Chapter 5
Semiotic Scaffolding: A Biosemiotic Link Between Sema and Soma

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The scientific understanding of the body, as developed in the medical and biological sciences, has never distanced itself from its basis in Cartesian sensory mechanics, the belief that the world reaches us through the mechanical (physicochemical) workings of the sensory system. And yet, the problem of how mechanical processes could possibly transform themselves to thoughts and ideas has never been decently answered, although metaphorical talk of "programming" or "information processing" may have created the illusion that the tools for a solution were now at hand. To get out of this impasse, we shall have to challenge the basic premise for these ideas; the belief in sensory mechanics as an exhaustive explanation for how the outer world enters our mind; instead of *sensory mechanics* we shall have to take *sensory semiotics* as the point of departure in the life sciences. The world around us reaches us through sign processes, semiosis, i.e., our lives do not play out in a mechanical body but in a semiotic body. Biosemiotics, the sign-theoretic or semiotic approach to the study of life and evolution is based on the understanding that biochemical processes are organized in obedience to a semiotic logic (Sebeok and Umiker-Sebeok 1991; Hoffmeyer 1996, 2008a). Molecular structures are not just chemical entities; they are also potential sign vehicles mediating communicative activity between cells, tissues, and organs of our body or between bodies.

This semiotic reframing of our fundamental ideas of life and organic evolution has obvious consequences for our understanding of that peculiar species of animals to which the authors as well as the readers of this book belong. One important consequence is that the human genome cannot be considered a "master plan" or controller of human development. As will be shown in this chapter, the genome is better understood as a semiotically controlled scaffolding system. However, as a scaffolding system, the genome is only the most basic form; multiple semiotic scaffoldings of a more and more overriding range are built on the top of the genetic scaffolding system, and most important in the context of cultural psychology, semiotic scaffolding systems painlessly bridges the mind–body gap, being in their function as controllers,

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essentially somatic and social, in one and the same process. The three instances or events brought together in a sign process, the sign vehicle (e.g., smoke), the object (e.g., fire), and the interpretant (e.g., fear), may—and most often do—belong to different hierarchical levels, as when a certain taste of crumbs of a madeleine cake dissolved in a cup of tea releases a strong emotional bodily memory in a person of long forgotten childhood Sunday mornings. Here, a certain combination of taste-provoking molecules constitutes the sign vehicle. The forgotten Sunday mornings is the object to which the sign vehicle refers, and the interpretant is the sudden feeling that Marcel Proust in his famous novel expresses in these words: "And at once the vicissitudes of life had become indifferent to me, its disasters innocuous, its brevity illusory—this new sensation having had on me the effect which love has of filling me with a precious essence; or rather this essence was not in me it was me. . . ." (Proust 1913–1927).

This, of course is a perfect example of what Jaan Valsiner called semiotic catalysis: the sign process here acts as a catalyst for the production of an unexpected insight, that might not otherwise have come to mind, an insight, furthermore, that has no intrinsic relation to the sign vehicle itself, the mixture of molecules releasing its production (Valsiner 2000; Kull this volume). As we shall see, this explanatory principle may be generalized to cover processes at cultural levels.

Needless to say, a semiotic understanding of life processes runs counter to deep ontological intuitions not only in the scientific society but also in the humanities. Before we can proceed with the biosemiotic analysis, it may be necessary to consider the legitimacy of these intuitions.

The Taboo Against Final Causality

When the toddler rises to her feet from under the table and bumps her head into the tabletop, she learns that it hurts because of something she herself did. You cannot bump into hard, heavy things, such as tabletops without hurting yourself. The child spontaneously and inwardly comes to know the workings of that causality which David Hume saw as a purely psychological phenomenon and Immanuel Kant understood as an a priori category of reason. Neither Hume nor Kant related causality to the simple bodily experience from which our conception of causality necessarily originates. The concept of "force" is ultimately a biological concept rooted in bodily movements, and the effects that flow from the use of force are experienced as caused by the force we have to spend in order to surmount the resistance that nature (or other people) raises against our actions. When we ascribe the mutual pulling of the celestial bodies to the workings of a gravitational force, we are therefore in effect projecting our bodily experiences onto the world at large. Thus, we provide the nonliving nature with a kind of bodily dynamics, which science, paradoxically, subsequently has used to "prove" that living nature basically is nothing but dead nature, DNA molecules, particles in motion.

