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Gestures in the 4th Dimension

Paul Bouissac
University of Toronto (Victoria College)

Any gesture can be defined as a *change* in the space coordinates of an articulate body. But, to be construed as a gesture, such a *change* must carry some meaning in the actual or virtual community in which it occurs. Whether a gesture is routine (performed unconsciously as the situation may require) or deliberate (in full awareness of a goal to be reached), does not alter this basic definition of a gesture as a spatio-temporal phenomenon. Thus, all gestures have by definition both space and time determinants. In its most abstract form, any gesture can be expressed by the equation:

$$g = i\ tn1(a1.b1.c1)\ .\ i\ tn2\ (a2.b2.c2)$$

in which *i* is a portion of space, a, b, and c are the 3D spatial coordinates, and t the time function. If research on gestures is to be grounded on metrics rather than on impressionistic phenomenology that depends on the languages in which it conducted, it must be based on this simple equation.

As a first step, gravity and neuro-muscular energy can be considered as constants but should ultimately be introduced in the equation because these factors may become variable under pathological and physical conditions such as, respectively, Parkinson disease or zero-gravity (or, by the same token, any variation of gravity). In addition, since gestures are biological phenomena, the changing of the space coordinates of an organism or parts of an organism must be explained in evolutionary terms as the implementation of adaptive behaviors. From this point of view, gestures are doubly time-dependent because they are constrained both by physics and by the varied systems of the biological clocks, not only their own but also those of the other organisms with which they interact. All these determinants are quantifiable. The object of this paper is not to develop the mathematical equation that should serve as a theoretical and methodological prerequisite for gesture research but simply to call attention to the 4^{th} dimension of gesture, a dimension which has been neglected so far in the literature. However, further advances in the scientific study of gestures cannot be achieved without elaborating first a formal approach to these objects of study.

The tentative equation that has been introduced above is designed to give an elementary form to the particular horizon of ignorance which must be kept in mind when the daunting field of gesture research is approached. An equation which would express all the dynamic relations among the constants and variables involved in any gesture should be conceived and made operational. This equation would undoubtedly be extremely complex and beyond the computational capacity of a single individual researcher. But it would certainly not be beyond the range of powerful computers as long as they are fed with accurate data. This complexity is obviously not beyond the computational power of the human brains which process and monitor gestures as 4-D objects both as behavioral outputs and as perceptual inputs. Only the mathematical expression of interactive gestural flows can lead to functional analyses and simulations.

An objection that could be raised concerns the possibility of determining the exact values of the parameters of such an equation. In other words, what can be observed and measured in gestures and in the contexts in which they perform their adaptive goals?
It is relatively easy to take precise measurement in laboratory conditions. But a natural science of gestures must ultimately apply to the everyday train of interactions among human organisms in the context of their built environment. The naked eye, unless it has been rigorously trained and follows a strict protocol, is greatly unreliable because natural perception tends to calibrate what is seen. Naturally, the video recording of strings of interactions provides more reliable visual raw data. But it would be a mistake to rely too heavily on this means of investigation as if it were the equivalent of a microscope. Phenomenological observations either direct or mediated by recording devices remain on the macro-level. This is a level that corresponds more or less closely to the categories provided by the lexicon of any given language. As such, it depends on the particular semantic mapping that this language affords and it is subject to a great deal of ambiguities and literal fuzziness. Naturally, descriptive metalanguages can be (and have been) developed but they do not go beyond a few neologisms and redefinitions. For instance, a term like "emblem" which was adopted to refer to a particular class of gestures and now belongs to the metalanguage of gesture studies, is greatly polysemic and does not coincide with its semantic value both in common English and in other metalanguages such as literature and art history.

Ultimately, gestures could be analyzed at the nano-level since they necessarily involve intra-neuronal molecular chain reactions but it will be more operational to explore an intermediary scale, the meso-level of neuro-circuitry as evolved anatomic architecture that sustain adaptive technical and social behaviors.

