

From the meaning to the world: the catasemiosis

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Abstract. We now know that meaning arises from an initial interaction between the bodies of living beings and stimuli from the outside world. This process, which leads to the development of semiotic structures, is known as anasemiosis. However, the description of semiosis would be incomplete if we did not take into account a second movement in which the body is involved in a second interaction with the world: that of the action exerted on this world by meaning. This movement can be called ‘catasemiosis’ (if the Greek prefix ‘*ana-*’ refers to a movement from the bottom up, ‘*cata-*’ refers to a movement from the top down), and the complete semiosis is made up of the interactive cycle of anasemiosis–catasemiosis.

After outlining the reasons why the consideration of catasemiosis has been largely neglected by the sciences of language and meaning, this paper situates catasemiosis within the general process of semiosis, establishes the complementary nature of the processes of anasemiosis and catasemiosis, and demonstrates that their structures are comparable since they are based on the same principle of opposition – or dipole. The discussion emphasizes the existence of an actional drive in living organisms, complementary to the interpretative drive, and shows that routinization is the catasemiotic equivalent of categorization at the anasemiotic level. Considering the sign as a tool and stressing the importance of the concept of energy in semiotics, it pays particular attention to tools, conceived as extensions of bodies, and to their mediating function.

Keywords: actional impulse; anasemiosis; dipole; principle of elementary contrast; semiosis; tool function

1. Anasemiosis and catasemiosis

1.1. Never one without the other

Paraphrasing Leibniz’s famous formula “Why is there meaning rather than nothing?”, we have established elsewhere (Groupe μ 2015) that the circuit of meaning

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begins in the natural world. This first process, which begins with stimuli emanating from this world and ends with the elaboration of semiotic structures, constitutes anasemiosis. Far from being a phenomenon unrelated to the body, this semiosis has its origins in the body. It is based on a series of modules that translate the digital phenomena of the world into impressions of a continuum, the reactions to which are finally transmitted to the cortex, where they are processed in a digital mode. This presupposes a contrast-generating segmentation process, which experimental psychologists and biosemioticians (e.g. Hoffmeyer, Emmeche 1991) consider to be the principle of perception. This segmentation would not be possible if our organs were not prepared to compare adjacent stimuli. Comparison automatically implies the ability to discriminate between at least two sensory events. The equipment used to make the comparison must therefore include at least two receptors, or enable two states of the same phenomenon to be measured at two different times. This is what we call the principle of elementary contrast, or dipole, which is based on the differential perception of a physical quantity (light intensity, for example), and this principle, without which there would be neither information nor meaning, is general in nature.

This aspect of the corporeality of meaning, which can be described as cognitive, must be approached through the interactions it has with its context (in the broadest sense of the term, including the experience of the world and of others, so that the corporeality in question is not solipsistic but social).

Yet if meaning emerges from experience, it also guides action; if it is produced by contact with the world, it also leads to actions exerted on the world; following an earlier distinction proposed by Jakob von Uexküll, biosemiotics distinguishes between signs of perception and signs of action (Kull *et al.* 2009). The description of anasemiosis must therefore be supplemented by that of catasemiosis. If anasemiosis is the first corporeality of meaning, catasemiosis is the second. We can even emphasize this corporeality by saying that anasemiosis and catasemiosis – which it is tempting to compare with the Peircean notions of upshifting and downshifting – are like anabolism and catabolism.

Our thesis can therefore be described as interactionist, in that the subject maintains a dual relationship with the natural world. This cycle can be illustrated by the diagram presented in Fig.1.

