

Constructing Representema: on the Neurosemiotics of Self and Vision ¹

Donald Favareau
University of California, Los Angeles
3300 Rolfe Hall, Los Angeles, California, 90095 U.S.A.
E-mail: favareau@ucla.edu

Portions of this paper have been previously published in *Sign Systems Studies Volume 30.1* entitled “Beyond self and other: On the neurosemiotic emergence of inter-subjectivity”

ABSTRACT

Convergent evidence from research into the neurobiology of vision reveals that the visual image is not something received whole from the environment and then presented to the mind. Rather, the evolution of the eye itself rests upon the evolution of a cell that over eons of interaction has been tuned to respond selectively to a range of photon configurations in the surrounding environment. Such cells in the aggregate interact with a vast distribution of other selectively specialized cells in the human brain to actively co-construct and result in a visual image that is not the product of brute mechanical reception and transmission, but of semiosis. This paper explores the suggestion that at the eye, like the entirety of the sensory sheet, functions as a sign-vehicle, the proper significante effect of whose cell-by-cell activity is not brute presentation in the dyadic sense, but an entire cascade of top-down and bottom-up, recursively generating semiosis mediating multiple levels of interpretive and life-sustaining activity and interaction. Using the neurobiology of vision as a paradigm case of neurosemiotic organization and interaction, then what is true for the eye is also, as Wittgenstein remarked, true for the ‘I.’ That is to say that on the neural level, Self - ‘the Subject felt’ - no less than ‘the Object seen’ is an ongoing, emergent product of sign-exchange activity which is embedded in cells which are embedded in brains which are embedded in bodies which are embedded in worlds - a rich construction of internally biological, externally physical and historically situated and semiotically sedimented conceptual elements none of which enjoy a

¹ Citation: Favareau, D. (2002). Constructing representema: On the neurosemiotics of self and vision. *Semiotics, Evolution, Energy and Development Journal* 2 (4), 2002.

privileged or autonomous causality in structuring or determining the resultant symbolic relation which is then presented, seen, or brought to mind.

1 ON THE NECESSITY OF ESTABLISHING THE DISCIPLINE OF NEUROSEMIOTICS

The explosive growth over the last two decades of neuroscience, cognitive science, and ‘consciousness studies,’ as generally conceived, remains as yet unaccompanied by a corresponding development in the establishment of an explicitly *semiotic* understanding of the relations of sign exchange at the neuronal level function in the larger network of psychologically accessible sign exchange. The use of explicitly semiotic terminology has been and remains assiduously avoided in the practices and explanations of traditional Western science in general – a stark methodological rebuttal to Hoffmeyer’s proposal that ‘intelligence lies not in the sign, but in the interpreting body...[and] the exploration of this inner semiosphere ought to be the aim of modern biology’ (1997:125), an exploration still yet to be undertaken a full 300 years after Locke’s call for the formulation of an explicitly semiotic *science of representation* – ‘the signs the mind makes use of’ (1690:461).

Nowhere is this disinclination more evident and, perhaps, more curious, than in mainstream Western neuroscience, wherein the very terms central to its whole agenda – terms such as ‘signal,’ ‘response,’ ‘message,’ ‘communication,’ and ‘command’ – are understood to its practitioners as mere metaphoric shorthand denoting mechanistic, asemiotic configurations and processes. Yet the abiding fear of anthropomorphization that attaches to an *inadequate* understanding of semiotic theory has made the use of explicitly neurosemiotic terminology anathema to the theorists of traditional neuroscience. Such fear is, of course, both counterproductive and unwarranted, for the role of the neurosemiotician – like the role of the cognitive neuroscientist – is not to anthropomorphize the individual activity of communally mindless neurons but to understand how the communal activity of individually mindless neurons anthropomorphizes, in a very minded fashion, *us*.

As the research I will be reviewing in this article amply illustrates, the explanatory power of traditional reductionist and mechanistic hypotheses ‘breaks down’ in cognitive neuroscientific endeavours earlier and more critically than in, say, classical physics – where for everyday, non-technical purposes, the problems of ‘meaning’ and of ‘knowing’ are not central to the stated endeavour. It is still very much the case that contemporary

neuroscience - so incredibly adept at discovering and describing the physio-mechanical aspects of biological sign-exchange - lacks even one generally accepted, much less fully explanatory, theory of the very principles by which the emergence of mental representation from neuronal electro-chemical signal transduction is even *possible*, much less actually accomplished. Nobel prize winning neuroscientist Eric Kandel (2000), in the most recent edition his seminal *Principles of Neural Science*, states both at its outset and at its conclusion that despite the exponentially increasing brain research literature extant, “the neural representation of consciousness and self awareness... [remains] biology’s deepest riddle” (Kandel, Schwartz, Jessel 2000:16).

“After all,” continues Kandel, “to study the relationship between a mental process and specific brain regions, we must be able to identify the components of the mental process that we are attempting to explain” (*ibid*). I will maintain in this article that it is precisely because of contemporary neuroscience’s refusal to identify and to include the *sign* as one of the ‘components’ to be investigated in the emergence of even the most primitive of mental representations, that the most semiotically sedimented and emergent representation of all – that of the ‘consciousness’ of a subjective, internally referential ‘self’ – has been averred to be incorrigible by some philosophers (Horgan 1999, McGinn 1999), and has earned David Chalmers’ (1996) definitive appellation as ‘*the hard problem*’ of consciousness and mind.

For if, as these philosophers have repeatedly asserted, mental representation *itself* follows laws incommensurable with the laws of physical systems – and if the material objects of the world likewise entertain no efficacy in the causation of mental events – then the problem of how a representational consciousness as such can arise in a physical system (without recourse to a ‘ghost in the machine’) truly *is* incorrigible.

