

ABSTRACTS OF ORAL PRESENTATIONS

SYMPOSIUM – AGENCY AND THE ENVIRONMENT

Thursday, July 28, 9.00-10.45

Chair: Rob Withagen

Situated action and the affordances of places
Harry Heft, Justine Hoch, and Trent Edmunds

Human practices, agency, and affordances
Erik Rietveld

Affordances and agency: Lessons from different fields of inquiry
Rob Withagen, Harjo de Poel, Duarte Araújo, and Gert-Jan Pepping

Autonomous Agency: What enactivism can provide for ecological psychology
Xavier Barandiaran

The concept of agency has been central to Gibson's ecological approach to psychology. Indeed, both in his theory of perceptual systems and in his notes on action, Gibson emphasized the active animal that makes its way in the world. Although Gibson has been criticized for not providing a fully-fledged theory of agency (Cutting, 1982), with his concepts of affordances, information and perceptual systems he offered a promising theoretical framework to elucidate this distinctive feature of the animate world. As Reed (1996) put it, "The goal of ecological psychology is to *explain* agency scientifically, not to explain it away or simply offer a discourse about it" (p. 19; emphasis in original). In the present symposium, four recent views on the ecological concept of agency will be presented. Harry Heft will discuss the concept of agency by considering affordances in the context of Barker's ideas on behavior settings. Erik Rietveld will argue for a Wittgensteinian, practice-based account of affordances and agency. Based on phenomenology and architecture, Rob Withagen will argue that the agent is often invited by the affordances of its environment. Finally, Xavier Barandiaran will consider agency, enactivism, and ecological psychology.

Cutting, J. E. (1982). Two ecological perspectives: Gibson vs. Turvey and Shaw. *American Journal of Psychology*, 95, 199-222.

Reed, E. S. (1996). *Encountering the world: Toward an ecological psychology*. New York, NY: Oxford University Press.

Situated action and the affordances of places

Harry Heft, Justine Hoch, and Trent Edmunds

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To date, discussions of agency from an ecological perspective have been limited to considerations of affordances. But, as I have proposed in prior writings, affordances are typically located in, and function as constituents of, behavior settings which are higher-order, dynamic, environmental structures that are generated by collective, interpersonal action (Barker, 1968). Indeed, in everyday life the psychological significance (meaning) of an affordance is, to a degree, established by the function it serves within the context of a behavior setting. This presentation will take up two issues: (1) Granted that affordances are perceivable, can the same be said for behavior settings? Preliminary evidence in support of this possibility will be presented. (2) Questions about agency with respect to affordances take on a different character when affordances are considered as constituents of behavior settings as compared to when they are considered in isolation. This presentation will explore one account of agency with respect to an ecological approach to situated action.

Barker, R. G. (1968). *Ecological psychology: Concepts and methods for studying the environment of human behavior*. Stanford, CA: Stanford University Press.

Human practices, agency and affordances

Erik Rietveld

University of Amsterdam, the Netherlands

How broad is the class of affordances human agents perceive? Affordances (Gibson, 1979) are possibilities for action provided to an animal by the environment – by the substances, surfaces, objects, and other living creatures that surround it. Are affordances limited to the domain of motor actions or do they extend to the realm of perceptual judgments and knowledge? I will present a Wittgensteinian, practice-based account of affordances (Rietveld & Kiverstein, 2011; Wittgenstein, 1953) and understand affordances as relations between aspects of a natural environment and abilities available to a form of life (cf. Chemero, 2003; 2009). Our skills as human agents include a practical knowledge of language and all sorts of epistemic abilities. By virtue of our abilities, the niche our form of life inhabits includes affordances for making correct explicit perceptual judgments and for knowledge. This sheds light on various aspects of situated normativity.

Chemero, A. (2003) An outline of a theory of affordances, *Ecological Psychology*, 15 (2), pp. 181-95.

Chemero, A. (2009) *Radical Embodied Cognitive Science*. Cambridge, MA: MIT Press.

Gibson, J. J. (1979) *The Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.

Rietveld, E., & Kiverstein, J. (2011) *Intentional Content: An Affordance-Based Account*. Paper presented at the workshop 'Phenomenology, Perception and Normativity', University of Pittsburgh, June 14-15, 2011.

Wittgenstein, L. (1953) *Philosophical Investigations*. Oxford: Blackwell.

Affordances and agency: Lessons from different fields of inquiry

Rob Withagen¹, Harjo J. de Poel¹, Duarte Araújo², and Gert-Jan Pepping¹

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University of Groningen, the Netherlands*

²*Faculty of Human Kinetics, Technical University of Lisbon, Portugal*

By arguing that the animal's environment consists of affordances, Gibson made room for the concept of agency in his ecological approach. After all, affordances were defined as possibilities for action and, thus, allow behavior but do not cause it. It is the animal that regulates its behavior with respect to the affordances. Although the nature of affordances is highly debated over the last decades, the majority of ecological psychologists follow Gibson in conceiving of affordances as possibilities for action. In the present talk, we will argue, based on different fields of inquiry, that affordances are not mere possibilities for action, but that they can also invite behavior. We will explore the implications of this new conception of affordances for the ecological concept of agency.

Autonomous agency: What enactivism can provide for ecological psychology

Xabier E. Barandiaran

IAS-Research Center for Life, Mind and Society, Dept. of Logic and Philosophy of Science, UPV/EHU University of the Basque Country, Spain

The notions of affordance, information, action or simply ecological context imply the assumption of an existing agent, a subject, an embodied perspectival point for perception-action. We identify three essential properties of agency: i) the establishment of an individual that defines an environment, ii) a causal asymmetric relationship between system and environment, and iii) a normative framework for action. Artificial life research on minimally autonomous systems provides detailed operational models of the emergence of autonomous agency in nature. We will present one such model and explore how biological agency can contribute to an operational notion of sensorimotor agency for ecological psychology. This is a key point of complementarity between enactive and ecological approaches to psychology and philosophy of mind, a complementarity that parallels the very dichotomy that is found at the root of natural agency: That between the emergence of an autonomous entity and the ecological context it inhabits.

FREE COMUNICATIONS – INFORMATION, ACTION, AND LEARNING

Thursday, July 28, 11.15-13.00

Chair: Reinoud J. Bootsma

Variability of practice and learning to land in a flight simulator

David Jacobs, Michael Huet, Cyril Camachon, Olivier Missenard, Rob Gray, and Gilles Montagne

Learning to control the Botafumeiro

Antoine Morice and Isabelle Siegler

Running for catchable and uncachable fly balls

Frank Zaal, Harjo de Poel, Joanne Smith, and Gert-Jan Pepping

Angle of approach effects in interceptive movements

Simon Ledouit, Rémy Casanova, and Reinoud Bootsma

Changes in functional interlimb interactions when learning a new bimanual coordination pattern with an internal or external focus of attention

Betteco de Boer, Lieke Peper, and Peter Beek

Variability of practice and learning to land in a fixed-base flight simulator

David M. Jacobs¹, Michael Huet², Cyril Camachon^{2,3}, Olivier Missenard², Rob Gray⁴, and Giles Montagne²

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²*Institut des Sciences du Mouvement, Université de la Méditerranée & CNRS, Marseille, France*

³*Centre de Recherche de l'Armée de l'Air, Salon de Provence, France*

⁴*School of Sport and Exercise Sciences, University of Birmingham, UK*

We describe two recent experiments about learning to land an aircraft in a flight simulator (Huet et al., 2011). The first experiment showed that learning occurs more quickly under variable than under constant practice conditions. This observation is attributed to the education of attention to the more useful informational variables: Variability reduces the usefulness of initially used informational variables, which leads to a quicker change in variable use, and hence to a larger improvement in performance. In the practice phase of the second experiment variability was selectively applied to some experimental factors but not to others. Participants tended to converge toward the variables that were useful in their specific practice conditions. This, we argue, further supports an explanation for variability of practice effects in terms of the education of attention. The presentation is concluded with a few more theoretical considerations concerning variability of practice and perceptual-motor learning.

Huet, M., Jacobs, D. M., Camachon, C., Missenard, O., Gray, R., & Montagne, G. (2011). The education of attention as explanation of variability-of-practice effects: Learning the final approach phase in a flight simulator. *Journal of Experimental Psychology: Human Perception and Performance*, 37, 1841-1854.

Learning to control the Botafumeiro

Antoine H. P. Morice¹ and Isabelle A. Siegler²

¹*UMR CNRS 7287 & Institut des Sciences du Mouvement Etienne-Jules MAREY, Aix-Marseille Université, Marseille, France*

²*UR CIAMS - Motor Control and Perception Group, Department of Sport Sciences, Univ Paris-Sud, Orsay, France*

In order to maintain the oscillation of a parametric pendulum such as the Botafumeiro, the famous giant censer of the Spanish Santiago de Compostela Cathedral, one has to increase and decrease its length with appropriate amount and timing. 15 novice participants were given 30 practice trials and no supplementary instructions to maintain for 2 minutes a 28° oscillation of a 2.5 m length custom-made parametric pendulum attached at the ceiling. Pendulum oscillations and lengths were measured using an optoelectronic system. Results show that all but one participant succeeded in learning the task. Participants suddenly discovered a satisfying perceptuo-motor solution after a few trials and used the remaining trials to gradually adjust the timing and amount of length variations. The time-course of behavioural responses is discussed in the light of direct learning theory and brings experimental evidences to the “education of intention”, “education of attention” and “calibration” phases.

Running for catchable and uncachable fly balls

Frank T. J. M. Zaal, Harjo J. de Poel, Joanne Smith, and Gert-Jan Pepping

Center for Human Movement Sciences, University Medical Center, Groningen, the Netherlands

The Chapman strategy is a beautiful example of how a specifying variable (optical acceleration) might be used for the continuous guidance of goal-directed behavior (running to catch a fly ball). For catchers to be able to use this variable, their perceptual systems must be able to pick up the information. The sensitivity of our perceptual systems to do so, and the way in which optical acceleration pick up takes place, has been questioned by several authors. In most cases, the arguments used to refute the use of optical acceleration lean heavily on the use of results from psychophysical judgment studies; participants made perceptual judgments about computer animations. Instead, we will present the results of a study in which we had participants run to catch real balls. The use of optical acceleration for running to catch fly balls predicts specific patterns in the running initiation times as a function of the characteristics of the ball trajectories (launching distance, landing distance relative to initial catcher position, height, etc.). Running initiation times adhered to these predicted patterns. As our next step, we will use the measured ball trajectories to reveal the variable that the perceptual system uses to detect 'optical acceleration'. In a second study, we address the issue of the perception of the (un)catchableness of approaching fly balls. Optical acceleration can be informative in this respect, but only when 'catchers' run at their maximum speed. Participants in our study indicated that a ball was uncachable, at any time during ball flight: sometimes they knew before starting to run, but many times they gave their assessment while already running to try to catch the ball. We will use the pattern of response times to search for the informational variable that underlies this catchableness affordance detection.

Acknowledgements. Part of this research was supported by a VIDI grant (452-03-356) from the Netherlands Organization for Scientific Research (NWO) awarded to Frank Zaal.

Angle of approach effects in interceptive movements

Simon Ledouit, Rémy Casanova, and Reinoud J. Bootsma

Institut des Sciences du Mouvement E. J. Marey UMR 7287, Marseille, France

Arzamarski et al. (2007) suggested that the angle-of-approach effect observed in earlier studies on lateral interception (e.g., Peper et al., 1994) resulted from biases in participants' perception of future passing distance. In a first experiment we replicated, in a new setting, the systematic angle-of-approach effect on the kinematics of interceptive movements for linear object motion trajectories. In a second experiment we determined participants' perceptual biases in extrapolating the future passing distance of static trajectory segments. In the third experiment we tested whether the angle-of-approach effect observed in Experiment 1 could be explained by the perceptual biases observed in Experiment 2 by evaluating interceptive movements for object trajectories constructed so as to continuously convey a zero perceptual bias. The results are discussed in the light of the ongoing discussion with respect to the information sources that may be used in the organization of interceptive movements.