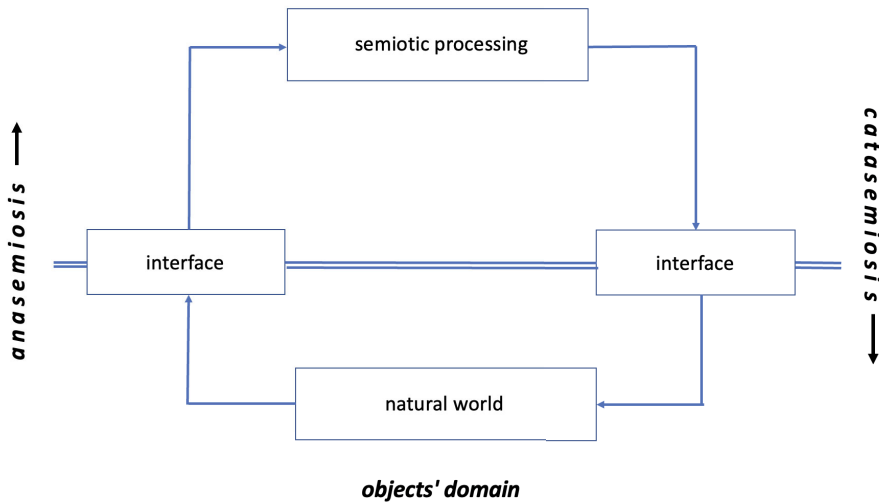


Figure 1. The cycle of semiosis.

The two processes, anasemiotic and catasemiotic, can certainly be studied separately, and one can even rightly focus on only one stage of one of them. In fact, this is what a significant part of the semiotic tradition has done: this discipline has often limited itself to a rigorous study not of the process of anasemiosis, but of the result of this process: meaning, seen in its systematicity, and even – a further limitation – to its textual manifestations alone. Certain philosophical currents, however, make the opposite choice: they posit action as primary and therefore prior to all perception.

But all these limitations of the point of view, however legitimate, must not make us forget that the two processes are inextricably linked by a presuppositional bond. On the one hand, anasemiosis without catasemiosis would be useless. On the other hand, insofar as it is not limited to simple mechanical phenomena, but envisages the action of subjects, an action on the world necessarily originates in a meaning attributed to this world and its actors.

This solidarity becomes even clearer when we consider the notion of energy, which can play a role in a unified theory of meaning, since meaning can be defined as potentialized work. In fact, we know that the formulas of entropy theory (or energy decay) are formally identical to those of information theory, except for the sign. In other words, all we have to do is reverse the sign in front of the value of one object in these fields to obtain the value of the corresponding object in the other. Hence the suggestion that information is negentropic (see Bonsack 1961).

From this we can deduce that anasemiosis is a movement of acquisition of information and catasemiosis is a movement of actualization of that information, an actualization or effectuation that moves in the direction of increasing entropy.

Meaning is therefore a promise of catasemiosis. We might even say that, logically, the two approaches postulate each other. This interdependence is strikingly expressed by Jean Baudet (2006: 133): “We can only claim to understand what we can transform.”³

If we draw all the consequences from this observation, we can formulate a conjecture which is difficult to verify but which, for reasons of symmetry, seems perfectly plausible. It consists in considering the link *dipole* > *meaning* – which is the basis of anasemiosis – as reversible, and applying its opposite to catasemiosis. Just as a dipole generates meaning, meaning would produce dipoles, and anasemiotic binarism would be matched by catasemiotic binarism.

By making meaning a shifter for catasemiosis, we are endorsing Horkheimer’s ‘instrumental reason’ (*instrumentelle Vernunft*), but protecting it from the ideological determinations rightly criticized by the Frankfurt School, by removing it from the contingency of a given culture and giving it a broader anthropological, even biological, content.

1.2. Loss of anasemiotic information, catasemiotic mismatch

The fact that catasemiosis is symmetrical to anasemiosis has an important consequence. While anasemiosis enables the category to be elaborated through a process of grouping (from a multitude of particulars, a single general is elaborated), catasemiosis quite naturally proceeds in the opposite direction: from the general – the category – it proceeds to particularization, its end being a specific action. And it is this inversion that opposes the two processes: since anasemiotic grouping is paid for by a loss of information, what has been lost can never be recovered in the movement of catasemiotic particularization.

