activity) to change so as to eventually depend on interactions with the world and with others to achieve autonomous closure. Enactivism is thus the synthetic move between functionalism and dualistic ontologies that forever separate interaction and constitution. It is the not-one and not-two.

Symposium I:

Sensorimotor Interaction

Direct Learning and Flow on Information-Calibration Manifolds

David M. Jacobs
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Universidad Autónoma de Madrid

Abstract: This presentation describes recent work in the direct learning framework. Three studies are discussed. The first study applies the framework to the learning of cart-pole balancing [1]. The main conclusion of the study is that continuously controlled perceptual-motor learning can be portrayed as a movement toward the more useful loci in an information-calibration manifold. The second study addresses explanations of how perception-action systems manage to move through the manifolds, introducing the concepts of potential-based and direct learning [2]. The third study applies these concepts to the learning of the final approach phase in a flight simulator, thereby relating the direct learning framework to previous work in variability-of-practice paradigms [3].

[1] Jacobs, Vaz, Michaels (2012) The learning of visually guided action: An information space analysis of pole balancing. Journal of Experimental Psychology: Human Perception and Performance, 38, 1215-1227.
[2] Jacobs, Ibáñez-Gijón, Díaz, Travieso (2011) On potential-based and direct movements in information spaces. Ecological Psychology, 23, 123-145.
[3] Huet, Jacobs, Camachon, Missenard, Gray, Montagne (2011) The education of attention as explanation for variability of practice effects: Learning the final approach phase in a flight simulator. Journal of Experimental Psychology: Human Perception and Performance, 37, 1841-1854.

Non-linear Coordination Dynamics: Focus on Motor Performance… and Beyond

Ralf Cox
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University of Groningen, the Netherlands

Abstract: This workshop contribution will emphasize the nonlinear nature of coordination dynamics underlying human performance in the motor domain and beyond. Nonlinear phenomena, in particular 1/f scaling and fractal patterns, are ubiquitous throughout the cognitive system. It is suggested that these plays a fundamental role in the coordination of motor as well as cognitive functions. The temporal structure in time series of human behavior is often overlooked in scientific inquiries of cognitive performances. However, it is becoming widely acknowledged in many scientific disciplines, including psychology and movement science, that temporal patterns of variability constitute a rich source of information about the coordinative basis of goal-directed behavior.

Attention will be given to techniques for detecting and quantifying the temporal structure of behavior and to the implications of this structure for coordination dynamics. Two complexity measures will be introduced, viz. 1/f scaling and Recurrence Quantification Analysis, that employ 'background noise' to gauge the extent of interdependence across, rather than within cognitive components. Two examples of empirical research will be presented.

The first research example will be on the performance of repeated goal-directed movements, in the classical Fitts task. Evidence is provided that movement variability is not a random phenomenon, but shows 1/f scaling, which appears more clearly with motor learning. In a second experiment, speed-accuracy trade-off was analyzed at three different scales of observation, revealing nested scales of performance.

In the second research example dyslexic and non-dyslexic word-naming performance in beginning readers is analyzed. Complexity metrics differentiate reliably between dyslexic and average response times, and correlate strongly with the severity of the reading impairment. The direction of change suggests that developmental dyslexia resides from dynamical instabilities in the coordination among the many components necessary to read, which could explain why dyslexic readers score below average on so many distinct tasks and modalities.

A bricoleur approach to sensorimotor cognition

Oscar Vilarroya
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Universitat Autònoma de Barcelona

Abstract: In this contribution I present a set of neural processing principles and evolutionary constraints that should be taken into account in the characterization of sensorimotor cognition. I review evidence supporting the choice of the set of principles, and then I assess how such principles apply to two cases, object perception-action and peripersonal space. The aim is to emphasize the importance of focusing cognitive models on how evolution shapes functional paths to adaptations, as well as to adopt fitness maximization analyses of cognitive functions. Such an approach contrasts with the widespread reverse-engineering assumption that the neural system comprises a set of specialized circuits designed to comply with its assumed functions. The evidence presented in the manuscript points to the fact that neural systems should not be seen as a seat of optimal processes and circuits addressing particular problems in sensorimotor cognition, but as a set of satisficing and tinkered components, mostly not addressing the problems that are supposed to solve, but solving them as secondary effects of the engaged processes. I conclude with a corollary of the challenges lying ahead of the proposed approach.