Arzamarski, R., Harrison, S. J., Hajnal, A., & Michaels, C. F. (2007). Lateral ball interception: Hand movements during linear ball trajectories. *Experimental Brain Research*, 177, 312-323.
Peper, C. E., Bootsma, R. J., Mestre, D. R., & Bakker, F. C. (1994). Catching balls: How to get the hand to the right place at the right time. *Journal of Experimental Psychology: Human Perception and Performance*, 20, 591-612.

Changes in functional interlimb interactions when learning a new bimanual coordination pattern with an internal or external focus of attention

Betteco J. de Boer, C. (Lieke) E. Peper, and Peter J. Beek

*Research Institute MOVE, Faculty of Human Movement Sciences, VU University
Amsterdam, the Netherlands*

When learning a new bimanual coordination pattern, interlimb interactions governing pattern stability may change noticeably. In the present experiment, the effect of learning was examined for three sources of interlimb interaction: integrated timing of feedforward signals, correction of relative phase errors, and phase entrainment by contralateral afference. Participants learned to execute a 90° bimanual coordination pattern. Three groups with a different focus of attention were compared: an internal group focused on their hand movements, an external-auditory group received auditory feedback closely related to the executed hand movements, and an external-visual group received abstract Lissajous feedback about the coordination pattern of the hands. Bimanual performance and interlimb interactions were measured prior to and after two learning days, and at retention a week later. Results will be presented considering learning pathways, changes in bimanual performance, and changes in interlimb interactions that govern coordinative stability.

FREE COMUNICATIONS – TEMPORAL CONTROL AND ACTION

Thursday, July 28, 15.00-16.45

Chair: Frank T. J. M. Zaal

Early, late and full visual information in parabolic catching: Effects on hand closing time
Joan López-Moliner

The control of movement
David Lee

Ecological lessons from plant signaling and adaptive behavior
Paco Calvo and Emma Martín

To merge, or not to merge? A study on audiovisual information as higher order invariants toward risk feelings in highway driving behavior
Takayuki Kondoh, Nobuhiro Furuyama, Tomoharu Nakano, Atsunobu Kaminuma, and Hideaki Nemoto

To merge, or not to merge? Ecologizing an index of merging decision in highway driving behavior
Nobuhiro Furuyama, Takayuki Kondoh, and Tomoharu Nakano

Early, late and full visual information in parabolic catching: Effects on hand closing time

Joan López-Moliner

*Institute for Brain, Cognition and Behaviour (IR3C)
and
Dept. Psicologia Bàsica, Universitat de Barcelona*

Timing a catch requires the visual system to obtain information of the arrival time of the ball to the aimed interception point. It can be shown that accurate time-to-contact information is available in the optic flow under some assumptions. One type of information relies on the elevation angle and can be more likely used in the initial part of the flight, while the other relies on expansion information. I explore the use of these types of information in one experiment in which subjects wearing a data glove had to catch balls in a VR setting. Four horizontal velocities (HV) and four initial vertical velocities (VV) resulted in 16 different trajectories with four flying times (0.61, 0.78, 0.94 and 1.11 seconds). The same trajectories were shown in 3 viewing conditions (early, late and full path). I recorded hand closure initiation time and closing time. Catching was consistent with using elevation information when only early information was shown, while expansion information explained catching in late and full viewing conditions. In addition closing time showed a clear dependence on initial TTC in the early visual condition. This dependence could reflect level of uncertainty of the final arrival time across different initial TTCs.

The Control of Movement

David N. Lee

*Perception-Movement-Action Research Consortium (PMARC). School of Philosophy,
Psychology and Language Sciences
and
Moray House School of Education, University of Edinburgh*

Fundamental to evolution are the control processes that enable animals to make purposeful, goal-directed movements, when interacting with others and the environment. A theory of these processes (*General Tau Theory*) will be presented. It is founded on five basic principles. (i) Purposeful movement entails *prospectively* controlling the closure of gaps (e.g. distance-gaps when reaching and stepping, pitch-gaps when vocalizing, suction-gaps when suckling). (ii) *Tau* of a gap (the time-to-closure at the current closure-rate) is the only information required for controlling gaps. (iii) Tau can be sensed directly by all known perceptual systems, unlike other gap measures such as size and velocity of closure. (iv) Coordinating the closure of gaps is achieved by *tau-coupling* (keeping the taus of gaps in constant ratio). (v) Tau-coupling is used in the nervous system to control movement. The theory is supported by experiments across species from single-celled organisms to humans, and by dynamic brain recordings. Studies on control of movement in the environment and in communicating with others will be described.

Ecological lessons from plant signaling and adaptive behavior

Paco Calvo and Emma Martín

Dept. Philosophy, University of Murcia, Spain

We explore the application of Lee's *General Tau Theory* to the control processes of non-neural systems such as plants. In the case of the image-forming capacities of plants (the basic components of an eye, that is, photoreceptor cells and some optical element that serves the purpose of refraction, are already present in the form of ocelli), we shall argue that very basic photoreception and single visuomotor capacities may be cast in terms of tau-coupling. In addition, we shall consider cases where photoreceptive cells are not in the ocelli, but in other structures. We propose the ecological study of other modalities, as in relation to responses in the transition zone (TZ) of plant roots; an area where all informational vectors are integrated.

To merge, or not to merge? A study on audiovisual information as higher order invariants towards risk feelings in highway driving behavior

Takayuki Kondoh, Nobuhiro Furuyama², Tomoharu Nakano, Atsunobu Kaminuma, and Hideaki Nemoto

²*National Institute of Informatics, Japan*

We demonstrated elsewhere that drivers' Risk Feelings (RF) for the lead car in car-following situations can be described in terms of the inverse of τ with the lead car (= distance / relative velocity between the host car and the lead car) and the inverse of time headway (= distance between the two cars / host car velocity) (Kondoh et al., 2008). Kaminuma et al. (2011) report on a driving simulator experiment and found out that i) the decision to merge or not to merge can be described in terms of the RF formula, ii) individual differences in RF for merging decision were normalized, with the RF value divided by the maximum RF value for each individual driver, and iii) the boundary condition of decision making of merging can be more clearly described when audiovisual information is considered than when visual information alone is considered. Although Kaminuma et al. (2011) were not aware of this, we are going to argue that their attempt can be understood as an attempt to make the RF a dimensionless π number.

Kaminuma, A., Nemoto, H., & Funakawa M. (2011). Ambient interface for automobiles using 3D sound images. In *Proceedings of the First International Symposium on Future Active Safety Technology toward Zero-traffic-accident* (FAST Zero '11), Tokyo, Japan.

Kondoh, T., Yamamura, T., Kitazaki, S., Kuge, N., & Boer, E. R. (2008). Identification of visual cues and quantification of drivers' perception of proximity risk to the lead vehicle in car-following situations. *Journal of Mechanical Systems for Transportation and Logistics*, 1, 170-180.

To merge, or not to merge? Ecologizing an index of merging decision in the highway driving behavior

Nobuhiro Furuyama¹, Takayuki Kondoh, and Tomoharu Nakano

¹*National Institute of Informatics, Japan*

A driving simulator experiment on the driver's decision to merge or not to merge in highway driving was conducted. Some drivers decided to merge when the Risk Feelings (RF; defined by $1/\tau + 1/THW$, where $1/\tau$ is the relative velocity divided by the distance between the lead and host cars, and $1/THW$ is the host car velocity divided by the distance; Kondoh et al., 2008) was equal or higher than 1.2, and others refrained from merging in the same condition. Further analyses revealed that while the former drivers exhibited a tendency to take account of both $1/\tau$ and $1/THW$, the latter only considered $1/THW$. These results will be discussed in terms of the proposal of Kaminuma et al. (2011) to normalize the RF formula as a whole at once. Differences between their results and the present ones are probably due to different experimental settings in terms of the $1/\tau$ - $1/THW$ phase plane.

Kaminuma, A., Nemoto, H., & Funakawa M. (2011). Ambient interface for automobiles using 3D sound images. In *Proceedings of the First International Symposium on Future Active Safety Technology toward Zero-traffic-accident* (FAST Zero '11), Tokyo, Japan.

Kondoh, T., Yamamura, T., Kitazaki, S., Kuge, N., & Boer, E. R. (2008). Identification of visual cues and quantification of drivers' perception of proximity risk to the lead vehicle in car-following situations. *Journal of Mechanical Systems for Transportation and Logistics*, 1, 170-180.

SYMPOSIUM – ECOLOGICAL APPROACHES TO TIME IN PERCEPTION, ACTION, AND MUSIC

Thursday, July 28, 17.15-19.00

Chair: Matthew Rodger

Perceptual events, action capabilities, and time: Temporal experience as a property of the constraints of affordances
Matthew Rodger

Sense of rhythm
Harjo de Poel

Biological time: An epiphenomenon reflecting the dynamics of processes?
Raoul Huys and Viktor Jirsa

Sense-making and musical time: An ecological approach
Mark Reybrouck

Interest in time stretches back from the musings of the earliest philosophers (*e.g.*, Zeno's paradoxes of motion) up to the scientific concerns of researchers in the present day (*e.g.*, special issue of *Phil. Trans. R. Soc. B*, 2009). How does our experience of time, succession, and duration relate to the scientific construct of physical time? How does rhythm emerge from sequences of events in time? Is perceptual time itself an illusion or epiphenomenon of dynamic biological processes? How does the flow of musical time arise from structured sound events? This symposium considers these temporal questions from an ecological perspective, bringing together ideas and empirical research on temporal theory, timing in action, and the experience of time in everyday scenarios. Rodger will discuss the idea of experienced time as a property of affordances in events, and the role that physical and biomechanical constraints play in perceived time and duration. De Poel will discuss 'sense of rhythm' and how this emerges from certain perceived spatio-temporal patterns. Huys will present a dynamical systems account, in which biological time is understood as an emergent property of the flow through state-space of perception and action. Finally, Reybrouck considers ecological sense-making in music and how musical time arises from the affordances of sound. The presentations in this symposium are intended to provide a state-of-the-art appraisal of current ecological thinking around one of the most challenging and fundamental topics in the study of mind and behaviour.

Perceptual events, action capabilities, and time: Temporal experience as a property of the constraints of affordances

Matthew Rodger

School of Psychology, Queen's University Belfast, Belfast, UK

Physical events are constrained by the limits of space-time; while event perception for an organism is further constrained by the processing limits of the nervous system which picks up the specifying structural and transformational invariants in their sensory array. Furthermore, to the extent that events afford actions, these affordances are constrained by limits of the motor capabilities of the perceiver. These ecological propositions can help account for why perceived time often varies from measured physical time according to the contents of sensation. As actions afforded by sensory events move closer to the limits of physical and/or biomechanical constraints, and hence closure of associated action gaps requires greater effort, perceived duration of such events increases. Recent data will be presented which support this claim. It is the present conjecture that experienced time is (at least partly) constituted by the biomechanical-physiological constraints of the action-relevant properties of sensory events.

Sense of rhythm

Harjo J. de Poel

*Center for Human Movement Sciences, University Medical Center Groningen,
University of Groningen, the Netherlands*

In daily life, people often show behavior that demonstrates their ‘sense of rhythm’, or perhaps a lack thereof. Rhythmic behavior comprises intimate coupling of production and perception of the timing of typically more than one component. For instance, for a drummer or dancer the movements of two or more limbs are mutually attuned to produce rhythmic patterns. Such sometimes very intricate and challenging rhythmic tasks imply tight coordination that may go beyond stable intrinsic dynamics (e.g., the attraction to in-phase synchronization). Interestingly, some experiments demonstrated that participants were able to achieve quite complex rhythmic movement patterns within a few minutes, provided that perception of the produced pattern was simplified. This suggests that complex rhythmic behavior is critically dependent on perception, or indeed ‘sense’ of the rhythm. Based on pertinent literature, I propose that ‘sense of rhythm’ can be generally understood in terms of the emergence of and entrainment to ‘anchor regions’ (e.g., beats) of spatio-temporal patterns.