This explains why practices, behaviours and attitudes inevitably have a character of inadequacy or inappropriateness. To give an oversimplified but eloquent example: repeatedly seeing placid ruminants may lead me to construct the corresponding category, but I could go on safari in Africa and see buffaloes, specimens that I could easily index in the said category. If, in the name of this categorization, I approach them unsuspectingly, the result is clear: I risk being trampled underfoot. Determined action is therefore by no means adequate action. This dual process of generalization and particularization, with its corollary of loss of information, is undoubtedly at the root of our trial and errors, tragic mistakes and grotesque

³ All translations from languages other than English are ours, F. É., J.-M. K.

misunderstandings. Let us generalize: the catasemiotic yield of the exploitation of meaning is necessarily < 1 .

1.3. The actional impulse

The complementary nature of anasemiosis and catasemiosis has another consequence: we are entitled to speak of an actional or transformative impulse.

If anasemiosis postulates an “interpretative impulse”, as can be demonstrated, and if anasemiosis supposes catasemiosis, then catasemiosis postulates an analogous impulse, just as potentiation presupposes effectuation. These two impulses are reciprocal: the interpreted information responds to needs that demand satisfaction, and the search for this satisfaction triggers the commissioning of an interpretative grid. For example, the categorization of an entity as food implies the possibility of eating it. And, symmetrically, the need for food activates the interpretative mechanisms for extracting the entities corresponding to the food category from the environment.

The basic interface mechanisms that operate between the world and the subject are identical in both cases. If anasemiosis can be described as a sequence of modules, we can safely postulate that catasemiosis also consists of a series of processes carried out by specialized modules, intermediaries between the processing of information by the cortex and muscular actions in the world. Still, the question of catasemiosis will ultimately allow us to return to a particular aspect of semiosis: its socialized character. The semiotic subject cannot be thought of as an isolated individual: in interacting with the world, it also interacts with its partners, who are part of the world. Meaning is therefore a system distributed among a multiplicity of instances, of which the individual is only one.

2. Forgetting catasemiosis?

If the first aspect of semiotic corporeality has only recently been studied in depth, the consideration of catasemiosis is even more recent.

2.1. Pragmatics

With the notable exception of rhetoric, which theorized symbolic action on others more than 2,000 years ago – notably with the concept of pathos – it was only in the second half of the twentieth century that the idea was affirmed that language “does not primarily have a descriptive function, but an action function” (Moeschler, Reboul 1994: 17–18) and that this language is not merely an

“instrument of reflection, but [...] a mode of action” (Malinowski, after Ogden and Richards, quoted in Benveniste 1970: 14). This gave rise to the branch of linguistics known as pragmatics. However, the scope of this discipline covers only a very small part of the process of catasemiosis. As we shall see, pragmatists do not consider all the semiotic acts that affect and transform the world: they focus on linguistic acts, and among these those that affect interactions between partners, rather than those that affect their environment.

It is therefore understandable that the institutional relationship between semiotics and pragmatics is still very tenuous. Jacques Moeschler and Anne Reboul, good representatives of the latter, even believe that these disciplines have nothing to do with each other (Moeschler, Reboul 1994: 503–504). This point of view is obviously understandable for those who have forged a restrictive and outdated conception of semiotics: the authors see it as nothing more than the study of fixed relationships between signifiers and signifieds, relationships established within a rigid and coercive code. Yet if we do not assign semiotics with this ultimately narrow field, then this discipline does indeed have a necessary pragmatic dimension. This broader point of view – which was also Greimas’ when he developed the concepts of modality, factivity and manipulation, and which is Jacques Fontanille’s when he envisages a semiotics of practices – is ours: the utterance is not pure meaning but also, among other things, a means of acting on the world and on partners; of modifying the representations and modes of action of these partners. We can therefore reintegrate the pragmatic perspective into semiotics and say that pragmatics is that part of semiotics that sees meaning as a condition for action.