Adaptation to feedback delays in human visuo-motor control. Why agent-environment interaction matters.

Marieke Rohde
Department of Cognitive Neuroscience,
University of Bielefeld

Abstract: There have been a number of studies investigating adaptation to visual feedback delays in human visuo-motor control. While some report strong adaptation with behavioral after-effects (Cunningham et al., 2001a, 2001b. Kennedy et al., 2009; De la Malla et al. 2012), others find little or no evidence for adaptation or after-effects (Smith & Smith, 1964; Ferrel, 1962; Held et al., 1966; Foulkes & Miall, 2000; Miall & Jackson, 2006; Morice et al., 2006). We hypothesize that this discrepancy in the literature is due to differences in training tasks used in different studies and how the introduction of a feedback delay perturbs them. To test this hypothesis, we trained human participants in a manual tracking tasks with a feedback delay. By varying the degree of visuo-motor predictability, we could modulate the kind of adaptation after-effect participants exhibit as well as whether they recalibrated their perception of simultaneity to compensate for the presence of the delay. Visuo-motor predictability in interaction appears to be a requirement for strong perceptual and behavioral delay adaptation. This study demonstrates the importance of closed-loop human environment interaction in the study of human behavioral and perceptual plasticity and reveals the sensorimotor Contingencies that underly our perception of simultaneity.

Information Dynamics in Minimally Cognitive Agents

Randall Beer
Cognitive Science Program,
Indiana University, USA

Abstract: Whatever else they may be, the notions of information and dynamics are mathematical concepts grounded in information theory and dynamical systems theory, respectively. Too often, debates regarding these concepts misconstrue or completely ignore these mathematical underpinnings. As mathematical theories, they can be applied to any system that takes the proper form. Thus, they intrinsically make no scientific claim as to “what’s really going on” in a given system. The more interesting question is what kinds of insights and explanations do these different mathematical languages provide and, perhaps most importantly, how do these distinct explanations relate when both languages are applied to the same system? In this talk, I compare and contrast the explanations that arise from applying both information theory and dynamical systems theory to the analysis of an evolved model agent capable of a solving a simple relational categorization task.

Theoretical explorations into the sensorimotor spatial coupling of oscillatory systems

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Dpt. Computer Science and Engineering Systems
University of Zaragoza

Xabier Barandiaran
IAS-research, Dpt. of Philosophy
UPV/EHU University of Basque Country

Abstract: Explanations in terms of oscillatory-coordination dynamics, on the one hand, and embodied and situated sensorimotor dynamics, on the other, are becoming widespread in cognitive science. However, there is still little research on how the closed sensorimotor loop might generate qualitatively different patterns of neural oscillations comparing with a parametric analysis of the isolated oscillatory system. We take as a departure point the HKB model whose dynamical properties are well understood and has been widely proven as a general model for dynamic coordination between two oscillatory components for a vast range of applications in cognitive science. In order to explore the properties of this model under closed sensorimotor conditions we present what we call the situated HKB model: a robotic model whose \brain" is the HKB equation, where a sensory input modulates the control parameter and the phase relation maps into a motor function. The parameters of the situated-HKB model are then optimized for a gradient climbing behavioural task. We solve the differential equations that define the agent-environment coupling and study the state space for increasing values of the agent's sensitivity. We find that the agent falls under different behavioural strategies for different sensitivity values. The presented results are compared with two different models: a decoupled HKB with no sensory input and a passively-coupled HKB that is also decoupled but receives an structured input generated by a situated agent. We can precisely quantify and qualify how the properties of the system, when studied in coupled conditions, radically change in a manner that cannot be deduced from the HKB model alone nor from passively coupled conditions. To our knowledge this is the first analytical solution of the HKB equation in a sensorimotor loop and qualitative and quantitative analytic comparison of spatially coupled vs. decoupled oscillatory controllers. We finally discuss the limitations and possible generalization of our model to contemporary neuroscience and philosophy of mind.