Biological time: An epiphenomenon reflecting the dynamics of processes?

Raoul Huys and Viktor Jirsa

*Theoretical Neuroscience Group, Institut de Neuroscience des Systèmes, INSERM
UMR 1106, Marseille, France*

Time is widely held to be an essential parameter underlying the control of behavior. Our contemporary notion of time as a linear flow, however, is not without discussion, in fact controversial in philosophy and physics. In addition, anthropological studies indicate that our notion and experience of time is not universally shared. Granting importance to ‘linear time’ and building theories of behavior and time experience thereupon may in fact primarily reflect our anthropocentric nature. Attempts to characterize the so-called “arrow of time” through first principles are traditionally rooted in an operationalization of change, which is a notion implying some sort of dynamics. In dynamic system theory, however, characterizing the dynamics through its flow in state space can eliminate time. Perceptual-motor behavior (but also processes) can be described as trajectories traversing state space; and the invariance (or structure) underlying a given process is captured by the flow topology in state space. A well-known topological structure, in that regard, is the limit cycle, which describes rhythmicity. Behaviors (and processes) can (in principle) be of arbitrary form, which can be accounted for by so-called Structured Flows on Manifolds (SFM). In the context of movement, various such SFMs have been identified in the literature. We propose that ‘biological’ time and ‘timing’ are properties following from behaviors and processes (portrayed as trajectories in phase space) rather than entities that are central to their control.

Sense-making and musical time: An ecological approach

Mark Reybrouck

Musicology, Katholieke Universiteit Leuven, Leuven, Belgium

Music can be studied in an objective way. Perceived music, however, is not reducible to its acoustic qualities, but can be considered as a collection of sound/time phenomena, which have the potential of being structured. What we hear at every moment, however, is only a small temporal window on the perceptual flux, a “now-moment” that can be extended in time. The delimitation of this extension is shaped by psychological and ecological constraints and is dependent upon mechanisms of sense-making and attentional strategies. Two mechanisms are discussed: the mechanism of event perception with events being defined as sequences of stimuli that are extended in time and that can be described in terms of their invariants, and the ecological concept of affordance. The events can be considered as the units of perception and memory. The affordances can be addressed in terms of what the sounding events afford for the consummation of behaviour. They have been defined mostly at the level of motor performance, but it is conceivable to broaden their scope and to define them also at the level of perception and simulated action.

SYMPOSIUM – (DIS)ASSEMBLING INDIVIDUAL AND INTERPERSONAL SYNERGIES

Friday, July 29, 9.00-10.45

Chair: Rita Cordovil

The formation of stable patterns of pencil grip in children
João Barreiros

Learning to cooperate: From individual to group synergies
Rita Cordovil, Carlos Luz, Ricardo Robalo, and Ana Diniz

Moving to the beat: Spontaneous and intentional coordination while Maraca-ing
Kerry Marsh, Alexander Demos, and Roger Chaffin

Interpersonal coordination supporting performance in video game tasks
Pedro Passos and Luis Vilar

The rowing crew as a synchronizing synergy
Harjo de Poel

In terms of motor behavior, a certain goal can be achieved through different patterns of movement coordination. Functional synergies (i.e., the grouping of structural elements that are temporarily constrained to act as a single coherent unit) are required to achieve and maintain goal directed behaviors. In this symposium, we present some empirical evidence of the dynamic processes of assembling and disassembling individual and interpersonal synergies that occur, at movement and behavioral levels, when individuals perform coordinated behavior during motor learning and sport tasks. João Barreiros and Rita Cordovil will address the dynamic characteristics of synergies, underlining the need to modify some of the existent synergies during development. João will talk about the formation of stable grip patterns in handwriting and discuss their resistance to specific task constraints, and Rita will address the question of individual control and group coordination in children's games. Kerry Marsh will present studies that investigate the emergence of coordinated movement through auditory information (shaking maracas). Pedro Passos will present the influence of practice with variability in the assembling of interpersonal synergies needed to perform a video game task. Finally, Harjo de Poel will discuss the importance of interpersonal synergies in rowing.

The formation of stable patterns of pencil grip in children

João Barreiros

*Faculty of Human Kinetics, Technical University of Lisbon, Portugal
and*

*CIPER – Interdisciplinary Centre for the Study of Human Performance, Lisbon,
Portugal*

The development of the pencil grip during early stages of infancy and childhood follows some principles: (1) progressive control of action involving distal finger joints, (2) adoption of mature grips, (3) selection of a limited number of grips, usually one single preferred grip. In recent years we performed a series of studies in which we manipulated several constraints, including the pencil diameter, the nature of the drawing, and the paper size. Children from 2 to 6 (N=120) were investigated in different experiments. The analysis of the pencil grip followed the system that was developed by Schneck and Henderson (1990). The results showed that older children used a restricted number of grips, which are very similar to grips observed in adults. In early stages of development many children use more than one grip; however the use of alternative grips is not dependent on the nature of the physical constraints that were manipulated. Instead, many children used alternative grips in the same circumstance. When a child presents a mature grip, that grip resists to induced perturbations such as the size of the pencil or the size of the paper.

Schneck, C. M., & Henderson, A. (1990) Descriptive analysis of the developmental progression of grip position for pencil and crayon control in nondysfunctional children. *The American Journal of Occupational Therapy*, 44, 893-900.

Learning to cooperate: From individual to group synergies

Rita Cordovil^{1,2}, Carlos Luz^{1,3}, Ricardo Robalo¹, and Ana Diniz^{1,2}

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³*Lisbon Higher School of Education, Lisbon, Portugal*

We analyzed the differences in group synergies used by children and adults while playing a children's game. A group of 6 to 10 year-olds and a group of adults were asked to play the game of the Fox and the Chickens. In this game, a group of children (chicks) should line up behind the mother hen and try to coordinate so that the last chick does not get caught by another child, the fox. The fox wins if the last chick is caught or if the chicks let go of each other. Two hundred short game situations were filmed. The success of the fox decreased as children learned to cooperate (88% in the younger children's group to 48% in adults' group). Simi motion was used to analyze the most typical coordination tendencies. Younger children tend to run away from the fox even when playing mother hen, not realizing that a group synergy is necessary to succeed in the game. Preliminary results indicate that the angle fox-hen-last chick and the displacement of each player seem to be important variables to analyze the dynamics of this game.

Moving to the beat: Spontaneous and intentional coordination while Maraca-ing

Kerry Marsh, Alexander Demos, and Roger Chaffin

University of Connecticut, Storrs, USA

Previous research examining the influence of auditory information on spontaneous synchrony using a rocking chair paradigm (Demos et al., 2012) revealed that hearing another's movement influenced spontaneous synchrony but less strongly than seeing the other's movements. This outcome may have been influenced, however, by the fact that changes in rocking tempo were strongly constrained by the chairs. In two experiments underway, we examine the role of auditory information alone on the emergence of coordinated movement using a new paradigm, shaking maracas. Participants were first asked to maintain their own tempo, when in the presence of their partner, and then later instructed to coordinate with the sound of the other person's maraca-ing. Preliminary results indicate stronger evidence of spontaneous coordination than in the rocking chair task, with spontaneous and intentional synchrony being equally strong in some dyads. Most dyads slowed down when instructed to synchronize. Some dyads were unable to synchronize when instructed and these dyads also did not show spontaneous coordination.

Demos, A. P., Chaffin, R., Begosh, K. T., Daniels, J. R., & Marsh, K. (2012). Rocking to the beat: Effects of music and partner's movements on spontaneous interpersonal coordination. *Journal of Experimental Psychology: General*, 141, 49-53.

Interpersonal coordination supporting performance in video game tasks

Pedro Passos^{1,2} and Luis Vilar^{1,3}

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This exploratory study aimed to investigate the influence of the practice conditions in assembling interpersonal synergies needed to perform a videogame task. Eight male participants were recruited, randomly paired and divided in two groups with different practice designs. The group with constant practice performed 20 trials in the acquisition stage using one videogame task. The group with variable practice performed 5 trials of each of the 4 different videogames tasks. One week after both groups engaged in the retention stage, performing 5 trials using a known videogame tasks, and the transfer stage, performing 5 trials using an unknown videogame task. The task consisted in playing a videogame that demanded dyadic cooperation between participants. For this, it was used the *XBox Kinect®* from Microsoft. Relative phase was used to capture dyadic coordination. Preliminary data suggests that practicing videogames with variability improved more significantly participants' performances than practicing the same task repeatedly.

The rowing crew as a synchronizing synergy

Harjo J. de Poel

*Center for Human Movement Sciences, University Medical Center Groningen (UMCG),
University of Groningen, the Netherlands*

Crew rowing is often used as illustrative example for synchronization of movements and/or inter-individual functional synergies. Indeed, in rowing practice and literature it is generally accepted that perfected in-phase synchronization of the crew enhances the performance of the boat-rowers system. But how well do they sync? Inspired by studies of inter-personal coordination dynamics, we applied coordination dynamics to crew rowing. Using such tools, we examined accuracy, variability and stability of crew coordination as a function of, *e.g.*, stroke phase (drive – recovery) and stroke rate. Moreover, in a recent study we showed that from a mechanical perspective antiphase crew rowing may even have considerable benefits over in-phase synchronized rowing, and that pairs could easily row antiphase without any training. Furthermore, although coordination dynamics predict instabilities for antiphase performance, *e.g.*, at increasing stroke rates, recent results suggest otherwise. Together, this demonstrates the expediency of coordination dynamics for crew rowing and promotes further exploration off- and on-water.

FREE COMUNICATIONS – COORDINATION, GAZE, AND DYNAMIC TOUCH

Friday, July 29, 11.15-13.00

Chair: C. (Lieke) E. Peper

Social priming: A tool to enhance impaired social coordination

Robin Salesse, Jonathan Del-Monte, Stéphane Raffard, Delphine Capdevielle, Manuel Varlet, Richard Schmidt, Jean-Philippe Boulenger, Benoît Bardy, and Ludovic Marin

The effect of the number of oscillators on the stability of finger-tapping movement: A comparison between intra- and inter-personal coordination systems

Kentaro Kodama and Nobuhiro Furuyama

Ecological foundations of human motion model

Wangdo Kim, Antonio Veloso, Veronica Vleck, and Filipa João

Keeping in contact: The role of gaze in skill learning

Ludger van Dijk and Raoul Bongers

Perception of object properties by dynamic touch is impaired in children with developmental disorders

Paula Silva, Juliana Ocarino, Thales Souza, Marisa Mancini, and Sergio Fonseca

Social priming: A tool to enhance impaired social coordination

Robin N. Salesse¹, Jonathan Del-Monte^{1,2}, Stéphane Raffard^{2,3}, Delphine Capdevielle^{3,4}, Manuel Varlet¹, Richard C. Schmidt⁵, Jean-Philippe Boulenger³, Benoît G. Bardy¹, and Ludovic Marin¹

¹*Movement to Health (M2H), EuroMov, Montpellier-1 University, France*

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³*University Department of Adult Psychiatry, Hôpital de la Colombière, CHU-Montpellier, Montpellier-1 University, France*

⁴*INSERM U-1061, Montpellier, France*

⁵*Psychology Department, College of the Holy Cross, USA*

Social priming is a procedure that affects the way people interact with each other. Such priming affects automatic imitation (the unconscious necessity to imitate others behavior), but little is known about its impact on social motor coordination. Crossing dynamical patterns theories and classical psychological paradigms, we investigated whether voluntary social coordination may be affected by such a manipulation. Pairs composed of a schizophrenic or a healthy participant and a control participant were positively or negatively socially primed (Leighton et al., 2010) before an interpersonal voluntary coordination task. Our results demonstrated that explicit social motor coordination can be primed (changes in pattern stability and accuracy), suggesting that unconscious (automatic) mimicry and voluntary coordination share common mechanisms. Our results also confirm that social interaction might be enhanced using a combination of social priming and voluntary movement coordination. These results have implications for therapeutic interventions in patients with social disorders such as schizophrenia.