However, pragmatics is far from having framed the whole field of the actional function of languages. Consideration of this function has so far been limited to acts that are performed solely as a result of enunciation. In the classic triad of locutionary, illocutionary and perlocutionary acts, it is clear that pragmatics – which had left the study of locutionary acts to linguistics proper – was mainly concerned with the study of illocutionary acts, on the pretext that the difference between the perlocutionary and the illocutionary “lies in the presence in the latter of a conventional aspect which the former lacks” (Moeschler, Reboul 1994: 62). Once we accept that the pragmatic perspective is based on information “drawn directly from perceptions of the external world” (Moeschler, Reboul 1994: 503), it is hard to see why it should refuse to take greater account of the perlocutionary and, beyond that, of actual action on the world.

Could it be that other manifestations of pragmatic thought take these phenomena into account?

2.2. Peirce and after...

For Peirce and his followers (cf. Marty, Marty 1992: §60), semiosis is “a process that takes place in the mind of the interpreter: it begins with the perception of the sign and ends with the presence in his mind of the object of the sign”.

Such a scheme (in which the verb ‘ends’ should not be taken literally, as we shall see) poses two difficulties.

The first is the nature of the relationship between this process “taking place in the mind” and the perception that would be its origin: it is not clear whether perception is considered here as an element in the process or whether it is merely the trigger. In the first hypothesis, perception would be purely “spiritual”, which would be a contradiction in terms – a spiritual perception! – or at least a very solipsistic view of this process. In the second case, we would still have to explain how (non-mental) perception relates to the process of (mental) semiosis. It is to this explanation, absent from all works on meaning, that we have devoted our *Principia* (Groupe µ 2015).

The second difficulty is more important: although semiosis is seen as a process, the description that is given to it focuses on its input. Although Peirce described two movements – upshifting, which goes from the object to the sign, and downshifting, which returns to experience and thus to the object – his theory does not envisage them with the same precision: in fact, what we retain, above all, from the output of semiosis is that it leads to a “final logical interpretant”.

The status of this interpretant is debatable, however. We know that it is often defined as the habit that the concept is intended to produce and that the habit is that “of acting in a given way, whenever [the interpreter] may desire a given kind of result” (CP 5.491). Yet the interpretations that have been given to this term diverge: for Claude Marty and Robert Marty (1992: §60, on semiosis), habit is clearly an interpretative process and not a class of material actions. Umberto Eco (1988: 204; see also Eco 1980), on the other hand, draws Peirce more towards practices, summarizing them as follows: “The final logical interpretants are habits, dispositions to act and thus to intervene in things, to which all semiosis tends”; and continues: “The interpretant of a sign may be an action or a behaviour.” This position seems to move in the direction of a complete pragmatics, taking into account practices, but the argument suddenly takes a turn that does not go in that direction, and even leads to a pirouette: “How does man act in the world? By means of new signs”; thus, “at the very moment when semiosis seems to have been consumed by action, we are once again in the midst of semiosis.” (Eco 1988: 204)

2.3. Acting through discourse, acting through deeds

Of course, we cannot deny that the sign can activate action on the world: this would contradict the very idea of catasemiosis, and we will come back to this in Sections 4–6 below with the question of the tool. Nor should we forget that when semiosis dissolves in action, this dissolution can be the beginning of a new cycle (see below). The point is to emphasize that the usual descriptions of semiosis leave out an essential intermediate stage between the categorizations resulting from anasemiosis and habit. However, this stage is the very condition for the latter: it is the stage of action, that is, the process that enables us to leave, if only temporarily, the semiotic system and return to the physical system from which it emerged.