We know about the world because we are in constant interaction with it, not just because our sense apparatus picks up signals from it, and this simple fact has far-reaching implications for the everlasting standstill between science on the one hand and transcendental philosophy or phenomenology on the other hand. The fact that we can project our bodily experienced causality into the world at large and derive trustworthy and nonfalsified understanding from it allows us to abductively reach the strong hypothesis that the world is in a deep sense of the same kind as is life. One important implication of this is that natural science cannot uphold its ingrained taboo against final causation, another—perhaps even more important—is that the claim of transcendental philosophy or phenomenology for a distinction between observable *phenomena* and indefinable *noumina*, becomes seriously weakened: if causality is basically rooted in bodily experience the idea of the thing-in-itself (das Ding-an-Sich) loses much of its substance (see later).

Ever since Francis Bacon's days science has considered it a "deadly sin" to explain the workings of nature in anthropomorphic terms: ". . . human understanding is like an uneven mirror receiving rays from things and merging its own nature with the nature of things, which thus distorts and corrupts it" wrote Bacon in the *Novum Organum* (Bacon 2000/1620, p. 41). The truth of this warning notwithstanding, it should be noticed that while a taboo against anthropomorphism in science was both rational and legitimate in Francis Bacon's own time, when humans were still thought to be the direct creations of God, it obviously became absurd from the moment Darwinism was accepted. According to a Darwinian understanding, humans were themselves products of nature and the very existence of human mental life, and the purposes implied thereby, would thus be in downright contradiction to the taboo against anthropomorphism and final causation in natural science. That some philosophers and scientists have felt it necessary to adopt the position of so-called eliminativism, the belief that mental life is an illusory or meaningless concept, speaks volumes of how deeply the taboo against final causation is rooted in the scientific ontology. Apart from the absurdity of denying the reality of human mental life, eliminativism itself ends up in absurdities; the pursuit of knowledge is a purposeful activity, and yet eliminativism could hardly exist without it.

Had scientists and philosophers been open to Charles Sanders Peirce's semiotic and evolutionary philosophy, this discussion might have come to follow other tracks. According to Peirce, the problem of final causation in scientific explanations is essentially rooted in the absence of a clear distinction in the Cartesian tradition between two things that should never be confounded: the concept of *purposive, consciously conceived end causes* which in a strict sense has validity only in the human world and *a general principle of final causation*: "It is a widespread error to think that a *final cause* is necessarily a *purpose*. A purpose is merely that *form* of final cause which is most familiar to experience" said Peirce (Peirce 1931–1958, Vol. 1, p. 211; italics added), or in other words, "purpose is the *conscious* modification of final causation" (Peirce 1931–1958, Vol. 7, § 366; italics added). *Psychological* end causes, such as the distinct purposes I might have in writing this text, are in Peirce's thinking just a special subcategory of the much broader category of final causes, and these, according to Peirce, are at play in any sort of goal-oriented activity in nature, as well as in culture. A final cause is simply the general form of any process that tends toward an end state (a finale).

An example of a natural law that embraces this form of a final causation is the 2nd law of thermodynamics, often called the "entropy law". This law does not stipulate how exactly entropy is going to increase, but it does stipulates that every change taking place in our universe must necessarily imply a global increase in entropy (although locally entropy may often be decreased—by being exported to the environment—which is the trick that keeps living systems alive). We are so used to thinking in the reductionist scheme of classical physics that it perhaps feels odd to ascribe causality to a principle like the entropy law, and yet in a modern understanding it is exactly the irreversibility described by this law, which accounts for the perpetual energy transformations that cause not only the organic life on Earth but also the whole universe to evolve. In his recent book, "Incomplete nature", the American anthropologist and neurobiologist Terrence Deacon outlines a possible path that may have led from a prebiotic world, governed by thermodynamic lawfulness, to the appearance of systems exhibiting, what he calls *teleodynamic* properties, i.e., systems in which causal processes have been ordered so as to exhibit "consequence-organized features"[1] (Deacon 2012a). Through computer simulation he has managed to construct a model that does in fact develop to perform as a teleodynamic system. If Deacon is right, it must be concluded *that life and final causation is—at least potentially—inherent in the fundamental physics of our universe* and rather than tabooing final causation right away we should make a distinction between acceptable and nonacceptable kinds of final causation.

When the tornado Sandy caused major destructions in New Jersey and New York, it was obviously not because Sandy "wanted" to take revenge on the poor New Yorkers or otherwise spoil their life. Likewise, when a monarch butterfly in October sets out on its migratory flight down from New York State to Mexico it is not due to any specific wish the butterfly might nourish. And yet, while an explanation in terms of finality may be appropriate to the butterfly's behavior, it is impermissible for the tornado. The difference is that the butterfly is a living system and as such it exhibits what Deacon calls *ententional* properties. By the term "ententional" Deacon refers to "phenomena that are intrinsically incomplete in the sense of being in relationship to, constituted by, or organized to achieve something non-intrinsic. This includes function, information, meaning, reference, representation, agency, purpose, sentience and value" (Deacon 2012a, p. 549). The migration of the butterfly is presumably more or less directly caused by information in the sense of its genetic setup that causes specific metabolic changes in response to certain particular conditions in its environment.

