Standing Committee for the Humanities

OMLL: The Origin of Man, Language and Languages

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Orofacial control in communication in human and non human primates (CRP 01-JA012)

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Abstract:

This project has been conceived as an integrated multi-disciplinar approach to a unique and focussed question, which is: how did human oral language evolve from pre-existing cognitive abilities in primates? This involves in fact a dialectic exploration of both continuities - searching the sensory, motor and cognitive pre-human ingredients that could have been "parasited" by speech and language - and evolutions - searching the evolutionary steps that could have filled some existing gap to provide a lacking solution to the phylogeny of oral language.

The project will capitalise upon three major research streams.

The first deals with possible prerequisites for speech in the geometry, musculature and sensorial abilities of the orofacial control system. This question has been raised in the most well-known terms by Lieberman and Crelin who postulated that Neandertals were a speechless species. The question is however more general. It concerns the possibility that the evolution of the musculature of the tongue, or the sensory innervation of the tongue-lip-palate systems could have provided a necessary basis for speech control.

The second is focussed on a series of recent discoveries from neurophysiology and neuropsycholoy, about the cortical circuits of perception-action relationship in non-human primates, and about the language circuits in humans and their relationships with the circuits of general perceptuo-motors abilities. This includes:

(1) The "frame-and-content" theory proposed by MacNeilage, which assumes that speech is made of two basic components: an oscillatory frame controlled by the medial premotor system including SMA and providing the basis of the syllable, and a segmental content controlled by the lateral premotor system including Broca, modulating this frame;

(2) the proposal of two possible circuits as precursors of language circuits: an SMA-Broca-Wernicke circuit in charge of "vocal self" tracking, and a prefrontal "Action Understanding System" with the so-called "mirror neurons" in the monkey, responding to both the production and perception of complex actions, and providing a potential pre-language sensori-motor precursor of language in non-human primates.

Lastly, a computational modelling framework is provided by "speech robotics", in which speech is considered as a sensori-motor system that must be studied with the tools of robotics: implement the articulatory models (jaw, tongue, lips, velum, vocal source), and the models of sensors (ear, eye, orosensorial tactile perception), and define a control-and-learning framework in which the system may learn basic speech controls from the observations of its sensors. This framework enables to test a number of assumptions about speech control, speech adaptability, speech acquisition in relationship with speech evolution, speech representations, etc.

The "Orofacial Control" project will bring together a number of specialists of speech and language with neurophysiologists, psychologists, anthropologists and specialists of modelling in robotics, who have all played an important part in the progress and discoveries described above, and organise their work in three strands which correspond closely to the three streams cited above:

* *Strand 1 - A comparative study of peripheral orofacial constraints*
* *Strand 2 - Frontal cortical circuits of action control in non-human primates*
* *Strand 3 - Speech control and speech robotics*