Corps agissant – Monde parlant

Acting body – Speaking world

Journée du programme *Perception Sémiotique et Socialité du Sens*

13 Mai 2009

Collège de France – Institut de Biologie
11, pl. Marcelin Berthelot 75005 Paris

9h **Jean-Luc Petit :**
Corps agissant – Monde parlant : une Phénoménologie corrélationnelle

9h40 **Friedemann Pulvermüller :**
Language woven into Action: From Wittgenstein to Brain & Cognitive Sciences

10h20 **Luciano Fadiga :**
The Motor Somatotopy of Speech Perception

11h **Natalie Depraz :**
Husserl et la Pratique du Langage Phénoménologique

11h40 **Maurizio Gentilucci :**
Language, Manual and Vocal – A Shared Communication System

13h **Repas**

15h40 **Guglielmo Tamburrini :**
The Brain and its Language in the Control of Robotic Actions

16h10 **Carmela Morabito :**
Action as a Cognitive Factor in a Historical Perspective

16h40 **Massimo Stanzione :**
The Motor Theories of Language Origin – A Critical Appraisal

17h10 **Jean-Luc Schwartz :**
Elements of a Perceptuo-motor Morphegenesis of Language Units

17h40 **René-Joseph Lavie :**
Towards a Model of Linguistic Know-how: Exemplars, Episodes, Alterit

18h10 **Christopher Macann :**
Action – Expérience – Expression

18h40 **Discussion générale**

Corps agissant – Monde parlant / Acting body – Speaking world

Des données récentes amènent les neurosciences à réévaluer le système moteur de l'homme en tenant compte du fait qu'il n'est pas uniquement dédié à des fonctions exécutives, mais qu'il contribue aussi à la perception et la compréhension du sens des actions d'autrui ainsi qu'à la communication par l'expression verbale. Au plan empirique, certaines théories « motrices » de la perception des objets de l'environnement et des gestes et expressions linguistiques en retirent un évident regain d'actualité. Au plan philosophique, les mécanismes de l'organisation biologique de l'être humain ainsi mis au jour sont peut-être une condition naturelle de possibilité de « l'incarnation du sens », thème de la phénoménologie. On sait que Heidegger et Merleau-Ponty – et déjà Husserl – avaient souligné la contribution du corps propre des sujets dans leurs interactions pratiques à ce que le Monde soit pour eux le champ sémantique des configurations linguistiquement exprimables. Cette journée interdisciplinaire réunira des neurophysiologistes, des linguistes et des philosophes pour déterminer ce que la découverte des mécanismes de résonnance entre les aires somatomotrices et les aires sensorielles du cerveau humain a pu apporter à une meilleure compréhension du lien « Action – Expression ».

Recent research has led the neurosciences to re-evaluate Man's motor system in the light of the fact that it is not exclusively devoted to executive functions but contributes to the perception and understanding of the meaning of the actions performed by others, as also to verbal communication. At the empirical level, certain 'motor' theories of the perception of objects in the surrounding world and of linguistic gestures and expressions have certainly benefited by an updating from this development. At the philosophical level, it is possible that the mechanisms governing the biological organisation of human being, thereby brought to light, feature as a natural condition of the possibility of 'incarnating meaning' – a major theme of phenomenological philosophy. We know that Heidegger and Merleau-Ponty – and Husserl before them – stressed the contribution made by embodied subjects in their practical interactions to the semantic field of the world's linguistically expressible configurations. This interdisciplinary one-day conference is intended to bring together neurophysiologists, linguists and philosophers, with a view to figuring out what the discovery of resonance mechanisms between the somatic-motor and sensory areas in human brain has brought to a better understanding of the connection between Action and Expression.

13 Mai 2009, 9h-18h

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Language Woven into Action: From Wittgenstein to Brain and Cognitive Sciences

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That language is “woven into action” was a postulate made by the late Ludwig Wittgenstein. That this could one day be proven in a very literal sense was probably not expected. However, recent work in neuroscience proved that the language system of the human brain is functionally connected with the action system controlling simple bodily movements and complex interactions. When subjects understand action words, their motor and premotor cortex become active. The motor system activations are so specific that they reflect aspects of the meaning of action language. For example, words referring to actions preferentially performed using the arms or legs, respectively “light up” arm and leg representations in the cortical motor system. Such activation emerges in fMRI recordings for single words, but also for sentences and, critically, abstract sentences that include arm- or leg-related words but otherwise seem abstract in their meaning ("She grasped the idea", "He kicked the habit"). This indicates that aspects of the meaning of single words contribute to meaning composition of abstract language along with a role of action links in such abstract meaning processing.