Leighton, J., Bird, G., Orsini, C., & Heyes, C. (2010). Social attitudes modulate automatic imitation. *Journal of Experimental Social Psychology*, 46, 905–910.

Acknowledgements. This experiment was supported by a grant from the Agence Nationale de la Recherche (Project SCAD # ANR-09-BLAN-0405-01).

The effect of the number of oscillators on the stability of finger-tapping movement: A comparison between intra- and inter-personal coordination systems

Kentaro Kodama¹ and Nobuhiro Furuyama²

¹Graduate University For Advanced Studies, Japan

²National Institute of Informatics, Japan

The present study attempts to clarify differences between intra- and inter-personal coordination systems. To achieve this, finger-tapping experiments were conducted in both intra- and inter-personal conditions. Two within-subject factors (i.e., the number of fingers and the phase mode) were investigated. In the intra-personal experiment, the participants were asked to tap, paced by a metronome, looking at their fingers moving, using the index fingers in the two fingers condition, or the index and middle fingers in the four fingers condition. In the inter-personal experiment, pairs of participants replicated the same task. Some results turned out not to agree with the predictions of the HKB model. First, in the intra-personal experiment, no significant differences were observed between in-phase and anti-phase modes in the two fingers condition. Second, in the four fingers condition, the intra-personal system was less stable than the inter-personal system in the anti-phase mode. We will discuss these results in terms of different perceptual information and the number of oscillators involved in different experimental conditions.

Ecological foundations of human motion model

Wangdo Kim¹, Antonio P. Veloso¹, Veronica Vleck², and Filipa Joao¹

¹*Biomechanics Laboratory, Technical University of Lisbon, Portugal*

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The answer to Bernstein's (1967) well-known question about the control of the degrees of freedom of the motor system, considered from a Gibsonian perspective, is that a system with many degrees of freedom can act as if it were a simple system only if sufficient constraints are established among its components by coupling them into a synergy (Araújo et al., 2006; Shaw & Turvey, 1999). We adopted the principle of direct perception in ecological psychology to formulate performance variables in the analysis of various human daily activities. We tested the ecological foundation frame through readily accessible benchmark gait data (Fregly et al., 2012). We tested the hypothesis that the aforesaid is important to the efficacy of the golf swing by comparing the perception-to-action diagrams of both high- and low-handicap golfers. We also investigated how the natural (third order) vibration of a lightly damped human leg spring can act as a shock absorber, at the moment of foot-floor impact, in a hopping exercise.

Araújo, D., Davids, K., & Hristovski, R. (2006). The ecological dynamics of decision making in sport. *Psychology of Sport and Exercise*, 7, 653-676.

Bernstein, N. A. (1967). *The co-ordination and regulation of movements*. Pergamon Press.

Fregly, B. J., Besier, T. F., Lloyd, D. G., Delp, S. L., Banks, S. A., Pandy, M. G., & D'Lima, D. D. (2012). Grand challenge competition to predict in vivo knee loads. *Journal of Orthopaedic Research*, 30, 503-513.

Shaw, R. E., & Turvey, M. T. (1999). Ecological foundations of cognition. II: Degrees of freedom and conserved quantities in animal-environment systems. *Journal of Consciousness Studies*, 6, 111-124.

Keeping in contact: The role of gaze in skill learning

Ludger van Dijk¹ and Raoul M. Bongers²

¹*Utrecht University, the Netherlands*

²*University of Groningen, the Netherlands*

This exploratory study examines the role of gaze in skill learning in order to find out how gaze regains the agent-environment fit as a skill develops. We studied novel tool creation as an example of a natural, yet novel skill. Participants had to construct a spoon, a fork, or a knife, depending on the task, from a set of objects. We monitored gaze and the objects manipulated over learning. Performance got more efficient across trials: trial duration as well as the number of fixations decreased, while the goal-directedness of gaze increased. Trial 1 had only a few goal directed fixations before trial and error constructing commenced. In trial 2 the goal-directedness also started low but increased sharply during subsequent exploration. In trial 3, gaze was highly goal directed from the start and construction started immediately. This demonstrates that early in learning affordances over a short timespan were detected, whereas later in learning gaze served affordances over a longer timespan. We suggest that gaze is able to regain the agent-environment fit by weaving together a skill.

Perception of object properties by dynamic touch is impaired in children with developmental disorders

Paula L. Silva, Juliana M. Ocarino, Thales R. Souza, Marisa C. Mancini, and Sergio T. Fonseca

Universidade Federal de Minas Gerais, Brazil

Individuals presenting movement impairments have limited possibilities for effortful interactions with environmental objects. Yet to be investigated are the consequences of such limitation to the ability of these individuals to perceive object properties by dynamic touch. Fourteen children with typical development, 10 children with Down syndrome, and 12 children with cerebral palsy were asked to report the length of hand-held rods after wielding them out of sight. Data analyses showed that perceived length was different between groups ($p < 0.05$). Importantly, length reports were more reliable and accurate in typically developing children, as indexed by AD% and MRS%, respectively. Lack of attunement of children with developmental disorders to inertial parameters lawfully related to object length seem to explain such finding. Pointedly, the maximum principal moment of inertia was a significant predictor of perceived length only in the group of typically developing children ($p < 0.0001$). Thus, pathological conditions that affect motor development may prevent or delay the processes of perceptual attunement and calibration that underlie the development of haptic perceptual capabilities. Theoretical and clinical implications of these results will be identified and discussed.

SYMPOSIUM – COGNITION AND ACTION IN SPORT

Friday, July 29, 15.00-16.45

Chair: Duarte Araújo

Use your brain if you have to
Rita de Oliveira

An ecological approach to sport expertise: Lessons learnt from perception, action, and penalty kicks
Matt Dicks

Informational constraints on performance in futsal
Luis Vilar and Duarte Araújo

Linking individual and team cognition in soccer
Duarte Araújo and Ricardo Duarte

This symposium will address different levels of analysis of cognition and action in sport. After a brief overview by Duarte Araújo, the first talk from Rita de Oliveira will focus on the link between brain and behaviour, the second talk will focus on individual expertise and cognition in sport, the third talk will focus on how individuals in dyads interact in order to achieve mutually exclusive goals, and the last talk will link individual with social behaviour when trying to achieve a sportive goal. Sport will be used as a task vehicle to demonstrate how representative experimental tasks expand our knowledge informing about complex behaviour performed on mundane ecological niches.

Use your brain if you have to

Rita F. de Oliveira

Human Performance Centre, London South Bank University, UK

In the sports literature there is disagreement: Is visual information primarily used for planning goal-directed movements or for their moment-to-moment guidance during execution? There are three main arguments for the former. First, visuomotor delays may render sensorimotor updates untimely for some movements. Second, longer target fixations are associated with expertise and accuracy. Third, with practice performers become less dependent on concurrent information. I will argue that these findings are critically dependent on the participant and task under study, and that critical variables are *visual timing* and the ability to *use* information. Expert sports people and people with coordination difficulties are at the extremes of a normal distribution curve for visuomotor performance. I will present behavioral results to illustrate their efficient use of concurrent visual information. I will also show that *more* visual information is not always an advantage (even when the information is relevant to the task) with consequences for the understanding of brain function.

An ecological approach to sport expertise: Lessons learnt from perception, action, and penalty kicks

Matt Dicks

*Research Institute MOVE, Faculty of Human Movement Sciences, VU University
Amsterdam, the Netherlands*

Current research supports the idea that perceptual expertise in sport is predicated upon an ability to accurately perceive the intentions of an opponent. However, there is mounting concern that traditional experimental methods - including laboratory based video judgment tasks - may not offer suitable conditions with which to fully study such expertise. Indeed, it has been argued that the experimental bias towards studying the role of perception with minimal consideration for action has led to a lopsided and limited understanding of perceptual skill. In light of this debate, an increasing number of researchers have drawn upon Gibson's ecological approach. Most notably, recent work strongly suggests that perceptual expertise is predicated on action as a reciprocal feature of a performer's perceptual skill. Despite the implications that these findings have for the broader domain of ecological psychology, until now, a review has not been forthcoming. In the current presentation, I will aim to address this issue, while also considering the implications for future perceptual expertise research.

Informational constraints on performance in futsal

Luis Vilar^{1,2} and Duarte Araújo^{1,3}

¹*Faculty of Human Kinetics, Technical University of Lisbon, Portugal*

²*Faculty of Physical Education and Sports, Lusófona University of Humanities and Technologies*

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In this communication we aim to show how players use information to create/prevent opportunities to shoot and score/save goals in futsal competitive environments. We recorded ten futsal matches and analyzed ninety sequences of play ended in a goal (n=30), a goalkeeper's save (n=30), and an interception by the defender (n=30). Spatial-temporal measures of coordination were computed before and after a shot occurred. Results showed that when a goal was scored the defender's angle to the goal and to the attacker tended to decrease; the attacker was able to move to the same distance to the goal as the defender; the attacker was closer to the defender and was moving at the same velocity (at least) as the defender. Moreover, the required movement velocities of the goalkeeper to intercept the ball were lower in plays ended in a save than in plays ended in a goal.

Linking individual and team cognition in soccer

Duarte Araújo and Ricardo Duarte

*Faculty of Human Kinetics, Technical University of Lisbon, Portugal
and
CIPER – Interdisciplinary Centre for the Study of Human performance, Lisbon,
Portugal*

There have been some attempts in performance analysis to characterize teams' collective behaviors during the match based on positional data. Different compound motion variables (e.g., surface area, stretch index) have been used to assess the collective linkage between players, i.e., collective cognition, during the match. However, this type of assessment does not capture how individual players' behavior is coordinated with team's behavior. The aim of this talk is to propose a method, the cluster phase method (Frank & Richardson, 2010), to measure the player-team relationship during soccer performance.

Frank, T. D., & Richardson, M. J. (2010). On a test statistic for the Kuramoto order parameter of synchronization: with an illustration for group synchronization during rocking chairs. *Physica D*, 239, 2084-2092.

SYMPOSIUM – PERCEPTUO-MOTOR DEVELOPMENT

Friday, July 29, 17.15-19.00

Chairs: Audrey van der Meer and Rita Cordovil

Longitudinal study of perception of structured optic flow and random visual motion in infants using high-density EEG

Audrey van der Meer, Seth Bonsu Agyei, and Ruud van der Weel

Levels of autistic prospective control during an interceptive task

Caroline Whyatt and Cathy Craig

Crossing the crocodiles' river: Learning to perceive affordances for others in cooperative tasks

Rita Cordovil and Vanda Correia

Quantifying the dynamics of children's individual and coordinative behaviour

Ralf Cox

It has been a while since a symposium dedicated to developmental phenomena featured in the EWEP program. This is a shame, since a better understanding of developmental processes is crucial for the understanding of perception and action in general. The four contributions to the present symposium each focus on fundamental concepts in Gibson's and Bernstein's theories with respect to infant and child development, i.e. affordances, prospective control, optic flow, and coordination dynamics and provide insight in the development of both brain and behaviour.

