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The emergence of the linguistic sign : vocomimesis, symmetry and enaction

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Abstract

STEELS postulates that the origins of the linguistic sign were both self-referential and vocomimetic. More precisely, vocal resonances accompanying bilaterally symmetrical, close-open movements of the jaw may have been unconsciously recruited by Homo *to refer back to the jaw and its anatomical region, before being mapped homologously to other bilaterally symmetrical parts of the body located to each side of the median plane, or along its 'midline'. I claim that this body-naming strategy, which may still be detectable submorphemically in certain Proto-Indo-European body-part words, involves key enactive concepts such as sense-making and embodiment, and neurophysiological phenomena such as mirror neuron systems.*

Keywords : semiogenesis ; vocomimesis ; embodied enaction ; symmetry ; mirror neuron systems

Résumé

La TSG postule que les origines du signe linguistique étaient à la fois auto-référentielles et vocomimétiques. Plus précisément, des résonances vocales accompagnant des mouvements bilatéralement symétriques de fermeture-ouverture de la mâchoire ont pu être recrutées inconsciemment par Homo *pour renvoyer à la mâchoire et sa région anatomique, puis projetées homologiquement sur d'autres parties du corps à symétrie bilatérale disposées de part et d'autre du plan médian, ou le long de celui-ci. Nous soutenons que cette stratégie de nomination du corps, qui semble encore décelable submorphémiquement en proto-indo-européen, implique plusieurs concepts-clés énactifs (fabrication du sens, incarnation…) et neurophysiologiques (systèmes miroirs…).*

Mots-clés : sémiogenèse ; vocomimésis ; énaction incarnée ; symétrie ; systèmes miroirs

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« Je suis encore là, avec les sensations
organiques qui m'arrivent de la périphérie
et de l'intérieur de mon corps ».
Bergson (1907 : 186)

Introduction

The central claim made in this paper is that the pre-reflective, vocomimetic body-naming strategy postulated by STEELS, a semiogenetic theory of the emergence and evolution of the linguistic sign (Philps 2006), appears to reflect several of the major tenets on which the concept of 'enaction' (Bruner 1964,[2] Varela et al. 1991, Di Paolo et al. 2010, Durt et al. 2017, etc.) is based, such as sense-making and embodiment, as well as those of more or less recent neurophysiological discoveries such as mirror neuron systems and somatotopic maps. The term 'mirror neuron' refers to a class of premotor neurons which respond both when an individual (simian, human) performs a goal-oriented action and when it observes a similar action being performed by a conspecific (Rizzolatti & Craighero 2004), and the term 'somatotopic maps' to « dynamical representations of the orderly and specific relation between particular body regions […] and corresponding motor areas of the brain » (MER).

STEELS is a gestural theory of the origins of the linguistic sign (see Allott 1989, Corballis 2002, Armstrong & Wilcox 2007, etc., for gestural theories of language origins) which posits that the developing neurocognitive and sensorimotor capacities of *Homo* allowed this imitative genus, long before the emergence of the species *sapiens* (whose place and time-depth in models of hominid evolution is still widely debated),[3] to evolve a self-referential articulatory strategy for referring to the body *in action*, and consequently to the bodily effectors concerned, by means of vocomimetic resonances. Being mutualized, these voluntarily controlled resonances would have been understood similarly by speaker and hearer alike in acts of negotiated, intersubjective verbal communication. In this respect, Paget premonitionally opined that speech, in which the postures and gestures of the vocal apparatus may originally have been as significant for the representation of meaning as the sounds they produce, emerged from an unconscious, pantomimic language, the gestures made by the speaker's organs of articulation being recognized by the hearer because the latter *unconsciously produced in his mind the actual gestures which had produced the sound* (1930 : 174, my emphasis).

I use the term 'resonance' to refer to any distinguishable speech sound which can be ascribed to some prominent modification in the shape of the vocal tract (TRA : 307), but also, given the intersubjective nature of verbal communication, in recognition of the neurophysiological discovery that gestures and sounds performed by the speaker cause activation of the same premotor neurons in the hearer's brain as in the speaker's, i.e. mirror neuron-grounded resonance behaviour (Rizzolatti et al. 1999). Furthermore, I use the term 'self-reference' as an 'umbrella' term to encompass both :

- *vocal self-reference*, i.e. the (presumably unconscious)[4] use by *Homo* of oro-naso-laryngo-pharyngeal resonances mentally extracted from the anatomical actions in which they were embedded (breathing, biting, sniffing, swallowing, coughing, gaping, etc.) to refer back vocomimetically to these actions and to the effectors themselves, both internal and external (the

[2] « By enactive representation I mean a mode of representing past events through appropriate motor response. » (Bruner 1964 : 2).

[3] See, for example : https://www.nature.com/nature/journal/v546/n7657/full/nature22336.html (*Nature* 546 : 289-292, 8 June 2017), accessed on 8.06.2017.