But are the motor activations in language processing a reflection of meaning comprehension and semantic memory – or rather a secondary consequence thereof? To answer this question, we have looked at the time course of cortical activation in action word comprehension. It emerged that the transmission of neuronal activity to motor systems emerges rapidly, within 200 milliseconds after the critical stimulus information was presented. This early activation, which is comparable to the earliest semantic activations reported so far, argues against a secondary effect and suggests that activation spreading to motor systems is a direct reflection of the comprehension of the words’ action reference. Correlation analyses provide further support for this idea.

Even though action activations are specific, in concrete and abstract semantic processing, and rapid, one may still question their functional relevance: Are motor activations important for language processing? Couldn’t it be that activation just “overspills” to the motor system off and on and that the functional links do not carry any critical function? To answer these questions, research has to focus on functional changes caused by changes of the brain. Patients with Motor neuron Disease show specific impairments in processing actions and action words and a similar deficit is visible after focal lesion in the motor system, even after small lesions in the motor cortex of the non-dominant hemisphere. The pattern of lexical and semantic deficits in Semantic Dementia (a special kind of frontotemporal dementia), which substantially degrades lexical

and semantic processing, still indicates differences between word categories consistent with a role of category-specific circuits in different parts of the frontal and temporal system for processing motor and visual information. In TMS experiments, functional activation of the motor cortex was demonstrated to influence specifically the processing of linguistic information and in memory experiments, we recently proved that bodily actions specifically impairs or facilitates category-specific action word memory.
These results show that motor system activation reflecting the meaning of language is specific, present in a range of linguistic processes, rapid, and functionally relevant. This is clear evidence that language-action links represent a critical part of the human semantic system. The results are best explained by distributed circuits including motor, sensory and linguistic representations as the cortical basis of language processing. Semantic circuits in these networks are category specific and involve sets of local clusters of cortex that process specific aspects of referential semantics.

The Motor Somatotopy of Speech Perception

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Listening to speech recruits a network of fronto-temporo-parietal cortical areas. Classical models consider anterior (motor) sites to be involved in speech production whereas posterior sites are considered to be involved in comprehension. This functional segregation is challenged by action-perception theories suggesting that brain circuits for speech articulation and speech perception are functionally dependent. Although recent data show that speech listening elicits motor activities analogous to production, it's still debated whether motor circuits play a causal contribution to the perception of speech. Recently we administered transcranial magnetic stimulation (TMS) to motor cortex controlling lips and tongue during the discrimination of lip- and tongue articulated phonemes. We found a neurofunctional double dissociation in speech sound discrimination, supporting the idea that motor structures provide a specific functional contribution to the perception of speech sounds. Moreover, our findings show a fine-grained motor somatotopy for speech comprehension. We discuss our results in light of a modified ''motor theory of speech perception'' according to which speech comprehension is grounded in motor circuits not exclusively involved in speech production.

Language, Manual and Vocal – A Shared Communication System

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Neurophysiological and behavioural evidence suggest that the manual and vocal languages share the same communication system. Studies of primate premotor cortex, and, in particular, of the so-called "mirror system" suggest a double hand/mouth motor command system that may have evolved initially in the

context of ingestion, and later formed a platform for combined manual and vocal communication. In humans, speech is typically accompanied by manual gesture, speech production itself is influenced by executing or observing transitive actions, and manual actions also play an important role in the development of speech, from the babbling stage onwards. Behavioural data show reciprocal influence even between word and symbolic gestures. Neuroimaging and repetitive Transcranial Magnetic Stimulation (rTMS) data suggest that the system governing both speech and gesture is located in Broca's area.

The Brain and its Language in the Control of Robotic Actions

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Brain Computer Interfaces (BCIs) enable one to control peripheral Information & Communication Technology (ICT) and robotic devices by processing brain activity on-line. The following epistemological, philosophy of mind, and ethical issues are examined in connection with BCI-controlled actions:

(i) According to so-called motor theories of thinking, the unique forms of motor rehabilitation therapy afforded by BCI systems may contrast the decline and extinction of thinking in completely locked-in patients.

(ii) Unconscious perceptual processes are used in BCI-enabled, brain-computer cooperative problem solving. There, the functional roles of human "operators" are accounted for at the sub-personal level – without appealing to their intentions, beliefs, and contents of consciousness. Since humans are neither required to act intentionally nor to be aware of their contribution to cooperative problem solving, it is appropriate to ask whether a sub-personal use of human being is lurking here.

(iii) Machine learning is crucially involved in human-machine adaptation processes required for BCI operation. The reliability of BCI learning depends on boundary conditions that are difficult to control, such as mental task execution history and overall mental context. For similar reasons, one can hardly deploy the more abstract mathematical framework of statistical learning theory to evaluate the reliability of learning. These epistemological issues distinctively shape ethical issues – notably including autonomy and responsibility problems – in current BCI environments.