Of plants and men: a neoGibsonian approach to minimal cognition

Emma Martín & Paco Calvo
Universidad de Murcia, Spain

Abstract: A panoply of strategies that rely upon the concepts of competence, cognition and representation is available in the embodied cognition marketplace. Such a toolkit can be put to the service of explaining how biological systems generalize. The underlying assumption consists in the articulation of a combinatorial syntactic structure. In this talk, we submit a way to transfer the generalization problem from cognitive architectures to theories of perception by laying the stress on minimal, rather than higher, cognition. Elaborating on recent 'plant neurobiology' literature, we shall argue that the ability of biological systems to generalize may be explained more ecologically by opting instead for a different triplet, formed this time by performance, adaptive behavior and direct perception. The result is a neoGibsonian approach to minimal cognition. We end up by considering how these ideas might apply to humans.

On interaction complexity, (space-time) resolution and intelligences

David L. Dowe
Computer Science and Software Engineering,
Clayton School of Information Technology, Australia

Jose Hernandez-Orallo
Department of Information Systems and Computation,
Technical University of Valencia

Abstract: The recognition and assessment of cognitive (and ultimately intelligent) interaction require transmission of information, or communication. We distinguish between the evaluation of cognition as a peer and as an observer, and analyse several issues that might cause a failure in recognising (and properly assessing) cognition, such as the interface, the time and space resolution, the observer's limitations, and others. We then elaborate upon the role that (algorithmic) information theory may play here, and whether cognitive interaction can be recognised and assessed with this theory.

Troubles in the antirepresentational paradise: enactivism, sensorymotricity and ecological psychology.

Manuel Heras-Escribano, Manuel de Pinedo
Department of Philosophy, University of Granada

Lorena Lobo
Perception and action research group,
Universidad Autónoma de Madrid

Abstract: Enactivism, sensorymotricity and ecological psychology share some basic assumptions. However, in this paper we defend that only the latter can fully account for cognition because it recognizes, and accounts for learning as one of its central features. Enactivism, with co-emergence of life and cognition, attributes normativity to nonsocial agents: this, we argue, is a category error. On the other side, sensorymotricity does not explain how different movements are related with a single informational invariant and considers all contingencies as separated events. Finally, we claim that ecological psychology, by means of direct learning, is the best theory for explaining cognition as adaptive behaviour because it can explain action (goal-directed behaviour) as something in between autoregulation and normativity.

Symposium II:

Social Interaction

Improving agent believability by integrating a model of intrinsic motivation in an artificial cognitive architecture

Raúl Arrabales.
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University Center for Technology and Digital Art, Madrid

Abstract: The scientific preeminence achieved by cognitive approaches during the last decades caused the old S-R (Stimulus-Response) psychological theories to be superseded by the more comprehensive S-O-R (Stimulus-Organism-Response) accounts. In this context, the first cognitive computational models appeared, as a qualitative step forward in relation with classical S-R-like control systems. Basic cognitive processes, such as perception, attention, learning and memory, were considered in the design of the new artificial control architectures referred to as cognitive, where the organism was modeled playing an active role in perception and action, rather than being a mere reactive agent. However, the grand challenge of human-like behavior generation remains an open problem nowadays. There seem to be a "cognitive gap" that needs to be bridged in order to attain human-level performance and believability in complex tasks. Undoubtedly, much work still need to be done in the domain of processes like attention, emotions and learning, not to mention the field of integrative super-functions such as machine consciousness or artificial cognitive development and ontogeny. In this work, the focus is put on the role played by the motivation process in the generation of human-like behavior. Specifically, the function of intrinsic motivation is analyzed from the point of view of the computational model behind an artificial cognitive architecture. From this analysis, conclusions are drawn as to what design principles should be applied for the definition of plans and goals, and their relation with other cognitive processes, in order to improve believability in artificial agents. Human-like behavior in complex environments, such as those involving social interaction, is characterized by the influence of intrinsic motivation. Therefore, when agent believability is the objective, the model of the organism wihin the S-O-R model has to take into account the intrinsic motivation process in order to reduce the cognitive gap towards human-like behavior.