In Peircean semiotics, however, we find a way out of this impasse with the twin recognition that: (1) ‘representation’ – as well as the capacity for *signification* of which representation is but a part – is *not* a process originating from, nor exclusively the domain of, the human mind and that (2) the nature of such ‘representation’ in a specifically human psychological context does not reduce to a linear, unitary process whereby one presently existing state or thing -such as the rich, subjective experience of ‘pain’ - isomorphically ‘stands for’ or corresponds to one other presently existing state or thing (the neuronal event *C-fiber stimulation*) and so on down the line in the manner of a computer interface until at last one reaches reach the static, underlying, and finally causal ‘program code’ – but that ‘representation’ is a process of ‘built’ and massively co-

constructed active *mediation* amongst elements (CP: 4.3)¹ in a complex, open system which ultimately allows the human organism to transcend the brute indexicality of physically present, coextensive and discrete relata and to participate *interactively* across its own organizational levels – levels which include the intrinsically dynamic elements of neuron, body, sign and world.

Critically, the neuron is a living cell and the environmental surround that each neuron is situated in, and with which it interacts most directly with at the site of the synaptic cleft, is a Heraclitian world of ever-changing chemical and molecular interaction and constitution, whose *analog representation* (the *synaptic potential*) is whatever unique configurational state that environment is in at the moment of synaptic - presumed to be quantal - release. Conversely, the electric current generated within the neuron and which travels down the axon, referred to semiotically enough as an *action potential*, possesses all the attributes of a purely *digital code*: it is either wholly present or wholly absent, its amplitude is not variable, it does not decay over time or distance. Most critically, *synaptic potentials generate action potentials which generate synaptic potentials which generate action potentials*. This ongoing process of semiosis wherein the interactive, consequential interplay between digital and analog activity constitutes new *signs* and new information at every nodal (synaptic) point constitutes a paradigm example of the semiotic interrelation called ‘code-duality’ (Hoffmeyer and Emmeche 1991, Hoffmeyer 1996 and SEED Volume 2.1) and is thus, I believe, the starting point upon which the establishment of a discipline of neurosemiotic must be built.

The totality of this systemic and incessant sign activity we reify as ‘mind.’ An ongoing, dynamic process of sign-exchanging cells embedded in sign-exchanging brains embedded in sign-exchanging bodies embedded in sign-exchanging worlds, the eternal interplay of symmetry breaking and of self-organization that characterizes the moment-to-moment experience of this recursively interactive system constitutes, in a very real sense, the very essence of ‘the mind.’

Properly seen, body, brain, mind and cell are but *levels* of the same one endlessly interacting complex system – and if we can view or treat them as distinct, it is more a testament to our own particular species-specific *Lebenswelt* – the culture of what Terrence Deacon (1997) calls *symbolic reference* – whereby we conceptually carve out of the sensory plenum of experience, elements of *quality* or, to use Peircian terms, iconicity

(firstness), elements of *relation* or indexicality (secondness), and elements of *synthesis* or *mediation* (thirdness) (CP 1.378).^{2 2}

In the Peircean conceptualization of brain activity that I will be arguing for, experience dependant and dynamically re-entrant *neuronal activity* constitutes, to paraphrase Colapietro's analogy with language, 'the process in which paths are blazed from the object to the sign to the interpretant,' whereas *consciousness* or *subjective awareness* constitutes 'the process in which these paths are traversed' (1989:19). Under this conception, the very biological semiosis that manifests the multitude of local electro-chemical sign-exchange into the global functional organization of our biological 'selves' finds its explicitly symbolic realization in the conceptual semiosis that manifests itself as our mental 'selves.' This opens up the way towards a *dynamic* view of the self that is *at once* iconic, dialogic and triadic.

For against the long-held *neural conduit metaphor* – wherein 'information' flows through neurons in much the same way as electricity flows through a copper wire, or even through a computer motherboard i.e. in ways in which neither the signal nor the vehicle of its transmission are understood to be participating in any way in semiosis – the massive data collected over the last half century regarding experience dependent dendrite growth, milieu responsive axon branching, epigenetic neural self-organization and the ongoing plasticity of synaptic weighting (Kandel, Schwartz, Jessel 2000) reveals the neural systems of living beings to be precisely what both its outward physical appearance and Sebeok's general theory of semiosis suggests that it would be: neither a carbon-based telephone exchange nor a peptide-bound motherboard for transporting bytes of pre-encoded data for the utility of some distal 'user' – but a living, interactive, massively re-entrant, semiotic *web*, the history of whose organization incorporates its past, is active in the present and extends outwards to the future – "a web of experience woven out of signs and used to catch various objects in our *Umwelt* for the sake of our survival and flourishing" (Colapietro 1993:179).

² Of the more prominent neuroscientists working in the field today, three in particular – Terrence Deacon (1997), Gerald Edelman (1994, 2000) and Antonio Damasio (1994, 1999) – all explicitly advance the notion that 'representation' in the body and in the mind exists as a *process* as opposed to as an entity or as a collection of neuronal and/or mental particulars. Yet while all three of these scientists acknowledge 'representation' as the recursive self-organization of interactions emerging out of, embedding, and becoming themselves embedded again within other interactions (for Edelman, on the neuronal level; and for Damasio, on the neuroanatomical), only Deacon explicitly recognizes and acknowledges that the very processes whereby representation emerges, is exchanged, and causes other representations to emerge *ad infinitum*, is essentially an embodiment of the semiotic triadicity of Peirce.

Thus, in its capacity to free us from a purely dyadic ontology of neuronal sign processes consisting only of signals and their carriers, the naturalistic re-introduction of *sign-objects*, *sign-interpretants* and *sign vehicles* into the provenance of neurobiology allows us to transcend the Saussurian assumption whereby mental activity *m* ‘signifies’ neural activity *n*. This invisible assumption of contemporary neuroscience, whereby the elements of ‘signified’ and ‘signified’ are conceptualized as being somehow dichotic and discrete and which, accordingly, may thus be correlated only *conventionally* or *arbitrarily*, is obviously an exceedingly curious position for any study of biological organization to take, and results in a *neural nominalism* which is more ubiquitous in the literatures of neuroscience and consciousness than it is remarked upon.