[4] This assumption is not set within any specific theory of consciousness.

lung(s), the jaw(s), the chin, the teeth, the lip(s), the nose, the pharynx, the larynx, the neck, etc.), e.g. the unconscious mental extraction from the complex, largely neuro-controlled anatomical action of 'swallowing', during which the epiglottis closes off the trachea as the tongue moves backwards and the pharyngeal wall moves forwards, of a glottal closure (transcribed phonetically as ʔ) to refer back to the action, and

- *bodily self-reference*, i.e. the use of these resonances, arguably incorporated into recombinable, structured segment groupings known as protosyllables, to refer to bodily actions other than those associated with the vocal tract and its effectors, e.g. nodding, gripping, nudging, kneeling, running and the corresponding effectors (head, hand(s), elbow(s), knee(s), leg(s)), unconsciously perceived as homologous with the actions and effectors of the vocal tract, for example the production of a *CV* protosyllable (Studdert-Kennedy & Goldstein 2003 : 239-240), in which *C* represents an occlusive (close-open) resonance recruited to refer back vocomimetically to the manual action of grasping, i.e. a close-open movement of the vocal tract imitative of, and coordinated with, a close-open movement of the hand (Gentilucci et al. 2001, Philps 2006 : 251; see also, for the notion of 'sympathy', Darwin 1998 : 40).

Although in its broadest sense, the expression *bodily self-reference* may be used to embrace any form of self-reference to the body, whether to the vocal tract and its anatomical environment or otherwise, it is methodologically crucial to distinguish between the two, if only because, seen from a cognitive viewpoint, self-reference involving the region of the vocal tract appears to be essentially metonymic as a conceptual mapping strategy, while self-reference involving other parts of the body appears essentially (but not exclusively) metaphorical.[5]

According to STEELS, the precursor of the linguistic sign was :

- *self-referential*, i.e. based on the capacity of a complex, self-organizing system to refer to itself (Donald 2001 : 136);
- *vocomimetic*, i.e. exploited the voice's ability, developed by early hominids as a means of mimetic disambiguation (Donald 2001 : 291), to create resonances with a referential intention;
- *metonymic*, i.e. involved the production of vocal resonances recruited to refer back associatively to the anatomical actions in which they were embedded, e.g. a laryngeal occlusion (ʔ) *to stand for* an action involving laryngeal occlusion (Philps 2006), such as coughing, deglutition, parturition, defecation, sexual intercourse, sneezing, lifting, and other actions implicating the Valsalva mechanism;
- *metaphorical*, i.e. involved the resonances recruited for vocal self-reference being homologously mapped (>>) to actions and their effectors associated with other parts of the body and their attendant spatial properties, functions and relations (Philps 2006), e.g. smacking (lips >> hands), gripping (teeth >> fingers), and protruding (chin >> knee). As pointed out by Lakoff & Johnson (2003 : 255-257), this is, like metonymy and meronymy, a neurally-grounded process, in that metaphorical mappings appear to be realized physically as neural maps, with adjacent bodily neuronal clusters projecting to neuronal clusters adjacent to the corresponding clusters in the motor cortex. For instance, when the neural regions associated with speech production are activated, activity spreads to adjacent sites associated with movement of the hands and arms (Iverson & Thelen 1999 : 22);
- *simulative*, i.e. involved the production of vocal resonances recruited to imitate the anatomical actions from which they resulted, which implies that this type of multimodal, dynamical representation constitutes a partial, contextualized reenactment of stored

[5] See Goossens (1990) regarding the interaction of metaphor and metonymy in expressions for linguistic action.

sensorimotor states (Barsalou 2003). An example of this would be the unconscious mental extraction from the act of coughing of the complex resonance produced by the close-open (constriction-release) glottal movement characterizing this neuro-controlled act, and its intersubjectively-understood use *as if it were* a cough (Philps 2006 : 253, Gallese & Cuccio 2015). Cough is a mechanism which involves an initial deep breath, a brief, powerful expiratory effort against a closed glottis, and opening of the glottis with closure of the nasopharynx and vigorous expiration through the mouth; like deglutition, cough can be produced and mimicked voluntarily and accurately, and may be used as a form of communication (Widdicombe 2003 : 17);

- *embodied*, i.e. involved (co-)activation of somatotopically-structured sensorimotor areas during language processing and comprehension (Gallese & Lakoff 2005, Rizzolatti & Sinigaglia 2008 : 124-125);
- *emergetic*, i.e. depended on the emergence of solutions in the self-organizing, self-regenerating system of the human body (Oudeyer 2006) which were maximally efficient at conserving and transforming energy over time (Odum 1989).

These postulates arise in part from the reconstruction in Proto-Indo-European (henceforth PIE) of submorphemic phono-notional relations such as the {*sn*-/nasality} and {*gr*-/prehension} dyads detectable word-initially in English phonesthemes (Philps 2011) and projected as far back as is permitted by gestural theories of the emergence of speech such as MacNeilage's neo-Darwinian frame/content approach (1998). MacNeilage is one of a number of scholars–others are Bickerton (1990), Donald (1990, 2001), Deacon (1997) and Oudeyer (2006)–to have argued that language displays characteristics which suggest that it is a phylogenetic adaptation or exaptation, and therefore may usefully be approached from biological and evolutionary perspectives. MacNeilage has also argued that the ethological phenomenon of fixed action patterning may be extendable, in an evolutionary context, to vocal babbling as a basis for speech and other forms of infant rhythmic behaviour. It may be noted in passing that the above-mentioned postulates also appear to be reflected to varying extents in other language families, such as Japonic and Semitic (Philps 2011 : 1134), as well as in Inuit (Bordin 2003) and Oceanic (Rae 1930).