One of the few general trends that can be ascribed to organic evolution is the tendency towards the production of species exhibiting more and more semiotic competence or freedom in the sense of "increased capacity for responding to a variety

[1] By teleodynamics Deacon means "a form of dynamic organization exhibiting end-directedness and consequence-organized features that is constituted by the co-creation, complementary constraint, and reciprocal synergy of two or more strongly coupled morphodynamic [self-organizing] processes" (p. 552).

of signs through the formation of (locally) 'meaningful' interpretants" (Hoffmeyer 2010, p. 196; Hoffmeyer in print). *Semiotic freedom* can be seen as one among other survival strategies in the evolutionary game, and as such it would obviously have been best suited to life forms of free moving animals, because of the need in such species for coping with fast spatial variations. While a diffuse nervous system already is present in the cnidarians (jellyfish, sea anemones, corals etc.) the first archaic brains appear some 550 million years ago in early bilateral animals such as flatworms. In much more advanced invertebrates like insects and octopuses, we already find very well developed brains, but it is in the vertebrate line and especially in the warm-blooded (and therefore much more active) mammals and birds, that we find species possessing the most highly developed semiotic freedom. The important point here is that ententional phenomena, as defined by Deacon, form a graded series relative to the complexity or sophistication of the ententional mechanisms that the different species have at their disposal. Thus, while conscious organisms have probably been around on Earth for some 200 million years it is only in our species—and thus only for the last 200,000 years—that linguistic intelligence has been present. Explanations in terms of final causes are therefore level dependent with human beings being probably alone in having distinct well-articulated purposes, mammals and birds alone in exhibiting consciously based choices of action, animals alone in having sufficient brain capacity for individually learned behavior patterns. All nonanimal species probably have very low or no capacity at all for individually initiated problem-solving strategies being, in this respect, nearly fully dependent on their genetic predispositions. Therefore, explanations in terms of final causation are only permissible when applied at the proper level relative to the kind of finality imposed.

The Stream of Bodily Semiosis

The fact that causality is rooted in bodily experiences and arises as a result of our own intentionality, and the understanding that such intentionality does not inherently contradict the basic physical lawfulness of our universe, shows us a way out of that "insurmountable" split between the world of unknowable and indefinable *noumena* and the world of knowable *pheno(u)mena* from which transcendental philosophy takes its point of departure. Kant claimed that "because the receptivity or capacity of the subject to be affected by objects necessarily antecedes all intuitions of these objects, it is easily understood how the form of all phenomena can be given in the mind previous to all actual perceptions, therefore *a priori,* and how it, as pure intuition, in which all objects must be determined, can contain principles of the relations of these objects prior to all experience" (Kant 2003/1787, p. 76). But, as we have seen, there is nothing a priori about our understanding of causality, and there is no good reason to believe that there is anything a priori about our understanding of space and time, for our understanding is basically coined in our bodily intentionality, in our semiotic interaction with the world in space and time.

With our fingers, arms, legs, etc. and through the means of thought and imagination, we expose the things before us to our curiosity and volition. If a Kantian would claim that the pencil on the table in front of me cannot in principle be known, I must answer that I can surely manipulate it and feel its form, hardness, temperature, and so on, and by doing so, I establish the missing loop in the sensory-cognitive scheme; I do not just sense the pencil mechanically, for my knowing the pencil does not start in the retina, and it does not end up in the brain, rather it flows back and forth through an indefinite number of loops where the pencil is integrated into the movements of my fingers and thus into a world of immediate as well as memorized bodily experiences and back again to neuronal circuits in the brain forming a continuous and branched set of loops. My interaction with the pencil is historical and semiotic, not mechanical. As the philosopher of science Tyrone Cashman has put it "what assures us that our images are in fact *about* the object in the world is that our sensory images track the changes in the world that the hands initiate. What assures us that our constructed concepts of what the world is like are truly *about* the world is both the way the concepts guide action, and the way that, through this ability, they can be falsified by the results of manipulation in experiment" (Cashman 2008, pp. 56–57).

The teleodynamics exhibited by living systems places cognition solidly in the stream of bodily semiotics, and phenomenology and science is challenged in symmetrical ways by this new understanding. The taboo against final causality (science) and the rejection of the possibility to know the "thing in itself" (phenomenology) are interconnected errors reflecting a general failure to recognize the fundamentally semiotic nature of life and cognition.