For until such time as researchers working in the mainstream of the brain sciences understand that neural activity *is* sign-activity and until such time as theoreticians conversant with the laws and properties of semiotic interaction can contribute to that understanding by dispelling once and for all the popular misconceptions that sign activity means mental activity performed by a psychological agent, the serious collaborative dialogue between neuroscience and biosemiotics will remain forever stillborn.

Bearing this last point in mind, and given the short amount of space available here, I would like to attempt something of a preliminary *rapprochement* between these two fledgling disciplines – each of which has much to offer the other and each of which, I believe, are investigating much the same phenomena – by applying an explicitly biosemiotic perspective to some of the more recent findings of traditionally conceived neuroscience in an effort to illustrate the mutual enrichment to be had by both fields via the incorporation of such a *neurosemiotic*.

2 EVOLUTIONARY AND ONTOGENETIC TUNING OF NEURONS FOR SELECTIVE RESPONSE

The fact that both individual neurons and the networks of which they are a part can be selectively ‘tuned’ by evolutionary and by ontogenetic experience i.e. they ‘take habits’ in the Peircean sense, was postulated most famously by Donald Hebb in 1949. Subsequently it has been demonstrated conclusively since by Palm (1982), Grey & Singer (1989), Tsumoto (1992), and Perrett et al. (1989a, 1989b, 1990), among a multitude of other researchers³³ (see, for example, the Face Recognition Research

³ Such adaptive, spontaneous ‘tuning’ through habituation, of course, is also at the basis of connectionist, or *neural networking*, models of information processing, self-organization, learning, and

Homepage at <http://www.cs.rug.nl/~peterkr/FACE/face.html> for just a partial listing of the hundreds of researchers currently working in this particular sub-field).

Kobatake and Tanaka's (1994) work on feature recognition at the level of the single neuron is representative of a vast corpus of research into the tendency for certain individual neurons to become *exclusively selective* or 'tuned' to respond to highly specific (often individual) colours, shapes, movements and particular biological stimuli such as fingers, faces and mouths (cf: Livingstone, Hubel 1987; Perret, Mistlin, Chitty 1987; Hubel 1988; Kandel, Schwartz, Jessel 2000; Zeki 1993, 1999).

Sensorimotor neurons – neurons that mediate both one's perception and one's effecting of the external world – likewise demonstrate high degrees of specificity, as the automaticity with which any 'conditioned response' or sustained 'deep' learning (such as speaking a language, driving an automobile or playing a musical instrument) will immediately attest. In practice, the massively accumulating data on the 'learning' 'planning,' 'storage' and exponentially recursive 'feed-forward/feedback interaction' of motor action sequencing and synchronization 'schemas' all but explicitly acknowledges the *semiotic* components inherent in such concepts as Gibson's (1950) 'motor affordances,' which holds that the *recognition* of the shape of an object and its physical 'opportunities for interaction' (its curves, protuberances, angularity, etc.) by a set of selectively tuned sensory neurons is what 'triggers' - in the mechanistic terminology acceptable to contemporary neuroscience - a *correlated* set of selectively tuned motor neurons to produce a corresponding reach and grasp (Gibson 1950, Arbib 2000).

Habituation of this type, I wish to argue, has at its basis *signification*, the process whereby detection of a certain stimulus in a living organism comes to elicit a specific response. On the neuronal level, such detection is far from straightforward, as the neurons where such 'selective tuning' have been found to occur may be buried deep within multiply embedded networks and pathways which, in turn, *themselves* have been organized both evolutionarily and through ontogenetic experience via detection, response and learning of contingent causalities, or, as one might reasonably say, semiotically.

Significantly, recent research in the neurobiology of vision, especially the groundbreaking work of Semir Zeki (1993, 1999) demonstrate conclusively that sensory percepts such as visual images are not so much 'received' from incoming photon

mind which attempt to build into mechanical systems the Hebbian postulate of experience-driven cell networking and self-assembly. For an excellent overviews and discussion of the shortcomings and potentials of connectionist and other AI/AL research, see Emmeche 1994 and Levy 1992.

impulses as they are semiotically and co-constructively ‘built’ across heterogeneous and massively intercommunicating brain areas. Thus we find that sensory signification *per se* is intimately bound up with motoric processes of bodily and environmental interaction in an ongoing process of semiosis that cuts across the sub-systemic distinctions of brain, body and world.⁴⁴

Semiotically, this visual network of organizational relations is only to be expected, as the evolution of the eye itself rests upon the evolution of a cell which has, over eons of interaction, been tuned to respond selectively to a range of photon configurations in the surrounding environment – a selectivity that ranges on the level of the single neuron from gross e.g. light detection, wavelength perception to extremely fine-tuned e.g. individual shapes, movement trajectories, and even highly specific faces, fingers, mouths and hands. Such cells in the aggregate interact with a vast distribution of other selectively specialized cells in the human brain to actively co-construct or ‘build’ a visual image that is not the product of brute mechanical reception and transmission, but of *semiosis*.

Even more recent findings regarding the neurobiology of visuomotor transformations strongly suggest that at least part of the semiotic and empathic grounding out of which *intersubjectivity* emerges may lie the activity of a certain class of selectively responsive neurons having both sensory *and* motor capabilities and that have been evolutionarily tuned to instantiate a congruent neural firing pattern both during one’s own execution of highly specific, goal-oriented, object-manipulating activities (grasping, tearing, biting) as well as during one’s mere passive observation of those exact same activities being performed by someone else (Fadiga, Fogassi, Pavesi, & Rizzolatti, 1995; Rizzolatti, Fadiga, Gallese, & Fogassi 1996; Gallese Vittorio, Fadiga L., Fogassi L., Rizzolatti Giacomo 1996; Iacoboni, Woods, Brass, Bekkering, Mazziotta and Rizzolatti 1999).