Models as Architectural Foundations for Interaction

Ricardo Sanz
Autonomous Systems Laboratory, Department of Automation,
Electronic and Computer Engineering,
Technical University of Madrid

Abstract: The 2013 ReteCog Workshop 1 will be articulated through two main themes: i) "Dynamics of agent-environment interaction and ii) "Social and emotional interaction". The question of iii) "How to relate the two themes" will also be another theme. This contribution targets a theoretical positioning concerning the architectural foundations for minds that addresses the three themes. We will show how mental models enable both meaningful agent-environment and social-emotional interaction.

In this contribution we discuss the concept of action based on mental models as a grounding theory both for the analysis of biological minds and the systematic construction of artificial cognitive systems. Indeed it constitutes the cornerstone of what we would call the model-based control theory of mind.

The topic of mental models have been a classic approach to the study of mind (Craik, 1943; Gentner and Stevens, 1983) focused on representational aspects. But in most cases the approach has just had an aura of metaphorical argumentation due to the lack of formalisation of the concept of model and the less than rigorous approach to the study of its use in the generation of mental activity.

The approach we take here establishes that the adaptive value of model-based minds is rooted in their control-enabling capabilities while in presence of uncertainty. Minds are controllers that keep our life going —expanding our genes— by building and using models of the surrounding reality —passive and active agents—, and the inner reality —the body and the mind itself. All these become critical in the production of advanced controlling capabilities. What is also interesting from the cognitive systems point of view, is that seeing minds as just model-based controllers, sets a strong, rigorous foundation for a naturalised epistemology. Knowledge will be identified with those models and they will prove critical for survival at large in an rule-following world. Minds build and use models of the inner and the outer to keep the organism as such. Is in this model-centric aspect that we want to concentrate upon: minds exploit models of the outer to keep the inner working.

This is not just fanciful musing. We'll try to make the real scientific case for it. Both in the artificial and in the natural. In the well known theoretical biology book Life Itself, Rosen introduces two minimal foundational premises upon which all the scientific enterprise —with its materialistic philosophy— depends:

> *Rosen (1991) / "1. The succession of events or phenomena that we perceive in the ambience is not entirely arbitrary or whimsical; there are relations (e.g., causal relations) manifest in the world of phenomena. 2. The relations between phenomena that we have just posited are, at least in part, capable of being perceived and grasped by the human mind, i.e., by the cognitive self."*

The phenomena we focus on has been the matter of study for millennia, so we are fully confident that they are there and that they are following some rules we must chart. All cognitive agent interactions — with the world, with others, with oneself —the age-old mind-body problem— will be clarified from a model-based control perspective.

Experimental results of learned behaviors in an autonomous social robot

Álvaro Castro González
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Carlos III University, Madrid

Abstract: In the near future, many researchers anticipate the spread of robots coexisting with humans in the real world. This requires a considerable level of autonomy in robots. This talk presents experimental results of a robot endowed with a biologically inspired decision making system which allows the robot to make its own decisions. Considering this kind of decision making system, the robot will not be considered as a slave any more, but as a partner.
The robot decides its future actions based on what it has learned from previous experiences. Although the current context of this robot is limited to a laboratory, the social robot cohabits with humans in a potentially non-deterministic environment. The robot is endowed with a repertory of actions but, initially, it does not know what action to execute either when to do it. Actually, it has to learn the policy of behavior, i.e. what action to execute in different world configuration, that is, in every state, in order to satisfy the drive related to the highest motivation. Since the robot will be learning in a real environment interacting with several objects, it is desired to achieve the policy of behavior in an acceptable range of time.