What is needed is an ontology of *semiotic realism*. The activities of living creatures are always end-directed; they all depend on a capacity to anticipate dangers and to anticipate where and when resources of different kinds might be accessible. To achieve this organisms produce internal "models" of significant parts of their surroundings, or Umwelts to use the expression the Estonian-German biologist Jakob von Uexküll introduced (Kull 2001). Although the Umwelts of animals may seem extremely limited in both spatial and temporal variety, when compared to our own human Umwelts, they nevertheless usually serve them well in making life-saving choices of action. Even a bacterium that chooses to swim right instead of left, because thousands of molecular receptors sitting in its cell membrane tells it that this is where most nutrient molecules are likely to be found, is in fact making a kind of anticipation. While it swims along, the bacterium continuously measures the number of hits between its own receptor molecules and the nutrient molecules in the medium, and as long as the number of hits per second is increasing it will proceed forward in the same direction. Should the frequency of hits start decreasing, the bacterium will eventually stop moving forward and instead start tumbling around, which then in time may bring it to move forward in a new and perhaps more favorable direction. It seems very likely that this molecular recognition mechanism is the earliest precursor of all processes of cognition in the life-sphere. One might perhaps object to calling it cognition at all, but rather than quarrelling on definitorial questions, we should recognize that no matter what we call it, this mechanism is indeed a kind of categorization—as pointed out by Frederik Stjernfelt (Stjernfelt 1992). The semiotic character of the process lies in the fact that unlike nonliving processes, the categorization of substances in molecular recognition, already realizes a split between object and property. Molecular recognition may *fail*—for instance if the bacterium erroneously categorizes synthetic sweetener molecules as sugar molecules—leading the organism to irrelevant or even poisonous substances; and such failure, we should add, becomes objectively measured through its consequences for survival.

A hardliner phenomenologist might object to the notion that the choice of a bacterium should bear any relationship to genuine human interpretational processes, pointing to the fact that the biochemical mechanism, which produce such bacterial choices, are by and large well known, and that under the given conditions, the bacterium could not have made the particular choice it made. The choice then, was compulsory—not free. Against this objection, I have two comments. First, one should observe, that our hardliner-phenomenologist owes us to show that human choices are mechanistically based on radically different, causally more free kinds of processes. I actually think this might be done at a scientific basis, even though, basically, human cognitive processes also in the end depend on processes inside cells that are biochemically quite well known. The difference, however, resides in the fact that human cognition is a result of 100 billions of interacting cells in the brain, while the bacterium, such as we know it from the lab, is entirely on its own.

This brings us to my second comment. Our hardline-phenomenologist should be aware that bacteria in the real world—as opposed to the lab—are never alone. Both temporally and spatially, they take part in a global community of bacteria even crisscrossing species boundaries. Microbiologist Soren Sonea dubbed this a "global organism" (Sonea 1991), and we all encounter the phenomenon in the form of bacterial resistance to antibiotics. The internal communication in the world of bacteria proceeds via the exchange of genetic material, and no matter which substance we invent in the fight against bacterial infections there will always, somewhere on the globe, exist a bacterium possessing some genetic material that may be used by bacteria to fight this particular poison. Due to communicative processes inside the global organism, such genes will sooner or later arrive in the human population and produce resistance among the pathogens. The global organism, if not the single bacterium, is capable of sizing up the situation and produce an adequate response, which is pretty much what interpretation and choice is about. All organisms on Earth are descendants from symbiotic conglomerates of bacterial cells that in the course of evolution have evolved to become animal cells, plant cells, or fungal cells, and it seems most parsimonious to see bacterial communicative behavior as a predecessor for human mental life rather than to assume mental life to have sprung into being by an, as yet, unknown independent mechanism in a later state of evolution.

A hardliner-biologist, on the other hand, might claim that terms such as semiosis and interpretation are confusing and superfluous since the concept of information is all we need; the bacterium simply receives information from the medium telling it where to find the nutrients, he might claim. But in saying so, he would in fact commit a category error, for information is not a substance and neither is it energy. So what does it mean, that the bacterium "receives" information? The concept "information" has been used in many different ways, but a reasonable understanding of the concept in this context would be that information is a measure for *a deviation from expectations*. So what the biologist should have said would be, rather, that the input from the medium combined with the bacterium's own swimming movements has caused an alteration in its "state of expectation". He could not of course have said this, though, for such a statement would conflict with the taboo against final causation; and in a way, he would be right, for expectations are loaded with human psychological implications which represent a kind of finality that does not belong to bacterial life. There is no need to introduce psychological language here, suffice it to use the much more parsimonious semiotic language; the bacterium does not receive anything, it actively searches the area (swimming), and eventually alters its course by interpreting relevant signs, which in this case are the measured changes in concentration of nutrient molecules. Any number of other chemical changes may take place in the medium and yet remain "unknown" to the bacterium, as long as they do not belong in its recognized Umwelt. The bacterium, in other words, actively selects those, and only those, events in the milieu that are meaningful to it. Information, as generally understood in biology, is much too poor a concept for describing the process involved.