The same correction must be made to Eco's description of symbolic action in the world. On the one hand, the signs that constitute action may well be those that make explanation, persuasion or negotiation possible: in any case, they pass through the body, which is why we spoke of an inevitable stage. Speaking is an activity that sets in motion directed muscular processes, just like writing a text that is read or drawing a curve that is perceived and interpreted; from this point of view, there is no difference between the word spoken by the mouth and the tool operated by the hand, between the mimicry that expresses and the gesture that transforms the material. On the other hand, Eco, like most pragmatists, focuses above all on symbolic activities – ordering, responding, advising, etc. – which have no spectacular physical dimension. This preference, however, should not obscure the fact that these acts have a material output in any case, but are located downstream in the social chain: when a soldier is given a (verbal) order, there is always a finger that presses or refrains from pressing a trigger. And it is also significant that the semiotics of manipulation, as programmed by Greimas and Courtés (1979: 220), has above all envisaged cognitive actions, relegating somatic actions to the background. The same glossocentrism can be found in the recently emerging “semiotics of practices”. “If practices can be described as ‘semiotic’, they must be able to be assimilated to a language,” says Fontanille (2010: 10); yet the units of the plane of expression of practices are, in his view, only accessible through various episemiotic manifestations (primarily verbal, but also gestural, physiognomic, etc.). Indeed, these units cannot “be deduced retrospectively from a transformation observed in detail”, for the reason that a practice would be “an unfolding open upstream and downstream, which therefore offers no scope for a confrontation between an initial situation and a final situation” (Fontanille 2010: 10), “*unlike a textualized action*” (Fontanille 2011: 132; emphasis added, F. É., J.-M. K.). Hence the decision not to study practices in action, but to grasp them on the basis of the statements that describe them. Yet this argument is disputable:

linguistic statements are as open as factual processes. Their closure is not given, but is the product of the methodological choice made by the discipline of linguistics, and such a decision can very well be made in the case of catasemiotic processes as well as in the case of all anasemiotic processes.

These clarifications do not exclude the possibility that the dissolution of semiosis in action may be the beginning of a new cycle (which is why we insisted on the temporary nature of the exit from the semiotic cycle): Fig. 1 suggests an infinite semiosis. Yet this is no longer a case of the interpretant referring to the interpretant: since the action has modified the world, a new anasemiosis can emerge from it, leading in turn to a new action. We could therefore correct Eco's sentence as follows: "At the very moment when semiosis seems to have been consumed by action, the conditions for a new semiosis are created."

However, if anasemiosis and catasemiosis can follow each other in an infinitely recurring relationship, these phenomena must remain legally distinct. It is not very profitable to dilute them in a single process, just as it is not very economical to group all the catasemiotic processes (the anticipation made possible by the category, then the effectuation...), all the anasemiotic processes and all their products (the segmentation of the field, the category...) under the same name of 'sign'.

2.4. What refusing catasemiosis means

Limiting the study of catasemiotic processes to the illocutionary, and thus treating them from an exclusively textualist perspective, without daring to cross the boundary separating discursive and perlocutionary phenomena, is an attitude symmetrical to that of ignoring the physiological underpinnings of anasemiosis.

In both cases, the two ends of the chain are rejected outside the field of research because of their corporeality. These two attitudes are manifestations of what we call 'autonomism', the counterpart of the ideology of mind-body dualism, and constitute a restriction that a truly general theory of meaning cannot accommodate.

3. Catasemiosis in the semiosis cycle

3.1. Anasemiosis and catasemiosis: dipolar structures

In order to explain the process that goes from the world to the interpretation (anasemiosis) and from the interpretation to the world (catasemiosis), we can propose a basic diagram (Fig. 2) in which the different stages of the process are briefly explained. In this diagram, 'O' designates the origin of the flow and 'X' its

direction, 'P' the property concerned, 'S' the sensor concerned and 'M' the muscle concerned. Classically, 'd' refers to an infinitesimally small difference and ' Δ ' to a finite difference. The gradient 'G' is the rate of variation of the quantity 'P' along the OX axis. Theoretically, it should be measured from infinitesimally small variations dP and dx , but in practice it can only be measured from two sensors separated by a finite distance, and having variations ΔP and Δx . We will therefore use the approximation $G = \Delta P / \Delta x \approx dP / dx$. This has two opposite consequences: if the sensors are very far apart (high Δx), the variation of P will be strong and easy to perceive, but its directional interpretation will not be very precise, and *vice versa*. The distance between the antennas of our radio telescopes (and those of many insects) is a result of this consideration.