Action as a Cognitive Factor in a Historical Perspective: From Reflex to Action in the Soviet 'Physiology of Activity'

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From the analysis of different aspects of scientific and philosophical thought in the XIXth and XXth centuries it clearly emerges the historical and interdisciplinary dimension of the motor theory of language and mind, which contemporary cognitive neurosciences are working at through action-perception theories. Recent neurophysiologic evidences provide a new insight about the

neural mechanisms that might underlie the process of object categorization and action understanding as well as speech production/comprehension. These processes seem to be deeply grounded in the bi-directional relationship between agent and environment, a relationship basically dependent upon action execution. In this perspective, action could be the founding principle of our knowledge of the world.
Looking at this topic through the lens of the history of science, we can see how in the course of the last two centuries, by the way of different theoretical routes, the development of both philosophy and scientific knowledge has produced a process of naturalization and progressive *embodiment* of mind, deeply changing the traditional concept of cognitive functions by rooting them in the organism's development and in its interaction with environment.
It would be possible to choose several different case studies, in order to reconstruct a sort of map to facilitate orientation within the complex theoretical landscape of this progressive naturalization of mind… Here I will only consider one single 'chapter' of this dense and stimulating theoretical framework, the so-called "Physiology of Activity" developed within the Soviet neurophysiologic and neuropsychological community in the second half of the XXth century as a deepening, a critique and, at last, an overcoming of the reflex concept.
The analysis will be especially focussed on Bernstein's work on motor control and on the motor model of mind he develops to theoretically overcome the simple S/R account of behaviour. In the words of Lurija (1987) Bernstein is "a rare case of a scientist who practically devoted his whole life to one problem: the physiological mechanisms of human movements and motor actions", a problem deeply rooted in Bernstein's interest in brain and mind, in the integrated models of behaviour and their epistemological value.

The Motor Theories of Language Origin – A Critical Appraisal

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My talk aims to a critical evaluation of some assumptions which are implied in the motor theories of language origin and, at least partially, also in the current research on Mirror Neurons (MNs). These assumptions have both an empirical and a theoretical character. They encompass three different explicative levels: the biological level (and its three explicative dimensions: ontogenesis, epigenesis and phylogenesis); the cognitive/semiotic level; and the level of the abstract categories used by contemporary – and rival – linguistic theories in order to define language as their "proper object".
(i) In my opinion, a motor theory of language origin could be better established on the basis of some bio-evolutionary scenarios: preadaptation, coadaptation, convergent evolution and exaptation. Therefore, both selective/adaptive and not selective (biologically neutral, but functionally adaptive) mechanisms could be relevant in explicating the natural origin of human capacity for developing

language. In addition, these mechanisms embrace all the three above mentioned explicative dimensions.
(ii) The semiotic and cognitive aspects have in turn a twofold "base of reduction": the "natural semiosis" (which is already present in primate cognition and primate social regulation, and which was and is a necessary premise for the development of human cognitive strategies); the social "spontaneous order" of symbolically constructed and transmitted verbal transactions (an order which constitutes the real environment, as a selective pressure for the emergence of the linguistic function in human cognition). Therefore, the debated jump from animal communicative systems to the human "proper" language could be interpreted as an effect of an amplification of the brain connective powers (extension of "natural semiosis"). This is usually linked to a systematic substitution of old and new "functional equivalences". As many authors suggest, the first step (brain powers amplification) could be an evolutionary outcome of a modified gene regulation. But the second step (the substitution of functional equivalences) directly implies the controls of "inner motions" and social interactions. Finally, some open problems will be considered. The main one is the difficulty to define the biological and evolutionary functions of some neurophysiological structures (e.g. the MNs), without conflicting with the manifold, abstract definitions of the properly linguistic functions (e.g. recursivity).

Elements of a perceptuo-motor morphegenesis of language units

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The analysis of large databases of human sound systems (e.g. UPSID, UCLA Phonological Segment Inventory Database, set up by Ian Maddieson) enables to derive a number of universal properties or clear regularities in these systems, e.g. the systematic organization in syllables alternating consonants and vowels, a preference for certain vowels (e.g. [i a u]) and certain consonants (e.g. [p t k]) in phonological inventories, a preference for certain types of phonotactic organizations in words (e.g. words beginning by a labial rather than a coronal consonant, words with a preferred number of syllables around 2 or 3), etc. These regularities should derive in our view from properties of the perceptuo-motor system making speech communication possible. We showed in a series of experiments and simulations that this seems indeed to be the case. Simulations are done in the framework of a perceptuo-motor theory of speech communication called PACT (Perception-for-Action-Control Theory), in which we consider that the units of speech communication are neither purely gestural nor purely auditory, but combine perceptual and motor properties: they are gestures shaped by perceptual processing, or percepts augmented by motor procedural knowledge. In this framework, phonological inventories should be both easy to produce (easy to control and to learn) and perceptually efficient

(that is contrastive and stable). We show how the syllabic organization could emerge in PACT, why certain vowels and consonants are preferred over other ones, and what could be a possible basis for some regularities in word phonotactics.