Sensory Semiotics

The little girl looks at the red strawberry and thinks "goody!". She does this, of course, because she has earlier tried to eat a strawberry like this and enjoyed it. But we will have to start our analysis somewhere, so why not right here, at this moment, when she sees this red strawberry? The reflected light from the strawberry reaches her through the eye's lens and is projected upon the retina where 130 million photoreceptors (rods and cones) are ready to catch the light signals and send them to local ganglia in the outer layer of the eye. A significant amount of processing of the visual signals takes place already at this local level and a condensed version is successively transmitted to the brain via the optic nerve. Part of the further processing is taken care of by a small almond shaped area in the limbic system called the amygdala that plays a decisive role in the appraisal or biasing of the visual inputs. The amygdala receives and sends signals directly from and to the visual system, reacting to visual stimuli without the involvement of consciousness (Siegel 1999, p. 133). Processes such as these may be involved in the strange sense of belief with which we sometimes unconsciously evaluate our experiences.

In this description, we have moved a long way from the traditional sensory mechanical scheme. And yet, terms such as "signals" and "processing" keep us inside a fairly mechanistic frame of thought. Are these "signals" to be conceived of as unambiguous "packets" of some "informational stuff"—whatever that would be? And is the processing anything else than the kind of algorithmic symbol manipulation that computers can do so easily for us? As long as these questions are not answered, it remains difficult to understand how a signaling activity— no matter how complex—could possibly end up as an experience of desire in the mind of a small girl. We are here confronting the so-called *hard problem* of consciousness (Chalmers 1996), and I shall not pretend that a semiotic understanding will give us any easy solution to it. However, while an explanation in terms of mechanistic or informational models leaves us with a downright impossible problem, the semiotic model points us to emphasize relational phenomena that, in principle, are independent of the substantiality of the related entities, and this opens new channels of explanation.

A sign process is a triadic relation whereby something called the "sign vehicle" (the sound of an ambulance for instance) is referring someone to an "object" (the need for stepping on the breaks) through the formation in the body and mind of a mediating process called an "interpretant". It is important to notice here that the interpretant is a relational *process* inside the interpreter (be it a human or some other receptive system), a process whereby the perceived sign vehicle becomes related to the object, in such a way that it somehow mimics the sign vehicle's own relation to that same object. Thus, the interpretant formed in the body and mind of a human person hearing the specific warning sound of an approaching ambulance is the process whereby this person becomes aware of the need for stepping on the break. A semiotic understanding of mental processes therefore does not require us to commit the usual error of misplaced concreteness; sign processes are never rooted in particular entities or processes, but are always just "snapshots" of the fluent open-ended relational dynamics of entities and processes. Furthermore, sign processes easily cross gaps between hierarchical levels. Thus, the social implications which may derive from one and the same mechanical process inside a person's ears is fully dependent on what goes on inside that particular person. The sound of an ambulance may for instance cause a traffic accident as a friend of mine told me had happened to her when she, a minute after she had seen her 8-year-old daughter from the car's window walking peacefully along the sidewalk of a busy street, heard the sound of an approaching ambulance and, irrationally frightened, bumped into another car parked along the street. In semiotics, there is no such thing as a compulsory link between cause and effect. A given sound may be judged insignificant, or it may release a pressing of the break, or it may even cause you to bump into another car.

A detailed semiotic analysis of the girl's "goody!" experience would include an enumeration of the long chain or web of sign processes in which the interpretant in one process is acting as a sign vehicle provoking the formation of a new interpretant at the next more comprehensive level. In the course of the process, the whole scale of contextual relations are drawn into the process, comprising not only the now-and-here (impulses from other senses) but also memorized material (the girl's former experiences with this category of visual impressions), and all of it must continuously be calibrated according to new visual, olfactory, auditory, or touch inputs that she might receive, and also according to her own motoric interaction with the objects of her field of vision (even if she does not move, small involuntary movements of the eye's focus, saccades, nevertheless continuously need to be integrated). Both cognitive and motoric activity becomes initiated through this chain of interpretants produced at more and more overriding levels (exclamations like goody!, or reaching out for the strawberry). Our sensing must be considered one open-ended loop of interactions between memory, sensory impulses, and motoric activity.