Longitudinal study of perception of structured optic flow and random visual motion in infants using high-density EEG

Audrey van der Meer, Seth Bonsu Agyei, and Ruud van der Weel

Developmental Neuroscience Laboratory, Department of Psychology, Norwegian University of Science and Technology (NTNU), Trondheim, Norway

Electroencephalogram (EEG) was used in infants at 3-4 months and 11-12 months to longitudinally study brain electrical activity as a function of perception of structured forwards optic flow, structured reversed optic flow, and non-structured random visual motion. Analyses of visual evoked potential (VEP) were performed on EEG data recorded with a 128-channel sensor array. Results showed infants to significantly differentiate between the radial motion conditions, but only at 11-12 months where they showed shortest latency for the forwards optic flow condition and longest latency for the random visual motion condition. It was concluded that brain electrical activities related to radial motion conditions change in infants between the ages of 3-4 months and 11-12 months. With locomotion experience and accompanying neurobiological developments infants around one year of age rely, more so than when they were younger, on the perception of structured forwards optic flow and appear to be more affected by the lack of structure in random visual motion.

Levels of autistic prospective control during an interceptive task

Caroline Whyatt and Cathy Craig

Department of Psychology, Queen's University, Belfast, Northern-Ireland

Growing evidence indicates the presence of significant motor problems associated with a diagnosis of autism, particularly in dynamic, interceptive tasks (Miyahara et al, 1997; Green et al., 2002; Green et al., 2009; Whyatt et al., 2012; Glazebrook et al., 2006; Frith, 2003; Rinehart et al., 2006). This study aims to understand differences in performance on a controlled interceptive task between children diagnosed with autism (aged 9-11) and age-matched non-verbal and receptive language control groups. Results suggest that poor interceptive skills associated with autism are due to impaired prospective motor control, specifically adapting to the temporal constraints of the task. These results will be discussed in light of perception-action coupling and the use of mature timing strategies.

- Frith, U. (2003). *Autism: Explaining the Enigma* (2nd Edition). Oxford, UK: Blackwell.
- Glazebrook, C., Elliott, D., & Lyons, J. (2006). A kinematic analysis of how young adults with and without autism plan and control goal-directed movements. *Motor Control*, 10, 244.
- Green, D., Baird, G., Barnett, A. L., Henderson, L., Huber, J., & Henderson, S. E. (2002). The severity and nature of motor impairment in Asperger's Syndrome: A comparison with specific developmental disorder of motor function. *Journal of Child Psychology and Psychiatry*, 43, 655.
- Green, D., Charman, T., Pickles, A., Chandler, S., Loucas, T., Simonoff, E., & Baird, G. (2009). Impairment in movement skills of children with autistic spectrum disorders. *Developmental Medicine and Child Neurology*, 51, 311-316.
- Miyahara, M., Tisujii, M., Hori, M., Nakanishi, K., Kageyama, H., & Sugiyama, T. (1997). Brief report: Motor incoordination in children with Asperger Syndrome and learning disabilities. *Journal of Autism and Developmental Disorders*, 27, 595
- Rinehart, N. J., Bellgrove, M. A., Tonge, B. J., Brereton, A. V., Howells-Rankin, D., & Bradshaw, J. L. (2006). An examination of movement kinematics in young people with high-functioning autism and Asperger's disorder: Further evidence for a motor planning deficit. *Journal of Autism and Developmental Disorders*, 36, 757-767.

Crossing the crocodiles' river: Learning to perceive affordances for others in cooperative tasks

Rita Cordovil^{1,2} and Vanda Correia^{2,3}

¹*Faculty of Human Kinetics, Technical University of Lisbon, Portugal*

²*Higher School of Education and Communication, University of Algarve, Faro, Portugal*

³*CIPER – Interdisciplinary Centre for the Study of Human Performance, Lisbon, Portugal*

The ability to perceive affordances for other people is fundamental for a successful social interaction. In this study, we investigated how 4- to 9-year-old children adjusted their behavior to solve a cooperative task that implied perceiving another child's step length. Children were grouped in pairs and one child was asked to cross a 6-m path (*i.e.*, “a river full of crocodiles”), as fast as possible, stepping only on the “rocks” that were placed on the ground by his/her partner. Preliminary results indicate that children's performance improves with age and by 8 years of age children start to adjust the placement of the “rocks” throughout the trial based on their companions' action-scaled information. Younger children generally stick to a stable solution to perform the task. The diversity of strategies exhibited to achieve this task illustrates the capability that children have to explore different solutions and to select the behavior that fits the dynamic existent constraints.

Quantifying the dynamics of children's individual and coordinative behaviour

Ralf Cox

Department of Developmental Psychology, University of Groningen, the Netherlands

The temporal structure of behaviour contains a rich source of information about its dynamic organization, origins and development. This information is essential for unravelling how children's actions are synchronized with those of other people, as in social interaction, or coordinated in a specific task, as during problem solving. In addition, it provides a framework for conceptualizing and understanding how behaviour emerges and develops from the interaction of body, brain and environment. By thoroughly studying the behaviour as it unfolds over time, employing nonlinear time-series analysis techniques, it is possible to reveal this information. A number of studies will be discussed to showcase applications in the study of behavioural development. The focus will be on the kind of answers such techniques can provide and its advantages above traditional central tendency measures, more than on a rigorous treatment of all the details of the analysis. Examples will come from various areas of developmental research, particularly children's play, gaze and problem-solving.

SYMPOSIUM – INFORMATIONAL MODIFICATION OF MOVEMENT DYNAMICS

Saturday, June 30, 9.00-10.45

Chair: Raoul Huys

Information structures behavioural dynamics: The example of reciprocal aiming
Laure Fernandez, Raoul Huys, Viktor Jirsa, and Reinoud Bootsma

Coordination dynamics of multisensory integration
Julien Lagarde, Gregory Zelic, and Denis Mottet

Human-robot interactions: Adaptation and control in rhythmic tasks
Renaud Ronsse

Interplay of information and movement dynamics in the context of rhythmic timing
Kjerstin Torre

Although the ecological and the dynamical systems approach to perception-action have been historical allies, the conceptual and methodological spillover between frameworks has remained limited. Ecological psychology attempts to identify informational variables that specify environmental properties and thus affordances to action; the dynamical approach to perception-action attempts to identify attractor structures associated with movement patterns and bifurcations between such structures. An identified bifurcation (or control) parameter that has received most attention, in that regard, is movement frequency, in particular in how it changes coordination stability. The question if and how (different ‘sources’ of) information affects the behavioral solution(s) to particular sensorimotor problems has received far less attention (at least so when cast in dynamical terms). The present symposium contains four presentations with a focus on the modification of movement dynamics through manipulation of the informational task-context. In particular, these presentations will elaborate on how temporal, spatial, and multi-modal information favours distinct behavioral solutions to specific sensorimotor problems both in human and robotic applications.

Information structures behavioural dynamics: The example of reciprocal aiming

Laure Fernandez¹, Raoul Huys², Viktor Jirsa², and Reinoud J. Bootsma¹

¹*Human Movement Sciences Institute UMR 7287, Marseille, France*

²*Brain Dynamics Institute UMR 1106, Marseille, France*

According to the ecological approach to perception and action, an agent is considered as a constituent part of an environment-agent system; movement is thus understood as emerging from the interaction between the agent's dynamics and those pertaining to the environment. The agent-environment coupling is thought to be informational (from the environment to the agent) as well as mechanical (from the agent to the environment). These couplings provide the conditions for the emergence of task-specific behavioral dynamics. Identifying how information impacts the particular characteristics of the behavioral dynamics in each specific case is a key challenge for the ecological psychologist. In this contribution we examine this influence for the case of (reciprocal) aiming that can be considered to capture the essence of goal-directed behavior in the simplest possible setting. Our results show that information exerts its influence at the level of behavioral dynamics and reveals a transition between two well-known dynamics patterns: the discrete and rhythmic mechanism.

Coordination dynamics of multisensory integration

Julien Legarde, Gregory Zelic, and Denis Mottet

M2H Laboratory EuroMov, Montpellier 1 University, France

In everyday life, senses like sight, audition, and touch influence the way we perceive the world. The brain has the fascinating capacity to put together different senses. Recent research reveals that many substrates in the brain may sub serve the convergence of the senses, from single cell to extending networks. What happens when a combination of perception and of action is required? This is a key issue, since monitoring an intended action requires the organization of movements in space or/and in time in harmony with our surrounding environment. Surprisingly enough little is known about how different senses and movement are combined dynamically. In the present talk we will present new findings about the conditions for efficient integration of cross-modal stimuli, for the pervasive class of adapted behavior involving multi-limb sensorimotor coordination. We used parametric protocols in coordination tasks to probe the boundaries of integration, seeking for non-linear, qualitative changes arising from coordination dynamics.

Human-robot interactions: Adaptation and control in rhythmic tasks

Renaud Ronsse

Centre for Research in Mechatronics, Université Catholique de Louvain, Belgium

Human-robot interaction offers a unique methodology to investigate the mechanisms governing motor control, both with intact participants and disabled subjects. For example, adaptations to computer-controlled force fields performed by a robot have significantly increased our understanding of motor learning. In such context, the robot typically induces a modification of the sensorimotor dynamics, which is progressively learned by the participant. More recently, dedicated robotic systems were developed to study motor recovery in spinalised animals, paving the way to promising devices for rehabilitation and/or assistance. In this talk, we will review our recent studies that investigated human-robot interactions in the particular context of rhythmic movements, i.e. a movement category involving different neural circuitries as discrete reaching-like movements. First, we will review our recent contributions focusing on the use of adaptive oscillators to provide robot assistance during the execution of rhythmic movements, both with the upper and the lower limb. We will stress the dynamics of cross-adaptation, i.e. the parallel adaptation of the robot controller and of the human participant, in order to optimize their mutual collaboration. Again, these results clearly establish the capacity of a human participant to adapt the locomotion pattern based on the modified dynamics induced by the robot. Second, we will discuss our contributions to the field of juggling, both by humans and robots. We will particularly focus on the role of visual feedback to induce different control strategies relying on different dynamics. This will bring us to discuss (i) the transfer of human-inspired control strategies of a simplified bimanual juggling task to a juggling robot; and (ii) the elaboration of a new perspective on the classical ball bouncing task by using optimality principles. This last finding was obtained by using a virtual reality environment and paves the way to appealing human-robot interaction protocols.

Interplay of information and movement in the context of rhythmic timing

Kjerstin Torre

Movement to Health Laboratory (M2H), Montpellier-1 University, EuroMov, France

On one hand, supply of information pertaining to a given sensorimotor task likely modifies the movement dynamics. On the other hand, movement dynamics may also provide and modulate task-relevant information. These two sides of the same coin have often been given different weights following representational, or dynamic systems and perception-action approaches to human behaviour. The predominant direction of the relationship between information and movement dynamics may actually depend on the properties of both factors. In the context of rhythmic movement, two timing processes have been distinguished, namely “event-based” and “emergent” timing, which mainly differ with respect to the forms of interplay between information used for temporal regulation and motor implementation. Here we reason on the basis of a gradual presentation of different rhythmic movement studies (unimanual self-paced, unimanual externally-paced, bimanual movements, etc.) to examine how the properties of movement dynamics and/or additional information available determine the involvement of one or other timing process, and thereby the predominant direction of the interplay between movement and information.