2. This section will refer to a range of gestures observed at the macro level in which time constitutes an obvious distinctive feature of their semantic profile. Let us consider "semantic profile" as a shortcut for a general class of meanings expressible by a movement of the arm during which two distinct velocities (slow vs. fast) create two distinct values. The term "profile" indicates that we are dealing here with gross categories of gestures in which the distinctive features are relative evaluations rather than exact measurement. Two people are walking side by side toward an exit which is too narrow for them to proceed through it together. If they are of equal status, the more assertive may accelerate and wait for the second person once he/she has crossed the threshold. But if their relative (social, gender, or age) ranking is an issue, a directional extension of the arm (either right or left) of one of them will signify to the other that she/he may or should go first. The velocity and intensity of the gesture (among other features) will determine whether it is a command (*should*) or an invitation (*may*), whether or not it is negotiable and subject to a counter proposal. This kind of gesture occurs when the relative ranking is potentially ambiguous and does not clearly fall within the cultural script that regulates the etiquette relevant to the situation.

3. Once it is recognized that time is an essential dimension of gestures, two hypotheses can be developed before any actual measurements are made:
(a) The first hypothesis bears upon the evolution of gestures. Many researchers have based their theories on the assumed communicative requirements of a bipedal social species living in a savannah environment. The need to communicate at a distance in mostly open space would have selected the gestural mode of interaction all the more so that for hunter and gatherer groups silence is a premium. Many of the prey species of *Homo erectus* have acute auditory and olfactory perceptual sensitivity but relatively poor long distance vision. But, in evolution, communicative systems do not burst into existence *ex nihilo*. So-called “hopeful monster” are theoretical fictions which are not plausible if only because, particularly in the case of social communication, such a new competence should have arisen simultaneously in the whole group, if not the whole species for being adaptive. Natural selection works on small variations occurring in preexisting organic or behavioral competences. It is now well established that early hominins were tree dwelling organisms living in a mostly opaque environment in which acoustic communication is far more adaptive than gestures. There is also good evidence that bipedalism started as a mode of locomotion on branches rather than on the ground. In such conditions, the social use of the limbs was necessarily restricted to grooming. It is therefore plausible that all human gestures started as close range social behaviors involving the haptic modality either as aggressive or submissive and affiliative behaviors. In contemporary *Homo sapiens*, a great number of communicative gestures involve touch. In many cases, actual touching is inhibited under various propriety constraints and gestures fade into intermediary personal zones. Biological evolution is the prime but not the exclusive ruler of the emergence of communicative gestures which can be productively understood in part as the results of gene-culture co-evolution.
(b) The second hypothesis derives from the first one. Time is not a homogenous quality of gestural movements. A gesture is subject to variations of velocity and intensity during its deployment in inter-personal space. It can burst and immediately reach its peak through the shorter path available or start slowly and run a fluid, meandering course. But, most of time, it is characterized by a temporal curve that combines acceleration and deceleration. The brain generates limb movements and monitors the speed and form of their trajectory. The neural computing takes into account both self-preservation and the completion of an adaptive purpose. This involves the complex factoring of physical and social constraints irrespective of whether a gesture is routine (depending on procedural memory) or deliberate (the conscious monitoring of a rehearsed program with feedback and feed forward coming from inner and visual perception). The control of the time fabric of gestures affords a rich source of distinctive features as well as stylistic variations. This is why the temporal dimension of gestures cannot simply be taken for granted but must be plotted as accurately as the dynamic space patterns they form.
Another crucial aspect is the capacity of gestures to set a rhythm and synchronize
Time factors: speed (velocity, intensity, burst), acceleration deceleration, adaptive reaching, rhythm, synchronization.
4. Another observation which is relevant to the 4th dimension of gestures bears upon the fact that gestures are social. Even technical gestures involved in the making of an artifact or the completion of a task most often require the synchronized cooperation of several

agents. Communicative and performative gestures are necessarily blended since mutual monitoring and occasional repairing merge in the interactive flow

Gestures: self- and other- monitoring of time and space coordinates

<u>References</u>

Berthoz, A., (2000). *The Brain Sense of Movement*. Translated by G. Weiss. Cambridge: Harvard University Press.

O'Higgins, P. and S. Elton, (2007). Walking on trees. Science, vol. 316 (1 June 2007), 1292-1294.

Thorpe, S.K.S., R.L. Holder, and R.H. Crompton, (2007). Origin of human bipedalism as an adaptation for locomotion on flexible branches. *Science,* vol. 316 (1 June 2007), 1328-1331.