Interaction settings for measuring (social) intelligence in multi-agent systems

Jose Hernandez-Orallo & Javier Insa-Cabrera
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Technical University of Valencia

Abstract: In this contribution we discuss several possibilities for an interaction setting used to evaluate (social) intelligence in multi-agent systems. The setting is based on a simple Reinforcement Learning scenario based on agents and cells, where agents compete or cooperate for rewards. We study the configurations where dynamics is not spoilt in the limit by equilibria, deadlocks or other inadequate properties, and where the complexity of agents and environment can play a meaningful role. We explore all these possibilities and its relation to the Turing test, game theory and some simple games such as matching pennies, and its connection with some other previous works starting from the Turing Test.

Emotion and the expression of action readiness

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Technical University of Madrid

Abstract: In this talk we introduce the morphofunctional approach to emotion modelling, using the issue of emotion expression as the entry point. We consider the notion of expressive behaviour and the function of emotion expression. Based on Frijda's theory, emotions are changes in the relationship with the environment through a change in action readiness mediated by autonomic arousal. This is the basis for the morphofunctional approach, which considers systems whose morphology can be changed or modulated to provide different functionality, and the effect of such modification are changes to the dynamics of interaction. Emotion emerges from the control of bodies which can not only perform actions, but also change their readiness and the dynamic space of interaction. In this context, the expressive nature of emotion is explained by the dynamic-relational aspects of emotional behaviour.

Towards an enactive approach of musical imagery

Ximena A. González Grandón
National Autonomous University of México, UNAM

Abstract: Musical imagery is a form of cognition that by definition is not directly available to actual experience. That is, there are no actual physical "auditory frequencies and vibrations" to be measured. So, can we explain musical imagery from an embodied and enactive approach without appealing to internal mental representations? From an enactive approach, imagery is a problem of higher-level cognition that can be considered an underdeveloped area. This paper takes this challenge as own, and in this presentation my aim is (1) to lend support to an enactive thesis holding that musical imagery is an experience grounded in the lived body, and (2) to take into account the emergent propioceptive and kinesthetic patterns.

Towards a Socially Enacted Autonomy-Body and Self in the Light of Locked-in Syndrome and Schizophrenia

Miriam Kyselo
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University of the Basque Country - UPV/EHU, San Sebastian

Abstract: Embodied approaches to cognition consider themselves as alternatives to a brainbound view of cognition. They decisively emphasize that the brain is not the minimal basis for cognition, but that the body plays a crucial role as well. But what do we actually mean by "the body" and to what extent is it a necessary condition for cognition? Is bodily action equated with movement? Is the human body just a biological phenomenon? How is it related to the human self and sociality?

I explore these questions by confronting embodied cognitive science with Locked-in Syndrome (LIS), a case of global paralysis, which despite the lack of voluntarily bodily action seems to leave the patient cognitively intact. I suggest that this poses a challenge to embodied cognitive science putting into question our basic assumptions on what it means to be an embodied human cognitive system. It casts doubt on the assumption that a body has mainly to do with movement and it reposes the question how tool-use figures in cognition. It also brings to attention the dimension of bodily subjectivity and raises a much-neglected issue in recent cognitive science: the role of the body in social interactions. I show that current strands in embodied cognition, i.e. the sensorimotor approach, the extended functionalistic and the phenomenological approach entail restrictive or loose notions of the body and are not able to fully account for cognition in LIS.

I formulate a proposal for an enactive concept of the body and argue that the enactive approach is currently the best framework in embodied cognitive science to account for the body's role for cognition in LIS. However, what is not fully taken into account from an embodied perspective on cognition is that humans are embedded in a social environment. The question remains how the body matters in social interaction.