⁴ Hoffmeyer (1996) asks how we are to determine where an ‘individual’ starts (or ends!) in an organism that is itself composed of millions of other individual cellular organisms. Clark (1996, 1999) in turn, argues that the situating cognition and ‘mind’ exclusively in brain and in body as well creates a misleading dichotomy that has been the bane of cognitive science. Hutchins (1995) further unlooses the bounds of inquiry by arguing that cognition *per se* is distributed across brain, body and world, while Jarvillheto (2001) finally, questions the validity of positing any body-world distinction at all. Thus, the issue of *mereology*, as Stjernfelt (2000) and Kull (2001) have recently pointed out, is one which any comprehensive semiotic investigation is going to have to ultimately confront.

On the neurobiological level, I will be proposing in a future paper that one felicitous way of dealing with such questions may be via an extension of Hofstadter’s (1979) notion of ‘self-organizing modularity’ which finds its neurobiological counterpart in Edelman and Tononi’s (2000) notion of neuronal ‘functional clusters’ and their ‘dynamic core hypothesis’ – the neural version, in effect, of Bateson’s ‘difference that makes a difference’ – that accounts for the emergence of relatively discrete entities from a plenum of recursive interaction.

The discovery of these so-called ‘mirror neurons’ in humans a little over five years ago may have profound implications not only for our understanding of the sub-personal architectonics of empathy and intersubjectivity, but for a fundamental reappraisal into the continuing viability of any neuroscience of consciousness and mind that is not ‘semiotically’ conceived.

Thus stated, how we to begin the application of an explicitly Peircean semiotic to the dissipative electrochemical activity of communicating neurons? More critically, having seen how selective neuronal response properties may become, over evolutionary and ontogenetic time, exclusively ‘associated’ with objects and activities that these neurons themselves will never directly experience or ‘see,’ is there yet any reason to believe that the organization of this activity constitutes anything other than an electro-chemical ‘bucket brigade,’ a transfer of streaming brute ion configurations that receive their semantic ‘meaning,’ if at all, only at the ‘input/output’ (sensory and motor) ‘ports’ of the self? Conversely, is it reasonable to assert that the organization of this densely inter-communicative neuronal semiosphere itself partakes in no way of the organization of sign-activity that constitutes ‘consciousness’ and the ‘meaning’-making mind?

3 CONSTRUCTING REPRESENTEMA: THE SIGN VEHICLE OF THE EYE

If we understand *semiosis* to be an organizing principle of *all* manner of sign-exchange, then the operational processes enabling *signification* from receptor cell to interneuron to effector cell and the processes enabling signification across the meta-systems of biological organization (cell, pathway, network, organ, system, body proper) and across levels of awareness (network signification, body signification, mental signification) reveal themselves as systemic parts in a lawful, interactive continuum – a view of mind and body that allows us to transcend the intransigent dualism of a contemporary neuroscience “which performs its analysis with an axe, leaving as the ultimate elements, unrelated chunks of being” (CP 7.570).

Situated within the web of neuronal interaction, the *relata* of semiotic interaction – as everywhere - are in no way ontologically ‘fixed.’ Icons, indices and symbols do not exist in neuronal semiosphere as entities *per se*, but only as any given instance of neuronal activity, whether in isolation or as part of a larger, transiently existing or stable configuration, is ‘taken’ to be so through the *interpretant* (or significate effect) of its particular instantiation.

Thus, activity whose distal object might be some perturbation outside the body is, through the vehicle of the sensory sheet, interpreted as a sign *variously* - that is: iconically at one point, indexically at another, symbolically⁵⁵ at yet another - throughout the resulting cascade of interneuronal activity. For “first of all and most radically, a sign is neither a thing nor an object but the pattern according to which things and objects interweave to make up the fabric of experience” (Deely 1990:55).

The research on the neurobiology of vision discussed above demonstrate the validity of this neurosemiotic understanding most compellingly: the eye, like the entirety of the sensory sheet, is a *sign-vehicle*, the proper significate effect of whose cell by cell activity is not brute ‘interpretation’ in the dyadic sense ($\exists x; x = y$), but an entire cascade of top-down and bottom-up recursively generating semiosis across levels of interpretative and meta-interpretative activity and agents.

‘The object seen,’ no less than the concept ‘the self,’ exists not as a unitary given ‘presented’ to consciousness in the manner of computerized information exchange, but is instead a rich construction of internally biological, externally physical and historically situated, linguistically-mediated conceptual elements *none* of which enjoy a privileged or *autonomous* causality in structuring or determining the resultant symbol which is then ‘presented’ ‘seen’ or ‘brought to mind.’

Objectification is thus a product of the process of signification and not the other way around. Deely articulates this subtlety most incisively when he reminds us that “an organism does not deal with pure sensations, it deals with objects; and *objects are sensations organized according to the nature, wants, needs, and desires of the organism having the sensations*” (Deely 1999:10, *italics mine*).

This object in Peircean terminology is the *immediate object* – “the Object as the sign itself represents it, and whose Being is thus dependent upon the representation of it in the sign” (CP 4.536) and is the built object of neuronal sign-exchange, providing ‘objects,’ and therefore future *grounds*, of semiosis for all of the internal processes of the nervous system – including, but by no means limited to, symbolic ‘consciousness,’ ‘ideation’ and ‘awareness’ at its farthest upper reaches. It is related to its *dynamical object* – “which is the Reality which by some means contrives to determine the Sign to its Representation” (CP 4.536) – through its situation in the history of an organism’s evolutionary and ontogenetic experience.

⁵ That is to say, through the significance of such activity as situated in its relation to the presently

Brion (1999) captures the essence of the sign's relation to its dynamical object in terms that are deeply resonant with the research findings of evolutionary and developmental neurobiologists (Brion 1999:45):

Because the sign does not stand for the object 'in all respects,' then the sign abstracts from the object. 'To abstract from,' however, entails selection. Selection entails choice. Choice requires criteria of selection. Criteria of selection necessarily rest on values. That is, the relationship of the sign to the object is value-determined. Thus, the Ground carries out its function as the locus of [signification] – when it is suffused by – a set of values

Neurobiologically, these 'values' – for survival and for thrival – operate as the biases and selection pressures driving neuronal organization (Damasio 1994; LeDoux 1996; Deacon 1997; Schumann 1997; Edelman, Tononi 2000). Such organization, in turn, constitutes the primary sign-exchanging network that not so much 'links' – as makes semiotically continuous – the external and the internal milieus.