According to STEELS, articulatory gesturing (Browman & Goldstein 1992) arose in *Homo* as an exaptation of the biphasic, articulated, close-open gestures made during oscillatory actions of the jaw such as those involved in gnawing or chewing, accompanied by controlled vibration of the vocal cords and supra-laryngeal modulation (see MacNeilage 1998). If this is so, then the ancestor of the linguistic sign would have been functional before becoming meaningful. Significantly, the concept of vocomimesis, which encompasses the possible use of nasal resonances for nasal actions (e.g. sniffing), occlusive resonances for occlusive actions (e.g. biting), and laryngeal resonances for laryngeal actions (e.g. coughing), appears to mesh with several of the basic concepts of enaction, as identified by Di Paolo et al. (2010 : 37), e.g. :

- *sense-making* : the creation and appreciation of meaning
- *emergence* : the formation of a novel property or process out of the interaction of different existing processes or events
- *embodiment* : the body is the ultimate source of significance
- *experience* : the body creates the sense of self.[6]

[6] See Damasio (2010) for a neurologically-grounded account of self, and Gallese (2017) for a discussion of the experience of man-made fictional worlds and how neoteny and embodiment can be applied to this area of human social cognition.

Once incorporated into recombinable segment groupings, notably by (still debated) processes of syllabification such as augmentation (*CVC*), reduplication (*CVCV*), and reanalysis (e.g. *VC* in *CVCV*) (see Jackendoff 2002 : 244 and Southern 1999 : 152-153), the originally vocomimetic *CV* protosyllable postulated by STEELS would necessarily have become arbitrary over time as the emergent language systems into which it became integrated evolved into perennial vehicles of human communication. As arbitrariness set in to these systems, its linguistic descendants would rapidly have become conventionalized and subject to analogical and other types of change, therefore becoming symbolic in the Peircian sense of the term, i.e. interpreted as denoting objects in consequence of a 'law' or a preformed habit (Peirce 1991). As one of the founders of biosemiotics, along with Von Uexküll (e.g. 1992) and others, Peirce addresses the issues posed by human language and abstract symbolic thought, as well as those pertaining to meaning, sense-making and representation in general, in terms of the biological significance of sign processes, an approach for which any semiogenetic theory of the origins of language which focuses on interpreting oral activity as symbolic of its own dynamic[7] necessarily holds implications.

One of the potential benefits of the model proposed by STEELS in this respect is that it allows the concepts of recursion (see Hulst 2010 for an overview) and reflexivity (see Jeremiah 2012 for a reconceptualization of the human subject as characteristically reflexive) to be introduced as two of the founding principles underpinning the emergence of human language at the earliest possible stage in the process. This gives pause for the conjecture that in modern languages, reflexive spatial gram systems which are formed from body-part words (Svorou 1994 : 31), e.g., in contemporary English, that including *(a)head, (a)foot, (be)hind*, and *(a)breast*, may have originated through the transposition into grammar, via the lexicon, of the invariant, topological relations characterizing the human body, seen as a cognitive domain.

It may also be relevant to my claim that a recurrent cognitive process I call 'body bleaching' (a type of decorporealization, see Philps 2006 : 253) manifests itself not only in the early syntax of transitivity in PIE (see Gamkrelidze & Ivanov 1995 [1] : 240), but also throughout the history of English. In the latter language, this process is detectable in the lexicon through the gradual disappearance from the definitions of certain verbs, whether stative or active, of prepositional phrases which contain terms denoting body parts that play an instrumental role. Examples of this phenomenon are to be found under *have* 'to hold <u>in hand</u>, in keeping, or possession', a sense first recorded in 814 (*OED*, my underlining), as against the later definition of 'to hold or possess, in a weakened sense' (*c*1000), and *smite* 'to administer a blow to (a person, etc.) <u>with the hand</u>' (*c*1160, my underlining), as against the later definition of 'to beat or dash against (something)' (*c*1440). This claim recalls what was conceivably one of the earliest manifestations of decorporealization in language, by which the sonic elements characteristic of co-enactive human call systems, likely vocomimetic, may have been semiogenetically bleached of their warning function concomitant with the emergence of the principle that signs can function in the absence of their referents (Bickerton 1990 : 155, 156), and with the onset of arbitrariness.

However, although such considerations are necessarily relevant to the enactive paradigm and its world-to-word perspectives, notably with respect to negotiated social interaction and collaborative sense-making, space and scope preclude me from developing these links here. Much also remains to be unravelled and assessed at the postvocomimetic level of mythomimesis, in particular the manner in which the earliest, co-constructed belief systems became embedded consensually and conventionally in the linguistic sign (Philps, forthcoming (2)). This holds true too for the roles played by myth and myths in general in enactive theories. For instance, viewing it as an attempt to deepen understanding in strongly biological domains

[7] I should like to thank an anonymous referee for this formulation and other suggestions for improvement.

such as life-mind continuity, Cummins & De Jesus define the myth as "a story of reference that provides structures and elements that serve to support and guide thinking" (2016 : 4), a story which is exemplified, within the bio-enactive framework they propose, by accounts of that prototypical autopoietic system known as a single celled bacterium.

1. Symmetry and STEELS

Bearing the above in mind, it appears necessary at this stage to speculate in greater depth on the nature of the resonances characterizing *C* in *CV* protosyllables since, as pointed out by Esling (2012), one cannot rule out the possibility, particularly if ontogeny is held to parallel phylogeny (see also MacNeilage & Davis 2000 on this subject), that the earliest articulated resonances developed in the human larynx (and pharynx), as it is in these areas of the vocal tract that newborns and infants begin to acquire and master their ability to produce meaningful sounds before those initiated in the mouth cavity. Furthermore, the larynx houses the lowest anatomical site in the vocal tract (i.e. the glottis) where the egressive flow of air from the lungs can be modulated and filtered for purposes of phonation and articulation (Philps, forthcoming (1)).