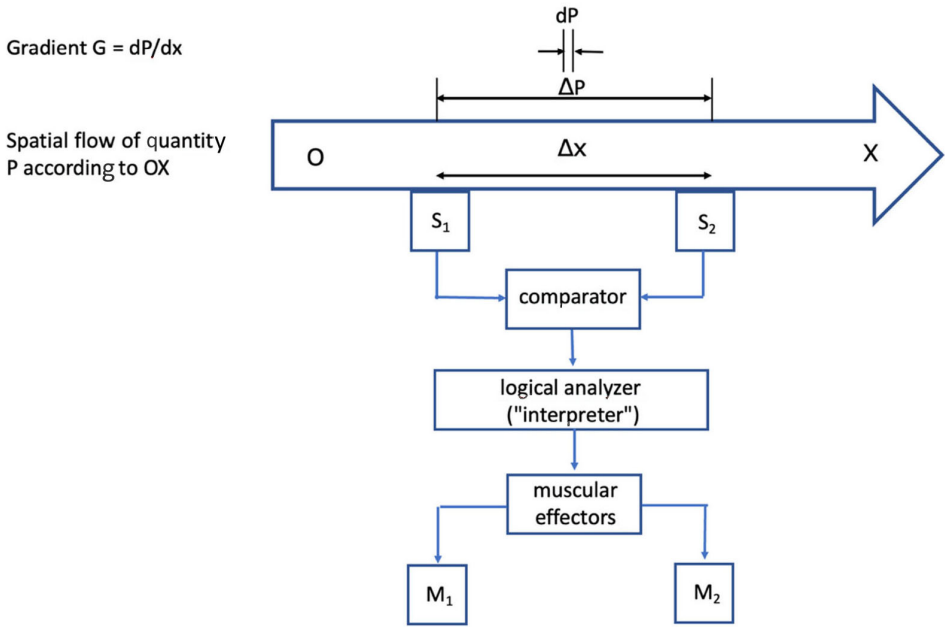


Figure 2. From perception to effectuation.

We can see that the intensities of the sensations 'S₁' and 'S₂' are compared and interpreted. It is at this exact moment that it becomes information. It is also at the level of the logical analyser that the abundance of data is grouped together, for the sake of economy, but each time in a different space, for the sake of efficiency: this double movement of dividing and regrouping is the fundamental process of the

constitution of meaning.⁴ It is also the logical analyser that homogenizes the units of the content plane and those of the expression plane.

The important thing is for us to focus on the lower part of the diagram. It shows that the interpretation leads to a decision⁵ which may, for example, consist of an order, the execution of which also necessarily mobilizes muscles. The phenomenon of tropism is easy to understand. For example, an earthworm flees from light: it perceives where the light is coming from and is capable of interpreting this information to order it to flee, whereas another organism (a moth, for example) would make the opposite decision.⁶ In fact, there are three possible responses to a gradient: to follow it (negative tropism), to turn back (positive tropism) and to do nothing (indifference). Since the actions modify the position of the sensors, the whole device is equivalent to a cybernetic cell with its feedback.

By returning to the physical world from which it came, semiosis mobilizes muscles. Of course, the muscles involved are not necessarily those of locomotion: it could be the opening of a sphincter to release an active substance, and so on. The important thing to note is that, like the dipolar sensors active in anasemiosis (S_1 and S_2), these muscular effectors necessarily work in pairs (M_1 and M_2). The structure of catasemiosis is therefore also dipolar, in order to allow reactions appropriate to the directional nature of the flows. This dipolarity is necessary because a muscular action develops a force that requires a point of support and a point of application. It is of course possible to use elasticity, a "spring effect", for the opposite movement: in this case a single effector is sufficient, but the second is then replaced by the inert elastic structure. In all cases, at least two points are needed to ensure muscular antagonism (Fig. 3).