SYMPOSIUM – EXPLOITING PERCEPTION-ACTION COUPLINGS IN PRACTICAL SETTINGS

Saturday, June 30, 11.15-13.00

Chair: Vanda Correia

Informational constraints on passing performance in field and virtual performance contexts
Vanda Correia, Duarte Araújo, and Cathy Craig

Affordances and environmental judgments
Benjamin Meagher and Kerry Marsh

Bespoke balance training games for older adults and people with Parkinson's
Cathy Craig

Challenging perceptual environments for training and evaluation in clinical settings
Lieke Peper

The symposium aims to present studies on the use of perceptual information to investigate and improve movement. This applied type symposium will provide recent research insights on how perception can guide action by presenting examples from everyday activities such as sport, health and room interior design. Developed under an ecological approach to perception and action, the symposium's speakers will present different task designs making use of virtual reality tools and also on methods to collect data from real world settings. Vanda Correia will demonstrate how rugby union players act influenced by what the environment affords in the actual game setting and in an immersive and interactive virtual reality simulation of a sub-phase of the game. Effects of expertise in the latter setting will also be addressed. Also making use of virtual reality, Benjamin Meagher will present experiments conducted in lab rooms and in virtual reality examining the influence of affordances of a room on people's judgments of spaciousness. A variety of circumstances are manipulated in the latter settings, such as the arrangement of the furniture and its functionality, the salience of unusual action possibilities and individuals' effectivities. Using the commercially available Nintendo Wii balance board interfaced with virtual reality tools, Cathy Craig will present her work program regarding the importance of visual information for the online control of balance in older adults and people with Parkinson's. C. (Lieke) E. Peper will provide additional examples of the exploitation of perception-action couplings in clinical settings. In particular, she will present a serious gaming set-up developed for children with cerebral palsy, and an instrumented treadmill that allows for the evaluation and training of gait adaptability, for instance in CVA patients.

Informational constraints on passing performance in field and virtual performance contexts

Vanda Correia^{1,2,3}, Duarte Araujo^{2,3}, and Cathy Craig⁴

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Team sports performance emerges as players interact with key constraints from the surrounding environment such as other players. An important issue concerns how the use of such information sources constrains the emerging actions. Consistent with this are the following works investigating performance in rugby union sub-phases. One considers 1vs1 occurring on the course of rugby matches (“field context”), the other considers an immersive and interactive 3vs3 virtual task (“virtual context”). The first study demonstrated how passing further or shorter is influenced by the time-to-close the gap between ball-carrier attacker and his marking defender. The second study demonstrated how passing further or shorter, or running instead, is influenced by the location of opening gaps in the defensive line besides verifying a rugby expertise effect. These findings provide insights on how skill in team sports emerges from the player-environment scale of analysis and may be grounded on the manipulation of tasks constraints.

Affordances and environmental judgments

Benjamin R. Meagher and Kerry L. Marsh

University of Connecticut, USA

In a series of experiments conducted in lab rooms and in virtual reality, we are examining whether the affordances of a room affect people's judgments of the spaciousness of a room, under a variety of circumstances. The experiments vary whether the same furniture of the room is arranged in a way to be more functional or less functional (e.g., better affords solo activities and social activities), whether unusual action possibilities of a room are made more salient (e.g., by holding a skateboard while in the room) or whether an individual's unusual effectivities they are given (ability to bike or fly in a virtual room) are hindered by the furniture arrangement. Results thus far are supportive that affordances affect judgements of spaciousness.

Bespoke balance training games for older adults and people with Parkinson's

Cathy Craig

School of Psychology, Queen's University of Belfast, Northern Ireland

Forty years ago Lee and colleagues (Lee & Aronson, 1974; Lee & Lishman, 1975) established the importance of visual information for the online control of balance. In this talk I will show how the commercially available Nintendo Wii balance board can be interfaced with virtual reality software to create balance training games with adapted affordances. By controlling the dynamics of the moving objects presented in the game we can create new opportunities for action that are more suited to the player's action capabilities. I will show how playing these adapted games for a period of 4 weeks can significantly improve aspects of static and dynamic balance in older adults and people with Parkinson's. The exciting possibilities of this NUI (Natural User Interface) technology as a way of exploiting principles of perception-action coupling will also be discussed.

Lee, D. N., & Aronson, E. (1974). Visual proprioceptive control of standing in human infants. *Perception and Psychophysics*, 15, 529-532.

Lee, D. N., & Lishman, J. R. (1975). Visual proprioceptive control of stance. *Journal of Human Movement Studies*, 1, 87-95.

Challenging perceptual environments for training and evaluation in clinical settings

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*Research Institute MOVE, Faculty of Human Movement Sciences, VU University
Amsterdam, the Netherlands*

Contemporary insights in perception-action couplings may be exploited in clinical settings. I will discuss recent advancements in this regard that have been developed within our research group. For example, Lissajous feedback has been shown to help overcome the coupling tendencies between the arms during bimanual performance. By using this type of feedback as a basis for computer games, we developed a serious gaming training for children with cerebral palsy, aimed at loosening the coupling between the arms. In addition, an instrumented treadmill (C-mill®) has been developed that allows for attuning acoustic and visual cueing patterns to an individual's gait characteristics. Visual cues may include stepping targets as well as obstacles to avoid. By presenting irregular cueing patterns or by suddenly perturbing the pattern, gait adaptability can be assessed and trained. Recent results of such gait adaptability training in CVA patients will be discussed.

ABSTRACTS OF POSTER PRESENTATIONS

Obstacles are treated differently than targets when adjusting hand movements in dynamic environments

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In a previous study, we analyzed hand movement corrections in response to displacements of targets and obstacles (Aivar et al., 2008). We found that it took more time to respond to the displacement of an obstacle than to the displacement of a target. To better understand this difference we modified the design of the experiment to make sure that the task demands were always completely identical. In each trial the hand had to pass two regions. Each region was occupied by either a target or a gap between two obstacles. Gaps matched targets precisely in terms of position and size, so there was no real reason to move differently when hitting targets than when passing through gaps. All possible combinations of successive regions were tested (in separate blocks): gap–target, target–gap, gap–gap, target–target. In 80% of the trials a displacement of one of the objects occurred. We found that participants responded faster to a target displacement than to the displacement of a gap at the same location, although it was evident that the required responses were identical. These results show that targets are treated differently than obstacles in movement control.

Aivar, M. P., Brenner, E., & Smeets, J. B. J. (2008). Avoiding moving obstacles. *Experimental Brain Research*, 190, 251-264.

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Quantifying forms of sensorimotor coupling with the situated-HKB model: What robots can tell us about ecological psychology

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We present what we call "the situated-HKB model", where a sensory input modulates the control parameter of the HKB model and the phase relation maps into a motor function that affects the agent-environment relationship in a simulated robot performing a gradient climbing task. We show how sensorimotor situatedness can qualitatively change the dynamic properties that have traditionally been attributed to the HKB model under parametric analysis. The analytic solution of the coupled agent-environment system (together with 1/f noise analysis of the coupling dynamics and a set of virtualization and perturbation experiments) allows us to distinguish between two types of sensorimotor coupling: reactive and interactive. Interactive coupling is defined by pink 1/f noise, weak internal attractor strength and fine grained sensorimotor coordination dependence. We generalize from our model and discuss the consequences of the dynamic properties of "interactive coupling" for the discussion over the constitutive vs. instrumental role of movement for perceptual invariants.

Direct perception: Contribution of Peircean pragmatism to the ecological approach

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This paper aims at identifying elements of Peircean Pragmatism that contribute to the study of direct perception presented by the Ecological approach. To do so, we will develop a discussion of possible approximations between such accounts in relation to the study of perception. First, we will present the Peircean approach to perception, which involves three elements: *percept*, *percipuum* and *perceptual judgment*. The *percept* simply appears in a spontaneous way to the organism, it is non-inferential. The *percipuum* suggests an understanding of a non-conceptual grasping of information available in the organism-environment system. The *perceptual judgment* encompasses information processing and interpretation that allows the organism to distinguish the existing elements of the external world. Next, we will describe the Ecological approach to perception, which is based on the notions of affordance and reciprocity. Finally, we will investigate in what extent Peircean Pragmatism contributes to the study of direct perception based on the notion of information.

A Kinect-based sensory substitution device on the torso and time-to-contact experiments

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This presentation concerns a sensory substitution device consistent of 72 coin motors placed on the torso. We (1) show a mobile version of the device in which a Microsoft Kinect is used to make vibration contingent on distance, (2) describe informal tests with this mobile device, and (3) present laboratory results of time-to-contact experiments performed with the 72-element matrix connected to a PC (i.e., without the Kinect). Controlling the device with a PC allowed us to create expansion patterns, which contain candidate variables for time-to-contact perception (e.g., haptic size, haptic tau, etc.). In the laboratory tasks participants estimated the arrival of a (simulated) approaching sphere. Observations include, first, comparisons between informational domains (visual, haptic, and visuohaptic); which helps us to determine to what extent a sensory substitution device based on this kind of informational patterns is exploitable for the perception of time-to-contact. Finally, a second comparison, between candidate variables for haptically-based time-to-contact perception, is addressed.

Intentionality: New horizons from the ecological philosophy perspective

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²*Federal University of ABC, SP, Brazil*

This paper aims to enquire into the nature of intentionality, focusing on its dispositional properties, from the perspective of ecological philosophy. Inspired by the works of Gibson (1986) and Petrusz and Turvey (2010), we propose a concept of intentionality, which is grounded on information conceived as law-like regularities. We claim that the central properties of intentional states are: (1) they afford orientation for action, (2) they indicate events in the world, and (3) they allow the identification of a state of affairs being about another, for embedded embodied organisms. In this context, the main problem to be investigated is: What is the ontological nature of intentional states? A provisional answer shall be given from an informational perspective that characterizes intentionality as a network of dispositional states that expresses law-like regularities of the organism-action system.

Gibson, J. J. (1986). *The ecological approach to visual perception*. New Jersey: Lawrence Erlbaum Associates.

Petrusz, S. C., & Turvey, M. T. (2010). On the distinctive features of ecological laws. *Ecological Psychology*, 22, 1, 44-68.

Affordances as dispositions: An ontological ground for perception

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Universidad de Granada, Spain

Ecological psychology provides us with an attractive framework to explain how agents deal with their environment. Among the concepts developed within the field, the concept of 'affordance' is key to understand how an agent is capable of adapting itself to a changing ecosystem: These are opportunities for action, and for those opportunities to be taken it is necessary both an environment and an agent. If that is the minimal basis for perception and it requires of two elements to be achieved, our proposal is to apply the very notions related to dispositional realism (readiness, directedness, etc) as a new way to clear up the very notion of 'affordance' within the debate on the ontological status of the concept.

Mechanical impedance as information for haptically perceiving another person

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²*Waseda University, Japan*

Through dynamic touch, people can perceive the properties of not only objects but also persons. This study aims to clarify how the affordances of persons are perceived haptically. In our experiment, we blindfolded our participants and asked them to hold stationary one of the two ends of a rigid rod and then haptically identify the person holding the other end. The mean percentage of instances of accurate identification was 75.0%. This result shows that humans can haptically recognize another person even by only touching a rod. In order to reveal the mechanism responsible for the high identification accuracy, we applied independent component analysis to the acceleration data measured on both ends of the rod and extracted the features of each person. The results of this analysis suggested that individuals differ in their mechanical impedance characteristics. We discuss the possibility that people can be identified using their mechanical impedance characteristics.

High-density EEG study into infants' prospective control of gaze

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Eye movements are among the first actions available to human infants to explore and learn about the world. But how accurate are infants in following moving objects? Six 8- to 9-month-old infants and one adult (as control) visually tracked a horizontally fast-moving car, where its final approach was temporarily occluded. Gaze and high-density electroencephalogram (EEG) were simultaneously recorded during the session. After tracking the car with the head and eyes for some time, the adult performed an anticipatory gaze jump to the other side of the occluder and waited for the car to reappear. Such a gaze jump could only be detected in 23% of the infant data. Infants showed a significantly lower activation of frontal sources and higher activation of visual sources, compared to the adult. This suggests that the information for gaze control is processed in visual cortical, but not yet in frontal areas of the developing infant brain.