If this were the case, then it is conceivable that *C* in *CV* originally corresponded to one or more indeterminate laryngeal resonances (noted *L*), in which case the earliest hominid protosyllable could be symbolized as *LV* (laryngeal + vowel, *V* likely being vocomimetic too). In support of this hypothesis, and remembering the example of vocal self-reference proposed above (i.e. the production of a glottal closure (ʔ) to refer back to the anatomical action of swallowing), is the discovery of a mirror neuron system in the human brain responsible for controlling oro-laryngeal gestures (Rizzolatti & Sinigaglia 2008 : 168), and of a larynx-specific area in the motor cortex that is activated comparably by vocal and nonvocal laryngeal tasks (Brown et al. 2008).

Whether traces of this supposedly original laryngeal resonance still exist in the oldest language families presently reconstructed is a moot point. In Philps (forthcoming (1)), I argue that infinitesimal traces of its existence may still be detectable in PIE and its daughter languages, both at the submorphemic level (Philps 2011), and in the possible relation between certain onomatopoeic articulatory gestures and their linguistic equivalents. An example of the former, if one accepts the tenets of the 'laryngeal theory' (Saussure 1879, Möller 1917, etc.), is the dyadic phono-notional relation {**H*/bilateral symmetry} identifiable in word-initial position in some, but not all, PIE roots referring to paired parts of the human body (counterexamples : **ĝénu*- 'knee', **ĝhés-r*- 'hand'). Within this brace, **H* is used as a cover symbol for the hypothesized PIE 'laryngeals' **h*$_1$ (possibly a glottal stop), **h*$_2$ (possibly a voiceless pharyngeal fricative) and **h*$_3$ (possibly a voiced pharyngeal fricative)[8], while the term 'bilateral symmetry' denotes the arrangement according to which the human body, viewed externally, is divided by one sagittal (or median) plane into equivalent right and left halves (or enantiomorphs), each being an approximate mirror image of the other.

Among the paired parts adduced in Philps (forthcoming (1)) are :[9]

- the shoulders (***h**$_2$*aḱs*- (NIL 259ff.)) [> Gk. *ἄξων* 'axle, axis', Lat. *āla* (<**h*$_2$*eḱsleh*$_2$-) 'shoulder, wing, axilla', OE *eaxl* 'shoulder' (> Mod. Eng. *axle*), etc.];

8 See Fortson 2010 : 64.

9 In the examples provided, the word-initial 'laryngeals' are emphasized in bold type.

- the ribs (*(***h₁**)*rebhi̯o-* (LIV 496)) [> Gk. *ὀροφή* ‘roof, ceiling’, OE *ribb* ‘rib’ (> Mod. Eng. *rib*), etc.];
- the elbow/forearms (**h₃elek-* (IEW 308)) [> Gk. (Hesychius) *ὠλλόν* ‘elbow’, Lat. *ulna* ‘forearm, ell’, OE *eln* ‘ell’ (> Mod. Eng. *ell, elnboga-* ‘elbow’ > Mod. Eng. *elbow*), etc.];
- the articulated parts of the body in general (**h₂épes-* ‘± limb, part of the body’, a nominal derivative of **h₂ep-* ‘± join, fasten’ (LIV 269)) [> Hitt. *ḫappeššar* ‘limb, joint, member, part of the body’, CLuw. *ḫappiš* ‘limb, member’, etc.].[10]

Yet other roots reconstructed with a word-initial **H* within the ‘laryngeal theory’, while not implicating the skeletal system, nevertheless refer to symmetrically paired parts of the body, or to parts located along the ‘midline’, whether considered from the front or the rear, e.g. :

- the eyes (**h₃okʷ* (NIL 370ff.)) [> Gk. (dual) *ὄσσε* ‘eyes’, Skt. *ákṣi* ‘eye’, OE *ēage* ‘eye’ (> Mod. Eng. *eye*), etc.];
- the navel (**h₃nobh-* (NIL 385-387)) [> Gk. *ὀμφαλός* ‘navel’, Skt. *nā́bhi-* ‘navel’, Lat. *umbilīcus* ‘navel’, *umbō* ‘boss on shield’, OE *nafela* ‘navel’ (> Mod. Eng. *navel*), etc.];
- the buttocks (**h₁ors(o)-* (NIL 246-248)) [> Gk. *ὄρρος* ‘rump’, OE *ears* ‘arse’ (> NE arse/ass’), etc.].[11]

Yet others refer to external parts of the body which may be analyzed as paired or not, e.g. :

- the nose/nostrils (**hₓnáss~*hₓnā́s* (EIEC 395, cf. NIL 307 ff. (*h₂enh₁-*)) [> Lat. *nāris* ‘nostril’ (pl. ‘nose’), *nāsus ~ nāssus* ‘nose’, OE *nosu* ‘nose’ (> Mod. Eng. *nose*), etc.];
- the mouth/lips (**hₓoust-eh₂-* (EIEC 387, cf. NIL 390-391 (*h₃ói̯ust-o-*)) [> OPrus. *austo* ‘mouth’, Lith. *uostà* ‘mouth of river’, Skt. *óṣṭha-* (< **hₓóust-hₓ-os*) ‘lip’, Lat. *ōstium* ‘mouth of a river’, etc.],

or to paired internal parts, e.g. :

- the kidneys (*(**h₁**)negʷhrós* (IEW 319, EIEC 329)) [> Gk. *νεφρός* ‘kidneys’, ON *nȳra* ‘kidney’, OHG *nioro* ‘kidney’, etc.];
- ± the lungs/internal organs (**h₁eh₁tr-* (IEW 344-345, EIEC 359)) [> Gk. *ἦτορ* ‘heart’, OIr. *inathar* ‘entrails’, OE *ǣdre* ‘artery, vein, sinew’ (pl. ‘kidneys’), etc.].