⁴ This strategy, the success of which has been confirmed by evolution, seems to be confirmed in all known areas of perception; it already begins in the peripheral organs (where the detectors of alignments, limits, corners or patterns are located). As for categorization, this, too, obviously consists of grouping information. Grouping by levels is found in the structure of the universe (elementary particles < atoms < molecules < cells < organs < organisms < societies) as well as in the most complex systems of meaning (where, under the name of articulation, of linguistic origin, it has inspired effective techniques of description); and it constitutes a powerful and undoubtedly universal procedure.

⁵ The diagram in Fig. 2 is, of course, very schematic, since there is, in principle, a decision module between the analyser and the effectors: faced with a set of stimuli '/smell/ + /light/ + /heat/' that allow the interpretation 'fire', I can decide sometimes to 'flee', sometimes to 'look for a fire extinguisher', etc.

⁶ Similarly, river fish can be divided into anadromous fish (those that swim upstream, such as trout or salmon) and catadromous fish (those that drift downstream). Even plants show tropisms: the vertical growth of a tree trunk in the field of gravity, the orientation of a flower towards the sun, the opening and closing of petals according to light intensity, the opening and closing of stomata, etc.



Figure 3. Kinematics of the inchworm, showing that at least two muscles are required for this process.

3.2. From digital to analogical and back again

Another problem for the living system is to convert digital impulses, which are the nervous form of information, into continuous, analogue muscular actions. These are analogue in that they are graded in intensity and direction. The question of the articulation of the digital and the analogical was discussed in Chapter II (§4.2) of our *Principia* (Groupe μ 2015), from a strictly anasemiotic perspective. The description of the inverse process we give here will complete that description.

The output interface we are looking for is the cellular site where a nerve ending transmits its signals to the myofilaments. Two successive transformations take place here, in exactly the same way as at the sensory interface, but this time in reverse order:

- the conversion of electrical impulses into chemical energy;
- the conversion of this chemical energy into mechanical energy.

The end result is a change in the elastic properties of the myofilaments, which stiffen when they contract.⁷ More specifically, two equally important responses are possible at this level: contraction and inhibition.

So far, the system is still entirely digital: the nerve impulses are all the same and so are the muscle contractions.

The conversion from digital to analogical will be possible thanks to the clear difference between the time constants of a nerve and a muscle. Excitatory nerve

⁷ The transductions take place in a special membrane that surrounds the fibres and receives the nerve endings at sites known as ‘motor end plates’: the sarcolemma. The sarcolemma is also physically coupled to a tendon, which is designed to transmit tension to various levers or organs, so that the process ends in either movement or resistance to movement. An electrical potential difference of -50 to -100 mV, known as the resting potential, is maintained on either side of the sarcolemma. Activation involves the release of acetylcholine from the end of the nerve. This chemical signal initiates a cascade of electrochemical events, essentially the depolarization of the resting potential, which falls from, for example, -90 mV to -50 mV. A current is then established between neighbouring zones, propagating the depolarization in the form of an excitatory wave or action potential. The polarity is reversed and can reach $+40$ mV. The excitatory wave can be fast or slow, depending on the type of muscle, but the filaments always respond to depolarization by contracting. The force exerted by a filament cannot be modulated, the response being all or nothing.

impulses have a very short duration (in the order of 20 ms) and can be sent at high rates (for example 50 per second), whereas the contraction phase of a muscle fibre is much longer (± 100 ms). If one impulse triggers a contraction, the next impulse may arrive before the contraction is complete. It has been observed that when the excitatory signals reach a frequency of 50 per second, the contraction continues without interruption or weakening. Similarly, as a tendon is connected to numerous muscle fibres, there is a fusion and summation of the contractions of these fibres.

In synthesis, a train of digital impulses, all similar, results in the contraction of a muscle and an analogical movement. Ultimately, these mechanisms enable us to understand how a sense, whose description can be accommodated by digital procedures, can be associated with an action on the world, that can be described in analogical terms.

Still, the description we have just given does not exhaust the question of the reasons for and functions of this articulation, which we must now examine.

3.3. The determiners of catasemiosis

The category presupposed by the sign and constructed by anasemiosis also plays an important role in catasemiosis. As we have shown, a representation of the world without categorization would not only be impossible, it would also be useless: allowing an infinite number of particular cases to subsist, it would not make it possible to act on the world in an ordered and coherent way.