I thus propose transcending the level of individual embodiment and make suggestions for elaborating on autonomy, the concept by which enactivists refer to the cognitive identity of human mind, from a social perspective. I propose to conceive of human mind in terms of an autonomous network that is based on the enaction of social processes of distinction and participation. Based on this notion I offer some clarification of the concepts of body, self and sociality as well as their interrelation.

I provide support for the plausibility of my proposal by applying it to another empirical context, namely psychiatry. What we think about the nature of human mind grounds our thinking about breakdowns and what happens in cases when it does not work. I explore possible implications of the concept of socially enacted human autonomy for mental disorders in general, and for schizophrenia in particular.

The role artefacts in sharing intentions

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Autonomous University of Madrid

Abstract: Cooperaction seems to be an important and basic ability, underlying to many human phenomena. It is commonly accepted that cooperation processes require some capacity to share intentions, but there is a huge discussion on how we should understand what sharing intentions means. In this paper I will try to show the role of artefacts in the configuration of shared intentionality and I will argue that this idea helps us to get over some problems of individualistic and internist approaches to shared intentionality.
Individualistic accounts of shared intentionality assume at least three suppositions: 1)shared intentions are built over individual intentions (we can distinguish those authors that defend shared intentions as the sum of individual intentions (e.g. Quinton, 1975) and those that accept an emergentist account (e. g. Bratman, 1999); 2) every agent involved in sharing intention needs to recognize the intentions of the other agents involved; 3) there must be somo kind of agreementbetween the agents in the form "we intend to do x together" or "I intend to do x with you and youintend to do x with me". This intentional structure entails some difficulties, such as explainig the human skill for knowing other's intentions and the capacity to get involved in tacit agreements.
Nest I will argue that artefacts can be a central element for understanding shared intentionality and explaining how agents can recognize other's intentions and reach a tacit agreement. In addition, my proposal aims to get further away from the idea that shared intentions are the result of individualintentions.

Embodied Action and Neurophenomenology

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Abstract: Standard approaches to neurophenomenology (Varela, 1996; Gallagher and Zahavi, 2009) emphasise the search for a match between the dynamics of experience, explored via the phenomenological method, and the dynamics of the brain, analysed using dynamical and complex systems theory to get a grip on the brain's temporal progress through its high dimensional phase-space. It is true that a successful science of consciousness will need to match a rigorous first-person account of experience with some rigorous third-person account. But, I will argue, the present third-person approach remains too focused on the brain, and not on the active body. Researchers in neurophenomenology are well aware of the importance of embodiment. But it is as if the only mathematical account available, to match up with our experiential account, is a dynamical systems analysis of brain activity. If this were true, then perhaps body and world would have to be incorporated as items which close a dynamical loop (indeed, such loops may well fundamentally alter brain dynamics). However, I will argue that already we have another (not necessarily competing) rigorous mathematical framework which is, from the outset, much better suited to match the dynamics of experience. The framework I am talking about is the sensorimotor theory of experience (Noë and O'Regan, 2001; Noë , 2004; O'Regan, 2011). Take, for instance, the perspectival nature of experience (Gallagher and Zahavi, 2009; Noë, 2004). When we abandon our habitual attitude (attending not just to things, but to how things are given to us), we find that we always perceive objects from somewhere; that we only directly encounter the facing side of objects; that the apparent shape of objects changes as we move around them; and so on. But, as Noë and O'Regan point out, there is an extremely rich and perfectly objective mathematical structure to perspectival action (to action correctly guided by our perspectival relation to the world). Using this and other examples, I will argue that the structure of experience matches directly with the detailed structure of actual, and potential, world-involving bodily actions. Noë and O'Regan have done more than any others to elucidate the third-person structure of these actions. Brain dynamics remain important, but here they have a different role: an agent's brain dynamics simply do not match the structure of its experience (in some examples, they cannot); they are just a part of the richer dynamics of the whole agent's interaction with the world.