In view of the probability that a high proportion of PIE words once attested ‘laryngeals’ (Lehmann 1952 : 28), notably in initial position, this may of course be put down to the chance factor, added to which is the fact that external paired body parts generally exhibit (more or less approximate) bilateral symmetry, formally and/or functionally. Significantly for my hypothesis however, very few of the oldest PIE words denoting unpaired body parts, whether internal (e.g. heart, stomach, liver) or external (e.g. head, neck), are reconstructed with an initial ‘laryngeal’, e.g. :

- the heart (**ḱḗr, *ḱr̥d-* ‘heart’ (NIL 417ff.));
- the stomach (**udero-* ‘stomach, abdomen’ (IEW 1104-1105), **pant-* ‘stomach, paunch’ (IEW 789), **gʷétus* ‘stomach, womb, intestines’ (IEW 481));

[10] Virtually all the PIE roots and their reflexes adduced in the present section pose thorny problems of reconstruction and analysis, both formal and semantic, which cannot be addressed here.

[11] Cf. Eng. *cheeks* ‘buttocks’ (fam.) for an example of top-down/front-back bilateral symmetry mapping.

- the liver (**i̯ék^{w}r̥*(*t*) '± liver' (NIL 392ff. (**i̯e-/ok^{u}-r/n-*));[12]
- the intestines (**gudóm* 'intestines' (IEW 393));
- the head (**k̂r̥rḗh$_2$* (IEW 574-576), **ghebhōl* 'head' (IEW 423), **káput* 'head' (IEW 529-530));
- the neck (**monis-* ~ **moneh$_2$-* 'neck' (IEW 747-748), **g^{w}rih$_x$u̯-eh$_2$-* 'neck' (IEW 474-475), **h$_2$enĝh(u̯)én-* '± neck' (< **h$_2$enĝh-*) (IEW 42-43 (**anĝh-*)).

Admittedly, the fact that the precise forms and meanings of the words concerned are often difficult to ascertain at such a time depth may indicate that they are derived from even older, unattested forms, possibly with an initial 'laryngeal' (see Philps (forthcoming (1)) for pre-PIE **Hp-* > **Øp-* > PIE **p-*). However, considering these data solely as the consequence of stochastic processes involving chance appears tantamount to rejecting the widely-held view that language as verbal communication is never random, if only because human activity is fundamentally purposive.

As for an example of the relation between an onomatopoeic articulatory gesture and its linguistic equivalent(s), one may adduce the possible link between the glottal stop produced vocomimetically when encouraging an infant to defecate (Diamond 1959 : 214) and, in PIE and its daughter languages, the word-initial velar occlusive occurring in **kak(k)eh$_2$ie/o-* (> Gk. *κακκάω*, Fr. *caca* (fam.)), **g^{w}uh$_x$-* (> Skt. *gūtha-* 'dung') and, under certain conditions, **skeh$_1$id-* 'defecate' (> OE *be-scītan* 'defecate') (EIEC 144, 186-187). This proposed link may arguably be reflected in the word-initial **(H)ø-/*k-* alternation reconstructed by some for PIE, e.g. **(h$_2$)ost-/*kost-* 'bone' (e.g. Rousseau 1990).

Another linguist to establish a link between PIE body-part words and the concept of symmetry, though at the morphemic level, is Cuny (1924), who points out that several words denoting paired parts of the human body contain **-u-/*-ū-*, which he analyses as a 'classificatory' morpheme, derived from (hypothetical) **do* < **dui-* 'two' (*ibid*., 25-26), or perhaps from **u̯ĭ̆-* 'in two, apart' (EIEC 193)). According to Cuny, the function of this morpheme is to mark the notion of parity, which may be defined in this context as « the symmetry of behavior in an interaction of a physical entity […] with that of its mirror image » (MER). Examples of the items he adduces are **ĝén-u-* 'knee' (IEW 380-381), **pérk̂-u-s* 'rib, breast' (IEW 820), et **bhāĝh-ú-s* '(fore-)arm, elbow' (IEW 108). Cuny further remarks that this phenomenon is also found in the names of instruments which exhibit forms of pairing or symmetry in general (*ibid*., 25), but he does not attempt to theorize the kind of semantic extension involved, or the types of symmetry implied.