Thus, deep within the interactive tangles of the dense neuronal semiosphere, we have seen how the semiotic *object* of neuronal activity may be best understood as "that specific item within its context to which all interpretants [or significate effects] of that sign are collaterally related" (Savan, 1976:16). Here again do we find the 'objects' of the inner semiosphere to be a nexus of collaterally related interpretative responses or *interpretants*, corresponding to what Edelman and Tononi (2000) regard on the neuronal level of organization as 'dynamic functional clusters.' And of all such built and situated 'objects' of our experience, one – the experience of a unitary 'self' – is the most built and situated, collaterally related nexus of all.

4 CONSTRUCTING REPRESENTEMA: THE SIGN VEHICLE OF THE 'I'

Human brains are remarkably unfinished creations at birth (Deacon 1997; Kendel, Swchwartz, Jessel 2000) and among the perceptions which serve as input for our earliest conceptual schemata, and their attendant neuronal self-organization, are the ongoing symbolic interactions – what Bourdieu (1977) calls the *habitus* – of a reality which both begins as and which then artifactually reifies itself into a system of ever more generative signs. "By being included in the process of behavior," writes Vygotsky, "the

existing conventions, principles and 'laws' emergent from the functional organization of the organism.

psychological tool [which is the artifactual vehicle of the *sign*] alters the entire flow and structure of mental functions” (in Werstch 1981:137).

Taking it as axiomatic, then, that cultural transmission and genetic inheritance together orient the individual towards a cognition of negotiated meaning in an ecology of dialogic signs, we can situate the deeply internalized, seemingly ubiquitous concept of ‘self’ as a product of the uppermost *symbol* level of our biological inner semiosphere. This is a level that, by definition, includes and yet exceeds both in abstraction and in semiotic freedom the supporting *iconic* and *indexical* levels of the never-ending sign-exchange activity mediating cell, brain, body, and world.

Such activity and its resulting properties of causation are non-linearly interactive *across* levels of organization – and in their *interdependent* creation of the symbol known linguistically as the ‘self,’ cultural sign-exchange and biological sign-exchange exist in intimate symbiosis. ‘Self’ is thus an emergent process of nested iconic, indexical and symbolic *localization*: it is the carving out of experiential boundaries inherent in the differential causalities of interaction – Bateson’s ‘difference(s) that make a difference’ – both on the level of cell network architectonics as well as on the level of what Terrence Deacon (1997) refers to as our *virtual* and *symbolic* selves.

For just as Zeki’s (1993, 1999) vision studies indicate that our visual ‘representations’ emerge as complex co-constructions of massively distributed, non-linear processes of interaction which culminate in – but in their constituent parts no way fully constitute – the experienced visual image, so too, does our far more semiotically sedimented sense of ‘self’ emerge from constituent iconic, indexical and symbolic interactions none of which *alone* contain the full, rich sense of ‘self’ so familiar to our symbolic consciousness. Precisely like a visual representation, this mental representation isn’t ‘given’ – it is built.

For in order to determine what ‘kind’ of sign any given neuronal sign activity constitutes, we need to ascertain how that neuronal activity *functions* as part of its particular representational process. I thus propose that on the neuronal level, as everywhere else, the *iconic* distinction – not necessarily between a fully semiotic ‘self’ and ‘other,’ but simply between any given discrimination *being x* and *not being x* – underlies and supports all ascending distinctions, as more increasingly complex hierarchies of organization necessarily rely on preceding ones for their realization and support.

Thus, the richly constructed symbolic concepts of ‘self’ *and* ‘other’ in their fullest, subjective phenomenological senses *require* the full hierarchically referential complement of icon, index and symbol for their realizations, a complement which may be formalized ontologically as *being, relation* and *law*.

Like Heidegger’s *dasein*, (Heidegger, 1962), the ‘what’ (as opposed to the ‘that’) of firstness that is often equated with the idea of ‘self’ is inaccessible and remains so until such time as it is brought into the system of relations capable of indexicalizing or symbolizing it – at which point, of course, it can no longer be apprehended ‘in itself’ – which is simply to say ‘in isolation’ from the referential system, the system of ongoing semiosis.

Similarly, I wish to argue, the fully semiotic ‘self,’ the self that can know itself *as* ‘a self,’ is likewise inaccessible except through its realization in a vast web of living, semiotic interaction. Because the self is comprised of – and thus cannot exclude – the *being, relations and laws* of its own situational historicity, of its constitutive relations, and of its physical embodiment, these relations constitute the very vehicles by which experience of ‘the world’ and experience of ‘the self’ must be navigated and thereby known.

Self-representation – the representation of ‘a self’ *to* a self, even before the further mediation of linguaform awareness – is accomplished through a massively collaborative interaction of sign-exchange across countless nodes of mediation between cell, brain, body and world. Neuronally, biologically and symbolically, ‘self’ is therefore *cumulative*, not *primal* – an *achievement*, not a *given*.

Yet, this does not mean that the often maligned ‘first person view’ that such semiosis results is either an ‘illusion’ or a category mistake. Rather, such ‘subjective experience’ is a *fact* of neuronal, biological and semiotic organization and a causally efficacious locus of meaning making and sign exchange embedded within, and embedding within it, countless other loci of semiotic interaction. As the philosopher Thomas Nagel (1986) so eloquently reminds us, there *is* a particular and singular, nonlinguistic and existential perspective ‘from here.’