Towards a Model of Linguistic Know-how: Exemplars, Episodes, Alterity

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I build on a theory of linguistic know-how that I developed, the Analogical Speaker. It is exemplar-based, it refuses categories and rules, and yet it accounts for the acceptability, or non-acceptability, of utterances. It does so in a monolingual mode and also in a plurilingual mode, what few theories achieve today with precision. Thus far, linguistic form only is addressed (not the 'meaning'). I will lay the down two main lines of its extension to 'meaning' (under way): 1. The modes of presence of *alterity* in it, which are twofold : (i) in-line with polyphony theory, the source of discourse changes at defined points; this fact, which is obvious in speech report, ends up contaminating almost all of grammar, and, following a recent move made by Genette, is thematized and formalized as 'metalepsis'; (ii) episodic utterances heard by the subject are recorded with an indication of their author; this is a necessary condition to properly account for the command of speech registers (how do I address whom). 2. The notion of *episode* in linguistic theory. In a theory of linguistic know-how that restricts itself to phonology or syntax, a notion of *exemplar* may suffice: we have exemplars with low or null context specification. When striving for meaning issues however, more is required: the exemplar must be substituted with an episode; an episode in this sense is the memorable part of an experience, Carnap's *elementar Erlebniss* possibly. I will sketch out the salient requirements on this notion. Lavie, R.-J. (2005) "Interspeaker variation and learnability in an exemplar-based productive model", Communication au Congrès "Gram to Mind", Bordeaux, mai 2005. *in* Lapaire, Jean-Rémi et al. (eds.) *Du fait grammatical au fait cognitif*, Presses Universitaires de Bordeaux (2008); aussi : http://halshs.archives-ouvertes.fr/halshs-00142394.

Husserl et la Pratique du Langage Phénoménologique

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En prenant appui sur une exploration pas à pas du propos du phénoménologue dans les *Idées directrices* I, je voudrais montrer sur pièce *comment* Husserl écrit, en sorte que son rapport au langage témoigne d'un souci authentique de faire du dire un faire. Ainsi, je vais pour ce faire à quatre niveaux de sa pratique langagière : 1. l'usage des termes et des concepts répond à un fonctionnement opératoire qui précède la nomination conceptuelle ; 2. les propositions sont autant d'énonciations qui ont l'organicité d'actes à part entière ; 3. les exemples correspondent à des modes de référence discursive directe de fragments de

réalité individuée ; 4. Les modes de discours privilégiés par Husserl interrogent directement la pertinence d'une méthode en première personne. Ces quatre plans témoignent deux à deux d'un double souci d'indexicalisation (1, 3) et de performativité (2, 4). De façon à *montrer* le fonctionnement du langage adopté par Husserl, et pour éviter de continuer à parler de ce fonctionnement sans l'opérer, sur un mode théorique rémanant, je prendrai pour chacun de ces plans un exemple précis, lié à un paragraphe de l'ouvrage de 1913 : j'espère ainsi faire apparaître en acte le niveau intrinsèquement pragmatique de la phénoménologie de Husserl. N. Depraz, *Lire Husserl en phénoménologue* : les *Idées directrices* I Paris, P.U.F./CNED, 2008 ; *Husserl : une phénoménologie expérientielle*, Paris, Editions Atlande, 2009.

Action – Expérience – Expression :

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Voici les trois mots-clés de mon travail sur le langage, annoncés dans l'ordre génétique qui s'impose à l'intérieur d'une phénoménologie ontologique* pour laquelle le langage n'est qu'un thème à traiter parmi d'autres, tels l'espace, le temps, les rapports personnels, l'éthique, etc. Et tout suite on se retrouve en face d'une tradition de la philosophie linguistique qui veut que ce soit le langage (et même le langage ordinaire) qui domine et qui prescrive donc à l'expérience et à l'action leurs formes possibles d'apparence. Deux buts sont donc visés par ma philosophie du langage. D'un côté, procéder comme n'importe quel psychologue en expliquant comment l'enfant construit, d'abord, son expérience à partir de son interaction avec le monde qu'il trouve en face de lui et de façon à ce qu'il devienne capable, plus tard, de donner expression à cette expérience dans un langage quelconque et, de l'autre, faire la critique de la philosophie qui ne veut rien savoir d'un tel engagement ontologique. Bref, revenir à l'approche traditionnelle sans être inculpé d'une naïveté inacceptable vis-à-vis du langage.

*C. Macann, *Being and Becoming. A genetic interpretation of the being of human being,* I-IV, Online Originals, London & Bordeaux, 2007: sales@online originals.com.