However, the real issue here is methodological rather than chronological, since any attempt to bridge the gap between the linguistic sign in 'evolved' languages and the indeterminable period when articulated speech emerged requires tools of analysis which allow the researcher to establish pertinent links between these two time references. It also involves the theoretical assumptions that a certain degree of systemic continuity exists between them, and that this is recoverable, possibly by means of a principle such as that formulated by Leyton (1992), i.e. that asymmetry is the memory that processes leave on objects. Clearly, our approach cannot be of a linguistic nature if it is held that articulated speech is the result of biological exaptation (Gould & Vrba 1982), and in any case, it is widely accepted that there is little or no hope of recovering information about language origins by tracing linguistic descent (Nichols 1998 : 128), at least by the comparative method. But if it is assumed that *Homo* has always possessed the anatomical capacity to produce nasal and occlusive resonances by allowing air from the

[12] Internal organs which appear singly to one side of the 'midline' may exhibit a form of bilateral symmetry (e.g. the liver), while others may be bilateral yet asymmetrical (e.g. the lungs).

lungs to flow through the nasal and/or oral cavities, then it becomes conceivable that modulating and filtering these resonances for referential purposes developed long before *Homo* became *sapiens*, and must have been conditioned, a minima, by the advent of a capacity for self-reference and self-representation (Donald 2001 : 135-136).

2. Symmetry, invariance and enaction

Although trivial, it may be opportune at this stage to recall that the term 'enaction' encompasses the word 'action', and that action principles are widely used to express the laws of physics, including those of general relativity (Einstein 2001). In its physical sense, action may be defined as an attribute of the dynamics of a physical system (over time) from which the equations of motion of the system can be derived (WIK).[13] Terminologically, changes in the coordinates or variables of an object that leave the action invariant are known as symmetry transformations.

As for human action, the realization of which may involve bodily motion, it is construed as implying an agent, and (typically) as being intentional, purposive, conscious, and subjectively meaningful in nature. With respect to the enactive construal of human action, Varela et al. (1991: 172-173) assert that perceptually guided action is enabled by cognitive structures emerging from recurrent sensorimotor patterns, and use the term 'action' in the expression 'embodied action' to emphasize that the sensorimotor processes of perception and action are axiomatically and evolutionarily inseparable in lived cognition (*ibid*., 173). While they do not explore the concept of symmetry in this particular work (but see Varela's (1976) study of symmetry and asymmetry in complementary pairs relating to cognition and autopoietic theory), it is clear that it must be taken into consideration. Collier (1996), for instance, affirms that symmetry breaking is fundamental not only to perception, but also to many other cognitive processes.

It is widely accepted that principles of symmetry play an important role with respect to the laws of nature, and that principles of invariance provide a structure and coherence to these laws, just as the laws of nature provide a structure and coherence to sets of events. And since speech constitutes one form of natural language in humans, along with signing and writing for instance, it may not be unreasonable to conjecture from the submorphemic and morphemic data presented above that the Einsteinian principle of the invariance of natural laws with respect to the transition from one inertial system to another may play a role in the emergence of natural language systems and the linguistic sign itself, even though such a hypothesis is doubtless light-years from being scientifically framable.

With regard to the process of symmetry breaking, however, this conjecture is not trivial, insofar as it allows an insight into how parity, understood as the symmetry of behaviour in an interaction of a physical entity with that of its mirror image, may be broken when words denoting bilaterally symmetrical body parts such as the 'eyes' are mapped (>>) to other, unary body parts, e.g. (*pars pro toto*) eye(s) (meronym) >> face (holonym), part of a complex process known as intra-domain conceptual projection (Fauconnier & Turner 2002 : 305). Initial parity may be further broken, with emerging, lower order symmetries creating new, dissymmetrical patterns in the resulting medium while at the same time revealing older, more symmetrical ones in the original medium, when words, along with the inferences they vector, are metaphorically mapped to the extracorporeal environment (a process known as inter-domain conceptual projection), e.g. eye(s) >> sun.[14] The following are some examples of intra-domain and/or

[13] https://en.wikipedia.org/wiki/Action_(physics), accessed on 1.10.2016.

[14] See Lincoln (1986 : 17-18) for the eyes/sun homology in Indo-European.

inter-domain mapping culled from words in PIE and their reflexes in the daughter languages which may or may not involve instances of symmetry breaking :

- **h₃ok*ʷ ‘eye’ (> Gk. (dual) *ὄσσε* ‘eyes’) >> ‘face’, defined as a central organ of sense (WIK)[15] (> Gk. *ὤψ* ‘face’, OIr. *enech* ‘face’ (EIEC 188); for an example of retroprojective mapping (<<), cf. OIr. *sūil* ‘eye’ < **séh₂ul-* ‘sun’ (EIEC 556));
- **h₂aḱs-* ‘± shoulder(-joint), axle’ (> Av. *ašayå̊* (dual) ‘shoulders’, Gk. ἄξων ‘axle, axis’ (EIEC 39, 516) >> ‘axle’, defined as a shaft attached to two wheels (WIK),[16] or possibly just one (cf. water wheel, WIK));[17]
- **ĝénu-* ‘± jaw, chin’ (> Gk. *γένυς* ‘chin, jaw’) >> **ĝénu-* ‘knee’ (> Gk. *γόνυ* ‘knee’); cf. also γωνία [< pre-Greek **gōnwia*] ‘corner, angle’ (EIEC 322, 336)).