Since an interpretant is always formed as a context sensitive response to an event (e.g., an electrochemical change of a cellular membrane), the interpretant is never a given once and for all but always a result of the specific history that the involved entity (e.g., a nerve cell) has gone through, so that former experiences will come to influence the interpretative process already at the earliest stages (ganglia in the eye). The sign process, in other words does not cause the response in the traditional sense of efficient causation, rather as pointed out by Vasiner and Cabell, it catalyses it or, as I have suggested, what we might here talk about *semiotic causation* : "bringing about things under the guidance of interpretation in a local contexts." (Hoffmeyer 2008b, p. 37)

Experienced Worlds

Now, one might ask the $1 billion question: at what point in the semiotic process should we talk of genuine experiences? To attempt an answer to this question, let us make a side trip to the animal world and pose the question: does a chimpanzee experience its world? Knowing well enough that neither a "yes" nor a "no" to this question can be decisively proved (as long as chimpanzees do not speak), it seems very unlikely that the answer should be a "no." First, because chimpanzees are so much like ourselves that it seems illogical to think that they should be deprived of that dimension of life which undoubtedly is the most important dimension of our own human life, our experienced life. Second, because there are now numerous well-studied examples of behaviors in chimpanzees that skilled ethologists do not shy away from likening to well-known human behaviors such as showing empathy, morality, or cheating (Bekoff and Pierce 2009). It is not easy to imagine someone cheating on you if this someone, does not have the faintest experience of your existence.

If we step further back along the evolutionary path and consider fish, reptiles, birds, and mammals we can actually point out a graded series of growing cognitive competence (Hoffmeyer and Stjernfelt in press; Hoffmeyer in print), and logically it becomes rather impossible to point out a definitive step before which there is no sentience, but after which sentience is present. In general, the rather gradual character of evolutionary change logically points us to a "more-or-less" view rather than an "either-or" view (either the animal has an experienced world, or it has not). Since the experiential world is multidimensional, this more-or-less must of course also be understood in a multidimensional sense. Thus, even in fish we find behaviors that seem to imply a kind of social intelligence that would be hard to explain in the total absence of sentience.

Let us take a look at the sophisticated relation between cleaner fish and their clients as discussed in Hoffmeyer and Stjernfelt (in press). Cleaner fish get their livelihood by eating and thus removing parasites from other fish called clients. In addition to the parasites, the cleaner also likes to eat the more nutritious body mucus of their clients which, understandably, maddens the client fish which may visibly "jolt" and dart off when cleaners bite them. A trade-off situation then develops between cleaners and clients in which the clients attempt to avoid cleaners that have previously cheated upon them or—more remarkably perhaps—which have been observed cheating on other clients (Bshary et al. 2002). Full-time cleaners such as the cleaner wrasse *Labroides dimidiatu s* may have about 2,300 interactions per day with clients belonging to over 100 different species (Grutter 1996). Bshary et al. lists a number of behaviors found in cleaners and clients that may be likened to behaviors more usually observed in primates: categorization, cheating, punishment, manipulation through tactile stimulation, and so-called altruism. Thus, cleaners can categorize their 100-or-so client species into types that may be cheated and types that are not so prone to cheating. Clients, on the other hand, may "punish" (inflict expenses upon) the cleaners, which would seem to imply an amount of individual recognition (probably by scent).

Rather than concluding for or against fish having experiences or sentience, I think our fast growing knowledge of the surprisingly sophisticated cognitive capabilities of fish and animals in general points us to abandon the idea of sentience as a unitary phenomenon. There are many kinds of sentience, and our own human kind of sentience is just one example in a multigraded series. A snake for instance has probably no idea whatsoever of the prey animal it is chasing, instead it has different modalities such as things to be searched for, things to be stroked, and things for swallowing (Sjölander 1995).

As a consequence, we must understand the establishment of experiences, such as the "goody!" with which we began this discussion, not as residing in some finished or final state of mind but as an emergent glimpse of recognition followed by a stream of new glimpses in a continuous flow embedded in the processes whereby the girl interprets her world, i.e., in the flow of semiosis. Our experiences (and those of animals) are always embedded in an emotional state of some kind and without operating with a directionality of one's life, that is, without implying final causation, sentience simply becomes incomprehensible. There will always be a reason behind sorrow, sadness, worry, joy, happiness, fear, anger, etc., and this reason—which does not itself need to be conscious and probably most often is not—locates the experience in the temporal directionality of our organismic strive (to use the term, that Darwin himself used in Darwin 1972/1859, p. 71).