What is important to remember, however, is that even our most seamless, immediate, and apparently monolithic perspective is, in fact, a *built* perspective. For, just as on the symbolic level, dialogic relations of *action* (‘x does y’) and *interaction* (‘x does y to z’) characterize the long, post-natal process of human differentiation *and* individuation, so

too on the upwardly organizing neural level, do specifically iconic patterns of neuronal activity (selectively tuned single neuron response, reflexes, fixed action patterns, and, most critically, the reflexive register of the experience of all of the above) become repeatedly associated in their co-occurrence with still other iconic patterns of neuronal activity, forming indexical relations which join these icons together into networks of functional relation (Pulvermuller 1999; Edelman, Tononi 2000; Llinas 2001), – the *lawfulness* of which forms the basis of proprioceptive ‘self-awareness’ and, ultimately, of the symbolic order.

Neurosemiotically, the ceaseless interaction of these recursive iconic, indexical and symbolic levels of organization provide the substrate for the emergence of a meta-system propensity towards ‘thirdness’ – a propensity which, in our species, finds its apogee in language and in the communal manipulation of publicly negotiated and therefore multiply perspectival signs. It is at this point in its organization that the internally ‘realized’ self – what we now see as the fully *dynamic* and *triadic* self (both in its relations with others and in its relations with its own levels of organization) – comes into its own.

The dialogic and triadic nature of our upwardly organizing self, we have seen, allows our organism to literally construct (realize) a ‘self’ that is made at least partly out of the internalized actions of others – actions which are internalized on the neuronal level via mirror system interactions, the nature of which are *intersubjective* by definition, as part of what mirror neuron pioneer Vittorio Gallese (2001) calls our ‘subpersonal architecture.’

For mirror neuron research, rightly construed, demonstrates that not only language, but also *actions themselves* constitute a ‘public’ domain upon which and out of which the ‘subject self’ is at least partially constructed. Thus, there is no fully cognized ‘*self*’ to speak of that does not take the actions of others as the fabric from which itself is weaved. Indeed, Pierce reminds us that to maintain that “I am altogether myself and not at all you” constitutes a ‘metaphysics of wickedness’ (CP 7.570). ‘Others’ are in a sense *in* us and in our actions from the start.

5 CONCLUSION

The proposal is thus made to consider the ‘self,’ both neurobiologically and in its semiotic multiplicity as a being that is simultaneously and interactively iconic, dialogic, and symbolic. I have argued that to equate the ‘self’ as coterminous with biological proprioception, with the first-person perspective, or with a node in a social matrix, is to

impoverish the conception of 'self' by several significant orders – for the self to *be* a self must be all of these at recursively at once and more. The full 'self' as we understand it in our daily lives, is a dynamically determined self at every moment and the relations of which it is inextricably a part are likewise dynamically and perpetually co-constructed. It is therefore as much a product of social interaction as of neurotransmission, for both the subpersonal and the extra-personal aspects of this 'self' are deeply rooted in a massively non-linear, re-entrant ecology of signs.

This is why, in undertaking the establishment of a discipline of neurosemiotic, it is all the more critical to distinguish the various levels of sign activity, lest we are misled, on the one hand, to positing an eliminativist reductionism that dismisses some of the most vital aspects of our being as merely epiphenomenal or even downright illusory – or, on the other hand, to conflating what is proper only to the milieu of linguistic, socially mediated, symbolic interaction to the brute iconic and indexical significations taking place on the level of the somatic or neuronal cell.

REFERENCES

- Arbib, Michael A. 2000. The mirror system, imitation and the evolution of language. In: Nehaniv, Chrystopher, Dautenhan eds., *Imitation in Animals and Artifacts*. Boston: MIT Working draft retrieved March 2, 2000 from the World Wide Web: <http://www-robotics.usc.edu/~billard/arbib/pdf>
- Bateson, Gregory. 1972. *Steps to an Ecology of Mind*. New York: Ballantine Books.
- Bourdieu, Pierre. 1977. *Outline of a Theory of Practice*. (Nice Richard, trans.). Cambridge: Cambridge University Press.
- Brion, Denis J. 1999. The arrow of time: The past and future of law. In: Edwina Taborsky ed., *Semiosis Evolution Energy: Towards a Reconceptualization of the Sign*. Aachen: Shaker Verlag, 29-52.
- Chalmers, David. 1996. *The Conscious Mind: In Search of a Fundamental Theory*. New York: Oxford University Press.
- Clark, Andy . 1999. An embodied cognitive science? *Trends in Cognitive Science* 3, 9: 345-350.
- Clark, Andy. 1996. *Being There: Putting Brain, Body and World Together Again*. Cambridge: MIT Press
- Colapietro, Vincent M. 1993. *Glossary of Semiotics*. New York: Paragon House.
- Colapietro, Vincent M. 1989. *Peirce's Approach to the Self : A Semiotic Perspective on Human Subjectivity*. Albany: State University of New York Press
- Damasio, Antonio. 1999. *The Feeling of What Happens: Body and Emotion in the Making of Consciousness*. New York: Harcourt Brace.
- Damasio, Antonio. 1994. *Descartes' Error: Emotion, Reason and the Human Brain*. New York: G. P. Putnam's Sons.
- Deacon, Terrence. 1997. *The Symbolic Species: The Co-evolution of Language and the Brain*. New York: W. W. Norton.
- Deely, John. 1999. Postmodernism and the perfusion of signs. In: Edwina Taborsky ed. *Semiosis Evolution Energy: Towards a Reconceptualization of the Sign*. Aachen: Shaker Verlag, 7-13.
- Deely, John. 1994. *Bright Air, Brilliant Fire: On the Matter of Mind*. New York: Basic Books.