Whatever the case, one linguist to have integrated the inextricably related concepts of symmetry and invariance into his theory of language at an early stage is Guillaume, who stated that he would always be « l’homme d’une seule idée, d’une seule vue directrice : recherche de symétrie et de dissymétrie. » (Guillaume 2010 : 2). Also, Bunn affirms (though without locating his theory of curvilinear wave form propagation specifically within the concept of enaction as discussed here), that the symmetry operations of translation (along a line), rotation (on a plane), and twist (of a solid shape) in three-dimensional space reenact the forms of a wave motion, and that because these forms occur wherever waves are formulated, they will appear in the sound waves of speech acts (2002 : 50). According to him, linear, circular, and helical motions are the three regular motions that are necessarily enacted by the angled joints of the body that describe quartered arcs and rotations of its limbs, while enactment of speech occurs in patterned form in the three-dimensional space of the mouth cavity.

Now as mentioned in the Introduction, STEELS attaches the highest importance to the role played by the unconscious perception of body joints and their actions in the emergence of the linguistic sign, insofar as it postulates that vocal resonances accompanying the close-open movements of the jaw were initially recruited to refer back to actions involving these movements and their effectors, and incorporated (as *C*) into vocomimetic *CV* protosyllables. Mapped metonymically from oro-pharyngo-laryngeal actions involving close-open mandibular cycles such as chewing or biting to the jaw itself, the protosyllable *H*/*PV*, hypothesized as being the earliest type of *CV* syllable (see section 1), may be assumed to have possessed the potential to refer intersubjectively not only to masticatory actions, but also to the muscles of mastication themselves (including the tongue and the cheeks), the lower jawbone and its joints, the teeth it holds in place, and thence to the teeth and the jaws in general.

The projection of this self-referential protosyllable from the jaw and its actions (i.e. vocal self-reference) to ‘name’ other jointed or otherwise connective parts of the body and their actions characterized by anatomical movements which are typically biphasic and oscillatory (e.g. flexion-extension, adduction-abduction, depression-elevation) such as the shoulder-joint, the elbow-joint, the hip-joint, the knee-joint, and the ankle-joint (i.e. bodily self-reference), would have been accomplished by a process of metaphorical mapping. Whatever the case, the importance of body joints in prehistoric cultures can be inferred from the worldwide presence of joint marks on representations of the human body, which served as exograms for symbolically-related, structuring activities such as counting, recording marital unions, emblematizing rights of inheritance, and constructing kinship charts, some of which mirror bilateral kinship groups (Schuster & Carpenter 1995 : 132-143). Unfortunately, space does not

15 https://en.wikipedia.org/wiki/Face, accessed on 1.10.2016.

16 https://en.wikipedia.org/wiki/Axle, accessed on 1.10.2016.

17 https://en.wikipedia.org/wiki/Water_wheel, accessed on 1.10.2016.

allow me to dwell on the role of symmetry and asymmetry in human body symbolism here; with regard to the concepts of dislocation and bilateral split representation for instance, the reader is referred to Lévi-Strauss (1963) and, in Pacific cultures, to Dunis (2009 : 45).

3. Mirror resonance and enaction

As stated earlier, the pre-reflective, vocomimetic body-naming strategy postulated by STEELS appears to implicate not only many of the concepts on which enaction is based, but also neurophysiological phenomena such as somatotopically organized mirror neuron systems, including auditory mirror neurons, which may be linked to empathy, defined in the present context as the capacity to experience what others do while attributing these shared experiences to others rather than to self.

It is now generally agreed, despite certain detractions (e.g. Hickok 2014), that mirror neurons, which are located mainly in Broca's area, are premotor neurons which become active not only during verbal activity, but also during oro-facial, brachio-manual, and oro-laryngeal movements, their primary function being to mediate that complex behavioural phenomenon known as imitation (Rizzolatti & Craighero 2004 : 172). These neurons are held to constitute the neural basis of a mechanism that creates a direct link between speaker and hearer in terms of production and perception processes by transforming an action performed by an individual into a representation of the same action in the motor cortex of the observer, thus fostering a direct, non-arbitrary, semantic link between two communicating individuals. According to Rizzolatti & Sinigaglia (2008 : 153), such interaction must satisfy the 'parity requisite', i.e. the condition that an understanding, hypothesized to be based on the existence of a common neural substrate capable of coding sensorimotor information, be shared by speaker and hearer alike.

However, an alternative approach to mirror neuron activation has been mooted by Gallagher (2009), according to whom it can be interpreted as part of the neuronal processes that underlie intersubjective perception rather than simulation. By this, he means, in his own words, that the articulated neuronal processes that include activation of mirror neurons or shared representations may underpin a non-articulated immediate perception of the other person's intentional actions, rather than a distinct process of simulating their intentions (*ibid*., 365). This claim requires perception to be conceived of as a temporal phenomenon and as an enactive process, thus echoing Kinsbourne's proposal that percepts are encoded enactively, i.e. in terms of the response possibilities that they afford (2002 : 311). Gallagher goes on to suggest that if perception is thought of in this way, we may construe mirror resonance processes as part of the structure of the perceptual process when perceiving another person's actions.

While this approach has the advantage of factoring time into perception, the role played by simulation in mirror neuron activity cannot be minimized, if only because, before being *inter*subjective, as in the shared we-centric space mapped by mirroring mechanisms proposed by Gallese (2009 : 530), simulation, at least in its embodied construal, is *intra*subjective, that is to say, it pre-exists as a potential in each I-centric individual. Each individual possesses the capacity to simulate (in the sense of intentionally creating an imitative representation, e.g., of a physical event), with the bodily means at their disposal, one of which is the voice and its ability to create resonances with a referential intention. In this respect, it has been demonstrated that mirror neurons not only code the meaning of actions in terms of vision, but also on the basis of their related *sound*. Gallese in particular affirms that mirror activity reveals the existence of a mechanism through which perceived events as different as sounds or images are nevertheless coded as similar insofar as they represent the diverse sensory aspects of the motor act's goal, thus allowing a direct form of action understanding, through a mechanism of embodied simulation (*ibid*., 521).