If we think of an emotion as a subjective reaction to a salient event, characterized by physiological, experiential, and overt behavioral change (Siegel 1999, p. 123), we might perhaps think of the origin of experiential life as rather narrowly connected to the (evolutionary) origin of emotional life. Needless to say, the taboo against anthropomorphism has made the ascription of emotions to "brute" animals a risky affair[2]. Here, we must take care to distinguish between emotions and feelings although such a distinction is in no way easy or simple. Primary emotions are spontaneous bodily

[2] As is often the case, Darwin himself had a clearer voice. In *The Descent of Man* he writes quite explicitly: "The fact that the lower animals are excited by the same emotions as ourselves is so well established, that it will not be necessary to weary the reader with many details. Terror acts in the same manner on them as on us, causing the muscles to tremble, the heart to palpitate, the sphincters to be relaxed, and the hair to stand on end" (Darwin 1981/1871, Chap. 3).

reactions such as sadness, anger, fear, surprise, or joy that come to us without interference of consciousness, and which are accompanied by well-defined physiological patterns that are also to some extent measurably present in animals seemingly exhibiting similar emotional reactions. Young birds, for example, that duck their heads in the nest when a hawk is passing over the nest are experiencing the same hormonal response as we see with fear in humans. Feelings, on the other hand are emotions that are consciously dealt with to produce context dependent nuances. What complicates the matter, of course, is that feelings often produce further secondary emotional responses that then trigger off secondary feelings in an infinite temporal loop of interaction between our cognitive life and our emotional life. As evidence for emotional response patterns in mammals and birds is fast growing in these years (see Bekoff and Pierce 2009 for a survey), it seems increasingly farfetched to claim that emotions are not present in species with lower cognitive capacity. Again, we should adopt a "more-or-less" view rather than an "either-or" view.

Let me suggest that we see semiosis, emotion, and experiential life as a graded series where semiosis is a fundamental characteristic of life as such—life without semiosis is unthinkable; emotions are a somewhat less fundamental property but most likely some preliminary kind of emotion must be at play in every multicellular organisms where a fast coordination of body parts is necessary in response to danger, or food, etc., since such coordination would presuppose a capacity for producing an instantaneously propagated "emotional" wave throughout the body[3]; genuine experiences, on the other hand, probably only occur in species possessing a central nervous system. The important point in the present context is that semiosis, emotion, and experiences are not thought to be essentially different categories, but rather to be a succession of more and more sophisticated elaborations of the same basic theme of teleodynamic existence. Considered in this way, the shift in perspective from sensory mechanics to sensory semiotics as the basis for perception opens up new fascinating agendas for studying the body–mind interplay.

Semiotic Scaffolding

In the biosemiotic perspective, the genome is not seen as a master plan for the organism, the way traditional biology sees it. The fact that, say, a snail genome will lead to the appearance of a snail-type living system and a wolf genome will lead to the appearance of a wolf-type living system, has implanted the conception in the minds of biologists that the genome *controls* the ontogenetic process. But this metaphor of "control" is far too strong. Genes are not control-units but *semiotic modulators*—they frame the biosemiotic integrations inside the body. In fact, the functional role of the genome very much is to act as a highly sophisticated digitalized inventory control

[3] One might perhaps think of this as a sudden "wake-up" glimpse, a little like when the pocket calculator is switched on (although we do not claim any emotional component in the pocket calculator).

system, a system that not only contains the specifications necessary to produce all the body's protein and RNA molecules but also a number of switches and locks by which an agent may access the archives. Thus, if a given enzyme is needed in a tissue, cells will turn on the switch that opens the particular lock normally keeping the coding region of the responsible gene from being transcribed. When enough of the enzyme has been produced, the switch is turned off again. So, if a given enzyme is needed, say a peptidase, the cell will click down the menu for enzymes, pick the submenu for peptidases and select a suitable one among the different kinds of peptidases on offer, depending on the kind of tissue and/or the concrete situation. The cellular machinery will then start off the process of operating the switches and keys corresponding to this particular gene (RNA splicing and other modifications included).