1+1≠2: Non-trivial interactions in bimanual reciprocal aiming

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²*Theoretical Neuroscience Group, Institut de Neuroscience des Systèmes, INSERM UMR 1106, Marseille, France*

The pattern-dependent stability of coordination and the tradeoff between movement speed and accuracy are among the most robust findings in the movement sciences. In the absence of accuracy constraints, 1:1 coordination is easier and more stable than $n:m$ coordination, and in-phase coordination is more stable than anti-phase coordination. The speed-accuracy tradeoff is mostly studied using Fitts' task, in which a participant moves between two targets. The gradual scaling of task difficulty (via target amplitude and/or width) evokes gradual changes in the dynamics leading to a bifurcation between discrete and rhythmic movements. We investigated the learning of a bimanual Fitts' task demanding that both the spatial and temporal constraints are dealt with simultaneously and here present our preliminary findings. One group of participants was challenged to learn the task in a 1:1 in-phase mode whereas another group was challenged to 'decouple' under asymmetric task difficulties. Both hands (left, right) were also tested for unimanual performances, which served as control conditions. Initial analyses show an increase of instances of $n:m$ locking (which was not imposed) in the decoupled group with learning. Further, multiple examples were observed where the dynamics pertaining to both hands in the bimanual conditions were both different relative to their unimanual counterparts. The latter finding cannot be explained by the 'standard' HKB coupling, and indicates that the (informational) constraints under dual task conditions are more than the simple addition of those pertaining to each task separately.

A revised Newell model of constraint-based motor coordination

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²*School of Psychology, Queen's University Belfast, Belfast, UK*

It is proposed to question the three categories of constraints (task, organismic and environmental) that specify the emergence of coordinated patterns of movement (Newell, 1986). The suggested model considers the task not as a separate constraint but as a property of the interaction between the organism and the environment. On this basis, the task becomes a situated character (a situation) within a direct and bidirectional interaction between organism and environment. This individual-environment relationship allows the emergence of this unique situation which shapes the resulting pattern of motor coordination. The restructuration of Newell's model with only two constraints emphasizes the role and the importance of the embodied situated organism in the understanding of motor coordination. Furthermore, this ontological simplification allows the model to be extended to accommodate the emergence of interpersonal coordination among two or more individuals.

Newell, K. M. (1986). Constraints on the development of coordination. In M. Wade & H. Whiting (Eds.), *Motor development in children: Aspects of coordination and control* (pp. 341–361). Amsterdam: Nijhoff.

Reorganization of visual skills in an expert *kendama* player

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²*Waseda University, Japan*

According to Gibson (1966, 1979) and Reed (1996) postural control is an activity in which the actor orients to the environment and keeps the perceptual systems tuned to available information. In line with this idea, Ito, Mishima and Sasaki (2011) demonstrated that postural control, especially head movements in response to visually perceived information, contributed to successfully performing the skilled task "Swing-in," which is one of the skills of *kendama*. In this study, we examined the reorganization of visual perceptual skills in *kendama* by manipulating the visual environment using a visual occlusion device mounted on goggles. One *kendama* expert participated in the experiment and performed Swing-in wearing special goggles, in which the lenses were designed to open and close rhythmically at preset intervals (experimental condition). She practiced 300 trials of Swing-in under the experimental condition and 30 trials with normal vision in the control condition, before and after the experimental trials. *Kendama* sessions were conducted twice a week for four weeks. We analyzed how the *kendama* expert was able to achieve skillful performance in the experimental condition using data of the *kendama* ball and the participant's movements. The role of visual perception on expert performance and in learning the visual control of posture is discussed on the basis of these results.

Gibson, J. J. (1966). *The senses considered as perceptual systems*. Boston: Houghton Mifflin.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Ito, M., Mishima, H., & Sasaki, M. (2011). The dynamical stability of visual coupling and knee flexibility in skilled *kendama* players. *Ecological Psychology*, 23, 308-332.

Reed, E. S. (1996). *Encountering the world: Toward an ecological psychology*. New York: Oxford University Press.

Object size affects haptic object identification

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¹*Keio University, Japan*

²*Meisei University, Japan*

This research shows that in object identification using only haptics, participants explored the object by different types of action. In the case of a large object that could not be enclosed by one hand, they slowly explored it using the whole hand. In the case of a small object that could be enclosed in one hand, they explored the whole object. That is, they rolled it and adjusted its orientation using mainly the fingertips (Experiment 1). But as the object increased in size, it also became heavier. It is possible that the difference in the exploration procedure was not because of its size but its weight. Therefore, we also examined different-size but same-weight objects. The result indicated that, irrespective of the target weight, the exploration procedures were different according to the object's size; that is, the object's size determined the type of exploratory action (Experiment 2).

Niche and affordances: An investigation within the Ecological Philosophy perspective

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The main goal of this work is to investigate the existent relation between affordances and niches within the Ecological Philosophy context. Therefore, the question that will guide our investigation is the following: Would it be possible to modificate a niche considering the emergence of order and control parameters which directs the actions of organisms? Our main hypothesis is that affordances, characterized as the possibilities that the environment provides for organisms to act (Gibson, 1986), constitute a viable attempt to answer the question that guides our work. A niche is constituted by the dynamic relationships that certain organisms establish with others and with the environment; it can be investigated through the main concepts that underlies the Ecological Philosophy, which are: the complex systems, the ecological information and the affordances.

Gibson, J. J. (1986). *The ecological approach to visual perception*. New Jersey: Lawrence Erlbaum Associates.

Learning to step on a target object with a sensory substitution device on the leg

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The present experiment investigates learning and perception-action coupling with a sensory substitution device placed on the lower leg. The device consists of a vertical array of 32 coin motors. The intensity of vibration of each motor is a function of the distance to the first-encountered surface in the task environment (in a particular direction). A total of 28 participants tried to step on ground-level target objects during about 3 hours. Participants were divided into 4 groups that practiced the task under different conditions: (1) with full vision, (2) with vision on 50% of the trials, (3) with vision decreasing from 80% of the trials in the beginning of the training to 20% at the end of the training, and (4) without vision. The kinematics of the stepping action were recorded. Preliminary analyses showed that performance improved significantly from pretest to posttest, in all practice conditions. Our study illustrates that the notions of information (in this case haptic flow) and perception-actions coupling may be fruitfully applied in sensory-substitution research.

Movement registration and kinematic variables in deceptive and non-deceptive penalty kicks

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² *Universidad Autónoma de Madrid, Spain*

This investigation studied the relationship between penalty takers' kinematic variables and the direction of the kicked ball. Kinematics were recorded for 720 penalty kicks, taken by professional and semi-professional players of the Portuguese Second Division, in an official-dimension setting. Penalty takers were asked to shoot left or right without simulation (non-deceptive condition) or to simulate a shot to the opposite side (deceptive condition). Correlation and regression analyses were performed on the kinematics of the penalty takers, with shot direction as dependent variable. Several sources of information, both local and collective variables, acquired a high correlation with ball direction at a temporal window prior to ball contact. Whereas some of these variables showed significant differences in their relation to ball direction depending on the deceptive condition, other kinematic variables were not significantly affected. We interpret these results as showing the principle of non-substitutability of genuine actions.

Temporal information drives motor adaptation to temporal delays

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²*Institute for Brain, Cognition and Behaviour (IR3C)*

³*Research Institute MOVE, Faculty of Human Movement Sciences, VU University Amsterdam, the Netherlands*

Visual feedback is known to be important when hitting moving objects. We know that people adapt to delayed visual feedback. The aim of this work was to study which kind of information drives adaptation to these delays. We designed a task where participants had to hit a target that moved in different directions and speeds. In different sessions, the nature of the feedback on the performance was varied. In some sessions, we provided spatio-temporal information: (1) seeing a moving cursor representing participants' position throughout the movement, or (2) seeing the moving cursor only the last 33% of the trajectory, which is not enough time for online corrections. In others, feedback consisted of showing the spatial error (end-point error). In all cases, the feedback was temporally delayed and this delay was increased trial-by-trial (reaching a total of 200ms). Results show that adaptation to temporal delays appears when the system has access to temporal information but not when feedback consisted of the spatial error only. We conclude that temporal adaptation needs the system to compare predicted and actual motion of the hand.

The effect of ambient sound on body sway while standing

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³*Waseda University, Japan*

Ambient sound consists of radiant sounds, their reflected sounds, and reverberations. Unsurprisingly, both sound upon which one is focused and ambient sound, which is not necessarily apparent to one's consciousness, provide animals and humans with information for controlling their behaviors. Individual participants were blindfolded and asked to remain standing still under five conditions, in each of which the ambient sound structure changed. In the first condition, participants stood still in the middle of a non-insulated, ordinary meeting room with background noise. In the second condition, about a hundred vertical wooden rods (1.5 m high) for scattering the sounds, were placed in the room to make a Π -shaped array. Participants were asked to stand at the center of the Π -shaped enclosure with their backs to the opening. In the third to fifth conditions, a flat wooden surface, which was supposed to work as a specular reflector, was set against one of the three internal sides (front, left, or right) of the enclosure. The motions of the body and the center of pressure were measured. Body sway data indicated a relationship between the fluctuation patterns of sway and the reconstructed ambient sound structures caused by changes in the layout of surfaces in the room.

Social affordances and personal identity in the context of virtual environments

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The objective of this work is to analyze the importance of social affordances for the perception of personal identity in the context of virtual environments. According to Gonzalez (2011), social affordances can be characterized as second degree properties emerging from the relationship between the physical affordances and invariants that are collectively shared by organisms in specific niches. We will try to argue in this work that, in terms of information networks, the perception of social affordances understood as collective informational properties can help us identify people in the virtual environment. This is because when we perceive the collective patterns that constitute people's lives, we perceive ecological properties related to their specific environments and individual trajectories. Our hypothesis is that the addition of the virtual environment to the physical environment in which people are embedded provides access to information concerning their evolutionary-historical process and consequently their "identities".

Gonzalez, M. E. Q. (2011, October). *Class notes*. State University of São Paulo, Brazil.

Towards a more ecological notion of intention

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It is usual in philosophy, but also in psychology, to understand an agent's intentions as a particular mental state. Typically, intentions are depicted as a specific kind of intentionality, that is, as mental states characterized by their *aboutness* (*i.e.*, their propositional content). This characterization, proper to an individualistic and internist approach, considers that the inner states of an agent are, somehow, independent of the context and necessarily previous to action. My proposal is that an ecological approach to perception and action should not disregard the need of a situated and active notion of 'intention'. We cannot forget the link between perception, action and intention. Having an intention is strongly related to the possibilities of action that an agent perceives, and there is a dynamical interaction between all these elements. I will defend that an agent's intentions are not characterized by their aboutness, but by their *directness* (Reed, 1996). In that sense, an agent's intentions are possible action flows, rather than mental contents. These intentions are directed to different elements and objects in the world, and allow the agent to get involved with her environment in very specific ways. Finally, I would like to show that an inferentialist point of view to explain how we understand others' intentions is the heritage of an internalist approach. A situated explanation will allow us to suggest that others' intentions may be perceived, in the means that their bodies, their movements and their environments are meaningful for us, as some studies on developmental psychology show (Reddy, 2008). To conclude, thinking that intentions are mental contents isolated and inaccessible could be conceptually confusing. If we recognize that our bodies are situated in the world, we cannot neglect that our minds are situated too.

Reddy, V. (2008). *How infants know minds*. Cambridge, MA: Harvard University Press.

Reed, E. D. (1996). The intention to use a specific affordance: A conceptual framework for psychology. In R. Wozniak & K. Fischer (Eds.), *Development in context: Acting and thinking in specific environments*. Hilldale, NJ: Erlbaum.

Age-related changes about haptic shape perception

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Haptics and cutaneous sensation of the hand play an important role when one extracts information about an object by touch. To investigate how age-related changes influence their roles in sensation, we compared three groups: two younger groups with or without a pair of gloves and an elder group. We measured exploration time to identify the object and the number of kinds of action. As result, for soft and complex objects, the younger with glove group and the elder group could not accurately identify the object. For example, to identify a sponge, the average exploration time was as follows: younger without glove, 58.6 s; with glove, 78.6 s; and elder, 87.5 s. The average number of kinds of action was as follows: elder, 7.5 items; younger without glove, 9.5 items; and with glove, 11.6 items. That is, the finger movement of the younger with glove group was faster and explored more items than that of without glove group. In contrast, the elders group's hands remained longer on one object.