- Deely, John. 1990. *Basics of Semiotics*. Bloomington, IN: Indiana University Press.
- Edelman, Gerald and Giulio Tononi. 2000. *A Universe of Consciousness: How Matter Becomes Imagination*. New York: Basic Books.
- Emmeche, Claus. 1994. *The Garden in the Machine*. Princeton, NJ: Princeton University Press.
- Face Recognition Research Homepage* [On-line]. Available On-Line
<http://www.cs.rug.nl/~peterkr/FACE/face.html>
- Fadiga, L., L. Fogassi, G. Pavesi, and G. Rizzolatti. 1995. Motor facilitation during action observation: a magnetic stimulation study. *Journal of Neurophysiology*, 73, 2608- 2611.
- Gallese, Vittorio. 2001. The shared manifold hypothesis: From mirror neurons to empathy. In: Evan Thompson, ed. *Between Ourselves: Second-Person Issues in the Study of Consciousness*. Exeter: Imprint Academic, 33-50.
- Gallese Vittorio, L. Fadiga., L. Fogassi, Giacomo Rizzolatti. 1996. Action recognition in the premotor cortex. *Brain* 119: 593-609.
- Gelder, Timothy van and Robert Port. 1995. It's about time: an overview of the dynamical approach to cognition. In: *Mind as Motion: Dynamics, Behavior and Cognition*. Boston: MIT Press, 1-44.
- Gibson, James J. 1950. *The Perception of the Visual World*. Boston: Houghton Mifflin.
- Gray C. M. and W. Singer 1989. Stimulus-specific neuronal oscillations in orientation columns of cat visual cortex. *Proceedings of the National Academy of Sciences, USA* 86:1698-1702.
- Hebb, Donald O. 1949. *The Organization of Behavior: A Neuropsychological Theory*. New York, Wiley.
- Heidegger, Martin. 1962. *Being and Time*. Trs. John MacQuarrie and Edward, Robinson London: SCM Press.
- Hoffmeyer, Jesper and Claus Emmeche. 1991. Code duality and the semiotics of nature. In: M. Anderson and F. Merrell eds. *On Semiotic Modeling*. pp.177-166. New York: Mouton de Gruyter,
- Hoffmeyer, Jesper. 1996. *Signs of Meaning in the Universe* Tr. Barbara J..Haveland. . Bloomington: Indiana University Press.

- Hofstadter, Douglas. 1979. *Godel, Escher, Bach: An Eternal Golden Braid*. New York: Basic Books.
- Horgan, J. 1999. *The Undiscovered Mind: How The Human Brain Defies Replication, Medication, and Explanation*. New York: Free Press.
- Hubel, David. 1988. *Eye, Brain and Vision*. New York: Scientific American Library.
- Hutchins, Edwin. 1995. *Cognition in the Wild*. Cambridge MA: MIT Press.
- Iacoboni Marco, R. Wood, M. Brass, H. Bekkering, John Mazziotta, Giacomo Rizzolatti. 1999. Cortical mechanisms of human imitation. *Science* 286 (5449): 2526-2528.
- Jarvilehto, Timo. 2000. The theory of the organism-environment system IV: The problem of mental activity and consciousness. *Integrative Physiological and Behavioral Science* 35:1 (in press). Manuscript may be accessed on the World Wide Web at <http://wwwedu.oulu.fi/homepage/tjarvile/art4.htm>
- Kandel, Eric R., James H. Schwartz, and Thomas M. Jessell, eds. 2000. *Principles of Neural Science* (4th. ed.). New York: McGraw-Hill
- Kobatake, Eucaly and Tanaka Keiji. 1994. Neuronal selectivities to complex object features in the ventral visual pathway of the macaque cerebral cortex. *Journal of Neurophysiology* 71: 856-867.
- Kull, Kalevi. 2001. Biosemiotics means biology. Paper presented at the First Annual Gatherings in Biosemiotics, Copenhagen, Denmark. May 24-27, 2001.
- LeDoux, Joseph E. 1996. *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. New York: Simon & Schuster.
- Levy, Steven. 1992. *Artificial Life: A Report from the Frontier where Computers Meet Biology*. New York: Random House.
- Livingstone, Margaret and David Hubel. 1987. Psychophysical evidence for separate channels for the perception of form, color, movement and depth. *Journal of Neuroscience* 7: 3416-3468.
- Llinas, Rudolfo R. 2001. *I of the Vortex*. Cambridge, MA: MIT Press.
- Locke, John. Nagel, Thomas. 1986. *The View From Nowhere*. Oxford: Oxford University Press.

- Palm, Günther 1982. *Neural Assemblies: An Alternative Approach to Artificial Intelligence*. Berlin: Springer-Verlag. 1690. *An Essay Concerning Human Understanding*. 1959 edition. New York: Dover Publications.
- McGinn, Colin. 1999. *The Mysterious Flame: Conscious Minds in a Material World*. New York: Basic Books.
- Peirce, Charles Sanders. 1931-1935. *Collected papers of Charles Sanders Peirce, vols. 1-6*. Hartshorne Charles, Weiss, Paul (eds.); *Vols. 7-8*. Burks, A. (ed.). Cambridge, MA: Harvard University Press.
- Perret, David, A.J. Mistlin, M. Harries and A.J. Chitty. 1990. Understanding the visual appearance and consequence of hand actions. In M. Goodale, *Vision and Action: The Control of Grasping*. Norwood, NJ: Ablex: pp. 163-180.
- Perret, David, M. Harries, A.J. Mistlin and A.J. Chitty. 1989a. Three stages in the classification of body movements by visual neurons. In H.B. Barlow, et al. *Images and Understanding*. Cambridge: Cambridge University Press: pp. 94-107.
- Perret, David, M. Harries, R. Bevan,, et al. 1989b. Frameworks of analysis for the neural representation of animate objects and actions. *Journal of Experimental Biology* 146: 87- 113.
- Perret, David, A.J. Mistlin and A.J. Chitty. 1987. Visual neurons responsive to faces. *Trends in Neuroscience* 10: 358-364.
- Pulvermuller, Friedmann. 1999. Word's in the brain's language. *Behavioral and Brain Sciences* 22(2): 253-279.
- Rizzolatti, Giacomo, L. Fadiga, V. Gallese, and L. Fogassi. 1996. Premotor cortex and the recognition of actions. *Cognitive Brain Research* 3: 131-141.
- Savan, David. 1976. *An Introduction to C.S. Peirce's Semiotics Part 1*. Toronto: Toronto Semiotic Circle.
- Schumann, John. 1997. *The Neurobiology of Affect in Language*. Oxford: Blackwell.
- Stjernfelt, Frederik. 2000. Mereology and semiotics. *Sign System Studies* 28: 73-98.
- Taborsky, Edwina. Ed. 1999. *Semiosis Evolution Energy: Towards a Reconceptualization of the Sign*. Aachen: Shaker Verlag.
- Thompson, Evan. Ed. 2001. Empathy and consciousness. In: *Between Ourselves: Second-Person Issues in the Study of Consciousness*. pp.1-32. Exeter: Imprint Academic

Tsumoto, T. 1992. Long-term potentiation and long-term depression in the neocortex.
Process in Neurobiology 39: 209-228.