The most important factor that has been turned around in the semiotic description of the process relative to more traditional informational descriptions is that agency here resides with the cell, the tissue, or the organism, not with the genetic system—not at the level of a macromolecule (DNA)[4]. Harvard geneticist Richard Lewontin expressed clearly why this is necessary, when he stated that: "genes do nothing in themselves" (Lewontin 1992)[5] (it follows that Richard Dawkins' much famed concept of "selfish genes" is outright nonsense). Language use in modern biology is profused with hidden *homunculi* (to use Terrence Deacon's expression (Deacon 2007, 2012a)[6], and biosemiotics is needed precisely in order "to make explicit those assumptions imported into biology by such unanalyzed teleological concepts as function, adaptation, information, code, signal, cue, etc., and to provide a theoretical grounding for these concepts" (Kull et al. 2009).

But the genome is only the most basic level in the web of semiotic scaffolding mechanism that controls the cooperation between the estimated 100 trillion cells that make up a human body. Each of these cells are ultimately autonomous units that in their whole construction are tuned to follow internal schemes towards proliferation. Yet, "mysteriously", all these cells manage to cooperate in life-long functional patterns or else we get ill. The "mystery" is hidden in the infinitude of semiotic interactions linking cells, tissues, and organs together into stable functional modules. Throughout evolution, new scaffoldings have been built on top of those already operative. Evolution is primarily about the establishment of successful semiotic scaffolding devices and genetic mutations are just elementary tools in this process that may often not rely on modifications at the genetic level at all. The genome, thus is only half the story, the other half being the *semiome*, the entirety of semiotic tool

[4] That anyone could imagine DNA molecules to possess agency is a total mystery to me.

[5] It often takes more than a dozen of different protein molecules to (1) unwind the threads of the double helix, (2) fix the position of the gene in the correct spatial position relative to other, more or less distant, locations on the DNA string, (3) attach the polymerase enzyme at the right location, (4) initiate the transcription, and (5) stop the process at the right place and time.

[6] "a homunculus argument as one in which *an ententional property is presumed to be "explained" by postulating the possession of a faculty, disposition or module that produces it, and in which this property is not also fully understood in terms of non-ententional processes and relationships*" (emphasis Deacon's; p. 64).

sets available to the species: the means by which the organisms of a species may extract significant content from their surroundings and engage in intra- or interspecific communicative behavior. The semiome defines the scope of the organism's cognitive and communicative activity (Hoffmeyer in print).

The human semiome is different from that of other animals mainly in being deeply embedded in linguistic practices. Most often, the difference between human cognition and animal cognition has been explained by reference to our supposed higher general intelligence. Following the work of Terrence Daecon (Deacon 2012b) we shall instead base our discussion on the peculiarities of the human linguistic semiome. As Deacon tells us: "Language is dependent on a widely dispersed constellation of cortical systems, each of which can be found in other primate brains, but evolved for very different functions" (2012b, p. 34). In the terminology of the present chapter, part of what happened in human evolution was an unprecedented loosening of the genetic scaffoldings stabilizing the cognitive roles of a range of modules in our brain. The adaptation to language required our brains to become essentially dedifferentiated allowing cognitive functions to be scaffolded through symbolic communication rather than by genetic predetermination.

Semiotic Scaffolding of Cultural Evolution

Whole new kinds of semiotic scaffolding mechanisms thus became available in our species. While all species on Earth posses some capacity for iconic and indexical referencing only language, i.e., symbolic referencing, makes recursive messages available, thereby opening for an infinitude of complex meanings to be thought out and socially shared. The invention of social semiotic scaffolding mechanisms such as dance and art, written language, city life, military organizations, cathedrals, the printing press, fast moving transportation systems, radio, telephone, movies, TV, personal computers and mobile phones, the internet, etc. has gradually offered new generations, stronger and stronger (in the sense of productivity, spatial and temporal range, efficiency, and precision) semiotic scaffolding structures, implying that deeper and deeper meaning contents can be grasped and shared up through human history. Each new jump to higher level semiotic scaffolding systems tends to homogenize cultural performances at the lower level while opening up for new complexity and expressivity at the higher level.

There is no determinism in any of this. Different cultural systems may proceed along these steps in many different ways, or they may be captured in "time-pockets" to the extent that they are not themselves open to newer and stronger semiotic scaffolding mechanisms. From the perspective of cultural psychology an essential question will be to understand how people develop culturally specific ways to cope with the semiotic scaffolding devices available to them. The concept of catalysis (Cabell 2009, 2011) seems to point out a fruitful way to an understanding of such processes. To take an example, while the exposure of the youth to social media like Twitter and YouTube was an obvious extension of the technological potentialities built into mobile phones, nobody did foresee the use of these new media to catalyze the series of mass protests in North African and Mediterranean nations that came to be known as the Arabic Spring. The catalyst in this case was not the phone as such or the social media but the grasping by huge population groups of a new semiotic scaffolding mechanism allowing for fast and anonymous spreading of knowledge and documentation.

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