Closing the gap between eye movements and perception in sport: The case of football penalty saving

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Eye tracking has represented over the last decades one of the most used techniques for studying perception in action, particularly in sport contexts. Yet, nowadays it remains unclear whether eye movements are fully representative of perception. Usually, eye-tracking data have been analyzed and interpreted under a specific theoretical paradigm (the cognitive one). We will present a brief review about how this topic has traditionally been approached (focusing on the cognitive approach), and some theoretical and methodological issues concerning the recording and the analysis of visual data. For instance, visual fixation has not always been considered within the same range of time. Then, we will try to relate eye movements to visual perception using the penalty saving action as an example. To this end, we will make use of some relatively new alternative paradigms like the ecological approach, the sensorimotor approach, and two visual systems in order to temporally and spatially situate eye tracking into perception in action.

The relationship between dwelling and locomotion: Discovering the house during the first 2 years of life

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Learning and knowing about one's living environment constitutes a central human activity. The term "dwelling house" includes locomotion from place to place within that space. Infants cope with changes in their bodies, skills, and environments from birth. Although several studies have examined a variety of habitats, little is known about infants' daily surroundings. This study examined the ecological niche utilized or occupied by infants from the perspective that, although adults and infants share the same physical environment, their environments differ in other ways. Two infants were observed in their houses in Japan during their first 2 years of life. The relationship between infants' actions and their locations were examined, including bouts of exploration in a variety of places. The results showed that the exploratory process involving locomotion focused on two types of configurations, enclosures and objects. This suggests that novel layouts in new environments present increased opportunities for infants in such environments.

Two guidelines to reconstruct an alternative evolutionary psychology: A Gibsonian assessment

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Universidad Nacional de Córdoba, Argentina (UNC), Centro de Investigaciones de la Facultad de Filosofía y Humanidades (CIFYH), Consejo Nacional de Investigaciones Científicas y Tecnológicas (CoNICeT)

I assume that it is possible to reconstruct an alternative tendency to evolutionary psychology, already in the observations that Lehrman (1953) sketched to Lorenz and then following the path traced by discussions within evolutionary biology as well as in cognitive psychology (Lickliter, 2000; Lickliter & Honeycutt, 2003; Lickliter & Schneider, 2006; Rabinovich, *in press*). Upon this basis, one distinctive feature of this tendency is centered in the characterization of systematic interactions between organism and environment during ontogenetic developmental processes. I propose two guidelines so as to recognize the value of this line of research: on the one hand, through the reconstruction of the studies in terms of the description of peculiarities of the functional specialization processes; on the other hand, by tracking interpretations of the features of the environmental structuration that systematically gives rise to cognitive development. In particular, I will reintroduce the notions of *perceptual system* and *affordance* (Gibson, 1979) in order to evaluate the style and richness of these investigations.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Lehrman, D. S. (1953). A critique of Konrad Lorenz's theory of instinctive behavior. *The Quarterly Review of Biology*, 28, 337-363.

Lickliter, R. (2000). An ecological approach to behavioral development: Insights from comparative psychology. *Ecological Psychology*, 12, 320-328.

Lickliter, R., & Honeycutt, H. (2003). Developmental dynamics: Toward a biologically plausible evolutionary psychology. *Psychological Bulletin*, 129, 819-835.

Lickliter, R. & Schneider, S. (2006). Role of development in evolutionary change: A view from comparative psychology. *International Journal of Comparative Psychology*, 19, 151-169.

Rabinovich, D. L. (*in press*). Hipótesis evolutivas para la cognición humana: Claves para una lectura alternativa. In *La representación en la ciencia y el arte: Selección de trabajos del V Simposio Internacional*. Córdoba: SIRCA Publicaciones Académicas.

A new method to assess dribbling competence in basketball

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The dribble is a fundamental skill in basketball and is used to create advantage in a 1x1 situation. We hypothesized that the players' amount of experience is a variable that influences the players' control over the dribble action. This study aims to create a method to assess the dribble control, which applies to the 1x1 situation in basketball. Situations were analyzed with 3D motion analysis software. The variable aiming to describe the ball - hand coupling was grounded on an imaginary plane intersecting the center of the ball that is parallel to the plane of the palm of the hand at the time of contact. The average distance between the central points of both planes could represent the quality of the dribble. Two groups, with distinct levels of expertise, were compared. Although there were no significant differences between groups concerning mean values, the coefficient of variation assessment suggests that results stability might be an indicator for the quality of the dribble.

Patterns of interpersonal coordination in rugby union: Analysis of collective behaviors in a match situation

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Teams sports collective behaviours are grounded on dynamic interactions that take place in a mutual and reciprocal relation between individual and the context. This study aims to understand if interpersonal coordination in team sports of rugby union necessarily demands an adaptive behavior from the players involved on each sub-phase of the match. For that purpose the authors used videogrammetry and digitizing procedures as a method of analysis of interpersonal coordination that took place during the formation of attacking subunits in rugby union. The results showed the existence of three types of outputs, which differ depending on the interpersonal coordination between attackers and defenders. Therefore, for high and positive correlation values (r values between $0.8 < r < 1$), possibilities of action exist that lead to success when the opponents have either inverse or lower correlation values. The conclusion was that interpersonal coordination within subunits becomes a relevant factor in analyzing the success in each match sub-phase.

An initial approach to violin technique from Bernstein's hypothesis

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Playing musical instruments demands a sophisticated and complicated process of learning. This fact has drawn the attention of researchers interested in motor coordination and movement control (Bernstein & Popova, 1930/2003; Baader et al., 2005; Konczak et al., 2009). The violin is one of the most representative musical instruments of this laborious development of motor coordination. Besides, it is important to take into account that the violin's physical composition is the result of a history of many centuries, a process guided by aesthetic goals (Boesch, 1993/2002). Our approach is based on Bernstein's hypothesis about the development of motor coordination. This hypothesis claims that at first the system tries to freeze those degrees of freedom at the periphery that could interfere with the resolution of the task (Bernstein, 1940/1967). Nevertheless, when dexterity in the task improves, the system would lift these restrictions and incorporate some degrees of freedom into a coordinated structure (Bernstein, 1940/1967). According to these principles, we try to relate values of various angles on the violin and on the body with dexterity level. For that purpose we registered the movements of violinists of diverse experience levels and checked the relevance of Bernstein's hypothesis with regard to our experimental data.

Baader, A. P., Kazennikov, O., & Wiesendanger, M. (2005). Coordination of bowing and fingering in violin playing. *Cognitive Brain Research*, 23, 436-443.

Bernstein, N. A. (1967). Biodynamics of locomotion. In N. Bernstein (Ed.), *The co-ordination and regulation of movements* (pp. 60-113). Oxford: Pergamon Press. (Original Work published 1940)

Boesch, E. E. (1993). El sonido del violín. In M. Cole, Y. Engeström, & O. Vasquez (Eds.; 2002), *Mente, cultura y actividad: Escritos fundamentales sobre cognición humana comparada* (pp. 133-147). México: Oxford University Press.

Bernstein, N. A., & Popova, T. S. (1930). Studies on the biodynamics of the piano strike. English translation (from Russian) published in 2003: *Motor Control*, 7, 1-45.

Konczak, J., Velden, H. V., & Jaeger, L. (2009) Learning to play the violin: Motor control by freezing, not freeing degrees of freedom. *Journal of Motor Behavior*, 41, 243-252.

Perceiving action during action execution: Intentional effects

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Perceiving an action is supposed to activate neural networks involved in the execution of this action (Rizzolatti & Craighero, 2004). Kilner et al. (2003) showed that performing arm movement while watching a human performing an incongruent movement increases movement variability (interference effect). This effect disappears when an industrial arm robot replaces the human arm movements, indicating that the anthropomorphism property plays an important role in that neural network. Oztop et al. (2005) confirmed such a statement by showing that this effect is present when the robot depicts humanoid appearance. Moreover, it was recently proposed that instructions might significantly affect human-robot interactions (Chaminade & Cheng, 2009). The following experiment compared human-human/artificial agent coordination when participants were not asked explicitly to synchronize with the confederate. Using spatial and temporal measures, our results show that non-intentional coordination can be used to assess questions about agency and to investigate specific properties of the perception-action system like entrainment or mimicry.

Chaminade, T., & Cheng, G. (2009). Social cognitive neuroscience and humanoid robotics. *Journal of Physiology-Paris*, 103, 286-295.

Kilner, J., Paulignan, Y., & Blakemore, S. (2003). An Interference effect of observed biological movement on action. *Current Biology*, 13, 522-525.

Oztop, E., Franklin, D. W., Chaminade, T., & Cheng, G. (2005). Human-humanoid interaction: Is a humanoid robot perceived as a human? *International Journal of Humanoid Robotics*, 2, 537-559.

Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience*, 27, 169-192.

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Modeling social motor coordination in Schizophrenia

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Even if schizophrenia is known to affect social interaction, reasons of such impairment remain unclear. Social motor coordination has been suggested as being an important embodiment of healthy social exchanges. Therefore, we examined whether social motor coordination is affected by schizophrenia. Investigating patients unintentionally and intentionally coordinated with control participants showed that schizophrenia decreased intentional but not unintentional coordination. A model is proposed to describe and understand such results. This model suggests that such a pattern of coordination impairment might be due to two intertwined processes: a decrease in the information exchange, and a delay in the information incoming from healthy participant's movements. Our study encourages further explorations of interpersonal motor coordination in schizophrenia and suggests new perspectives in characterizing and improving social interactions of patients suffering from social impairments.

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Learning of a visually guided balance task: A direct learning perspective

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According to the Gibsonian perspective, events and objects are specified by the information available in ambient energy arrays. Perception is thus said to be direct, in opposition to theories that posit the need for intermediate processes of disambiguation or enrichment of poor stimuli. Under an analogous perspective, the ecological approach to learning posits that learning is not based on increasing the sophistication of enrichment processes, but instead is a matter of educating attention to invariants in energy arrays. The theory of direct learning (Jacobs & Michaels, 2007) sees the informational variables relevant to perception and action as constituting a continuous, low-dimensional space. Learning is portrayed as an information-guided movement through the space to a locus that gives better support to performance. The research reported here (Jacobs, Vaz, & Michaels, 2012) explores an application of the theory of direct learning to a visually guided balancing task: Participants moved a cart constrained to a linear track to balance a pole fixed on an axis in the cart.

Jacobs, D. M., & Michaels, C. F. (2007). Direct learning. *Ecological Psychology*, 19, 321-349.

Jacobs, D. M., Vaz, D. V., & Michaels, C. F. (2012). The learning of visually guided action: an information-space analysis of pole balancing. *Journal of Experimental Psychology: Human Perception and Performance*. [Epub ahead of print]

**The problem of the object of study in the dynamical approach
in cognitive science: A philosophical appraisal based on R.
Beer's research program in computational neuroetology**

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I tackle the problem of the delimitation and configuration of the object of psychological study, attending particularly to the recent dynamical approach in the cognitive sciences (van Gelder & Port, 1995; Beer, 2000). I defend the idea of a considerable, discernibly Gibsonian, reconfiguration of the object of study which can be defined in terms of the formative principles of adaptive behavior, abstract principles derived from agent-environment interaction dynamics. To sustain this claim, I focus on the methodological restrictions defining a representative line of dynamicist work: the categorical perception model in computational neuroetology developed by Randall Beer (1996, 2003). By analyzing this model, I highlight the way a group of phenomena is successfully transformed into a scientific domain upon which certain problematic issues become treatable through the specific tools available in the context of current dynamical research.

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- Beer, R. D. (2000). Dynamical approaches to cognitive science. *Trends in Cognitive Sciences*, 4, 91-99.
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