Vygotsky, Lev. 1978. *Mind in Society: The Development of Higher Psychological Processes*. Tr. Michael Cole. Cambridge, MA: MIT Press.

Zeki, Semir. 1993. *A Vision of the Brain*. Oxford: Blackwell Scientific Publications.

Zeki, Semir. 1999. *Inner Vision: An Exploration of Art and the Brain*. Oxford: Oxford University Press.

NOTES

1. Of the more prominent neuroscientists working in the field today, three in particular – Terrence Deacon (1997), Gerald Edelman (1994, 2000) and Antonio Damasio (1994, 1999) – all explicitly advance the notion that ‘representation’ in the body and in the mind exists as a process as opposed to as an entity or as a collection of neuronal and/or mental particulars. Yet while all three of these scientists acknowledge ‘representation’ as the recursive self-organization of interactions emerging out of, embedding, and becoming themselves embedded again within other interactions (for Edelman, on the neuronal level; and for Damasio, on the neuroanatomical), only Deacon explicitly recognizes and acknowledges that the very processes whereby representation emerges, is exchanged, and causes other representations to emerge ad infinitum, is essentially an embodiment of the semiotic triadicity of Peirce.
2. Such adaptive, spontaneous ‘tuning’ through habituation, of course, is also at the basis of connectionist, or *neural networking*, models of information processing, self-organization, learning, and mind which attempt to build into mechanical systems the Hebbian postulate of experience-driven cell networking and self-assembly. For an excellent overviews and discussion of the shortcomings and potentials of connectionist and other AI/AL research, see Emmeche 1994 and Levy 1992.
3. Hoffmeyer (1996) asks how we are to determine where an ‘individual’ starts (or ends!) in an organism that is itself composed of millions of other individual cellular organisms. Clark (1996, 1999) in turn, argues that the situating cognition and ‘mind’ exclusively in brain and in body as well creates a misleading dichotomy that has been the bane of cognitive science. Hutchins (1995) further unlooses the bounds of inquiry by arguing that cognition *per se* is distributed across brain, body and world, while Jarvillheto (2001) finally, questions the validity of positing any body-world distinction at all. Thus, the issue of *mereology*, as Stjernfelt (2000) and Kull (2001) have recently pointed out, is one that any comprehensive semiotic investigation is going to have to ultimately confront.
4. That is to say, through the significance of such activity as situated in its relation to the presently existing conventions, principles and ‘laws’ emergent from the functional organization of the organism.⁶

ENDNOTES

- ¹ On the neurobiological level, I will be proposing in a future paper that one felicitous way of dealing with such questions may be via an extension of Hofstadter's (1979) notion of 'self-organizing modularity' which finds its neurobiological counterpart in Edelman and Tononi's (2000) notion of neuronal 'functional clusters' and their 'dynamic core hypothesis' – the neural version, in effect, of Bateson's 'difference that makes a difference' – that accounts for the emergence of relatively discrete entities from a plenum of recursive interaction.
- ² Of the more prominent neuroscientists working in the field today, three in particular – Terrence Deacon (1997), Gerald Edelman (1994, 2000) and Antonio Damasio (1994, 1999) – all explicitly advance the notion that 'representation' in the body and in the mind exists as a *process* as opposed to as an entity or as a collection of neuronal and/or mental particulars. Yet while all three of these scientists acknowledge 'representation' as the recursive self-organization of interactions emerging out of, embedding, and becoming themselves embedded again within other interactions (for Edelman, on the neuronal level; and for Damasio, on the neuroanatomical), only Deacon explicitly recognizes and acknowledges that the very processes whereby representation emerges, is exchanged, and causes other representations to emerge *ad infinitum*, is essentially an embodiment of the semiotic triadicity of Peirce.
- ³ Such adaptive, spontaneous 'tuning' through habituation, of course, is also at the basis of connectionist, or *neural networking*, models of information processing, self-organization, learning, and mind which attempt to build into mechanical systems the Hebbian postulate of experience-driven cell networking and self-assembly. For an excellent overview and discussion of the shortcomings and potentials of connectionist and other AI/AL research, see Emmeche 1994 and Levy 1992.
- ⁴ Hoffmeyer (1996) asks how we are to determine where an 'individual' starts (or ends!) in an organism that is itself composed of millions of other individual cellular organisms. Clark (1996, 1999) in turn, argues that the situating cognition and 'mind' exclusively in brain and in body as well creates a misleading dichotomy that has been the bane of cognitive science. Hutchins (1995) further unlooses the bounds of inquiry by arguing that cognition *per se* is distributed across brain, body and world, while Jarvilheto (2001) finally, questions the validity of positing any body-world distinction at all. Thus, the issue of *mereology*, as Stjernfelt (2000) and Kull (2001) have recently pointed out, is one that any comprehensive semiotic investigation is going to have to ultimately confront.

On the neurobiological level, I will be proposing in a future paper that one felicitous way of dealing with such questions may be via an extension of Hofstadter's (1979) notion of 'self-organizing modularity' which finds its neurobiological counterpart in Edelman and Tononi's (2000) notion of neuronal 'functional clusters' and their 'dynamic core

hypothesis' – the neural version, in effect, of Bateson's 'difference that makes a difference' – that accounts for the emergence of relatively discrete entities from a plenum of recursive interaction.

- ⁵ That is to say, through the significance of such activity as situated in its relation to the presently existing conventions, principles and 'laws' emergent from the functional organization of the organism.