4. Conclusions

As Saussure himself points out, while sciences other than linguistics have objects of study given in advance which are then examined from different points of view, in linguistics, it is the viewpoint that creates the object (1973 : 23). And certainly, if one views the linguistic sign from within the epistemologically-circumscribed girdle of Saussurean linguistics, the dyadic relation between the *signifiant* and the *signifié* is, by conception, arbitrary (i.e. unmotivated) and differential, thus leaving any supposedly motivated connection between the sign and its referent outside the purview of the observer. But if the latter, while accepting the validity of Saussure's positions, is prepared to pan from the morphemic to the submorphemic level, and to construe certain submorphemic elements as vectoring dyadic, phono-notional relations, then a number of potentially motivated links begin to emerge such as, in Modern English, {*sn*-/nasality} and {*gr*-/prehension}. If the observer is further prepared to view notions through a cognitive prism, then the importance of the link between the linguistic sign and the concepts of 'body schema' and 'body image' (e.g. De Preester & Knockaert 2005) quickly becomes apparent, encouraging one to view these dyadic relations in terms of the general concept of embodiment (embodied enaction, embodied self, embodied simulation, etc.).

This in turn may lead one to explore the neural aspects of embodied cognition, notably the hypothesis that certain phenomena present in language such as metonymy and metaphor are computed conceptually via neural maps linking the sensorimotor system with higher cortical areas (Lakoff & Johnson 2003 : 255). Another neurally-based hypothesis concerning the existence of so-called 'brain maps' is advanced by Damasio (2010), who affirms, significantly for STEELS and the importance it attaches to the vocomimetic encoding of jointed body parts and their actions in the naming of the human body, that when skeletal muscles are connected to two bones articulated by a joint, the contraction of their fibres generates movement. The latter modifies the configuration of the body in space-time and, consequentially, the dynamical, somatotopically-organized body maps represented in the brain, and thus in the mind (*ibid*., 95).

If the observer is not prepared to move in this direction, then their view may be directed towards constructing a null hypothesis to model a situation in which no correlation exists between *L* in *LV* (seen as the earliest type of protosyllable) and *H* in PIE (seen as a 'laryngeal'), or between PIE words denoting paired parts of the human body and word-initial 'laryngeals' in this language. However, as already pointed out, language as verbal communication, being purposive, is never random. Furthermore, human perception is directed towards action according to Bergson (1907), an early precursor of the enactive and sensorimotor approaches.

In final conclusion, if the postulates of STEELS properly reflect some of the initial conditions of emergence of the linguistic sign, then the latter would appear to have originated essentially as an enactive, mirroring solution to the problem of developing human intercommunication by verbal means which was adopted, albeit unconsciously, by *Homo*. Furthermore, if the PIE body-part data adduced also reflect these conditions, this would provide support for the hypothesis that the actions of external, bilaterally symmetrical parts of the body were originally encoded vocomimetically in consequence of the transmission to the muscles controlling the vocal apparatus, via the nervous system, of somatotopic representations in the primary (SI) and/or secondary (SII) somatosensory cortices (Cheung et al. 2016), which map not only relations between specific body regions and corresponding motor areas of the brain but also, it seems, their bilaterally symmetrical characteristics.

And indeed, recent studies suggest that SII within the parietal operculum is composed of areas responsive to hand and foot stimulation that contain mirror-symmetric somatotopic maps of the body surface (e.g. Eickhoff et al. 2007), and that premotor connection configurations exist which are ideally suited for coordinating bilaterally symmetrical jaw movements, as well as for

enabling co-activation of specific jaw, tongue, and facial muscles (Stanek et al. 2014). If this is so, bilaterally symmetrical parts of the body may therefore be analyzable in terms of appropriate *principles* of symmetry (laws of invariance, conservation, motion, parity, balance, breaking…) as applied to the human milieu. Whatever the case, it is worth recalling in this respect that the human brain is formally and functionally lateralized, and that the somatotopically-organized audiovisual mirror neuron system is itself bilaterally distributed.

However, these postulates are necessarily conjectural since, due in particular to lack of empirical data and secure methodology, we can only backtrack to the indeterminable period during which articulated speech emerged in *Homo* by speculative reasoning, an approach which may not be scientifically justifiable, and which in any case is scarcely open to meaningful testing by experimentation. This universal issue is nonetheless tempered by the observation that some of the fundamental postulates of STEELS appear to be corroborated not only by certain aspects of recent theories of cognition, such as embodied enaction and simulation, but also by relatively recent, experimentally verified neurophysiological discoveries such as mirroring mechanisms and somatotopic mapping.

Although it would be foolhardy at this stage to jump to conclusions as to the exact nature of the self-referential, vocomimetic body-naming strategy hypothesized herein, or of the possible cause-effect relations that may underlie it, given the imperfect state of our present knowledge and the perspective of significant new scientific discoveries in the fields concerned, certain pieces of the puzzle seem to emerge through the prism of STEELS, and may hopefully lead to the conditions of emergence of the linguistic sign being adequately modelled.

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