In the same way that categorization enables cognitive economy on the anasemiotic side, it enables economy – this time energetic economy – on the catasemiotic side, by allowing the routinization of repetitive tasks.⁸

Here, too, the levels of categorization vary in the same way as in anasemiosis (cf. Groupe μ 1998, 2015; Klinkenberg 2004). A (locally) optimal level is reached by the interaction of the two opposing forces of economy and profitability.

Sign systems also play a role, several of their properties being relevant here:

- they stabilize the category (in particular by reinforcing its inter-individual stabilization); they facilitate the repetition of the actions to which it can lead: in other words, they reinforce routinization;

- since they constitute an indirect and therefore long semiosis, they allow us to experiment with substitutes instead of experimenting with things. This is particularly the case with narratives, which have both a syntactic and a social dimension: they provide frameworks for giving meaning to the actions of subjects and their partners (see Gallagher 2006; Gallagher, Hutto 2008). This is also the case

⁸ This routinization (which can be compared to Peirce's 'habit') defines the tool: see Section 4 below.

for a system such as chemical formulae (Schummer 1996). The experiential function, which is a property of all sign systems, is made possible by the rules with which these systems are equipped. Signs thus become what Ursula Klein (2001) rightly calls “paper tools”, arguing that their pragmatic and syntactic aspects make them entirely comparable to physical laboratory tools. This notion of the tool as an instrument of catasemiosis is so important that it will be discussed in Sections 4–6 below.

However, in order to describe the whole semiotic chain, we need to mobilize concepts other than ‘category’ and ‘sign’.

These include

- memory (presupposed by both the sign and the category), which stores information that can be retrieved later on demand, and whose essential role in semiosis is well known;
- intention (with its underlying expectations, desires and beliefs) and decisions. Whatever the status given to them by the various cognitivist paradigms,⁹ these “mental states” have their place in the sequence of instructions sent to the muscles. The fact that the degree of awareness of a decision and its exact place in the sequence are now highly controversial phenomena in no way detracts from their importance.

On this subject, it should be pointed out that the word ‘intention’, so often used, actually refers to a nebulous range of contents. Since the work of Benjamin Libet, we now know that the awareness of an intention follows the neuronal activity that prepares it for action: it does not precede it, contrary to what common intuition suggests; the trigger for the said action cannot therefore be conscious will (cf. Wegner 2002; Soon *et al.* 2008; Cleeremans 2010). Libet’s work and that which followed it has certainly been discussed in so far as, at first sight, it seems to establish the rule of the unconscious as absolute and to refer to a brutally mechanical determinism. This, however, is not the case. As Searle (1983) has already argued, we need to distinguish between several types of intention. Lafargue and Sirigu (2004: 81) thus isolate ‘intention in action’ – the kind we have just been talking about – and ‘prior intention’, the kind of premeditated plans that provide a framework for the former. The mechanisms governing these two types of intention are located in distinct brain structures (prior intention is developed in the prefrontal cortex,

⁹ The “theory of mind” defines them as part of a paradigm of types that allow us to interpret the behaviour of others and make inferences, while “simulation theories” see them as a projection of the states of the observing subject. These two paradigms, which are falsely exclusive, are also recoverable by a cognitive semiotics: mental states can indeed be based on a referential function (which simulation theories presuppose), and there is nothing to prevent them from forming an encyclopaedia.

intention in action in the parietal cortex). The supplementary premotor area acts as a crossroads between the mechanisms of these two areas, so that the two types of intention can be articulated; yet they can also be disconnected (in which case the subject’s actions no longer conform to a premeditated plan). Furthermore, as a further *caveat* to the thesis of complete determinism, the potential for motor preparation may very well not lead to action, especially if the decision to act does not correspond to the prior intention, thus, “we are not free to will, but only free to refuse” (Lafargue, Sirigu 2004: 83).

These observations confirm the relevance of the distinction between short and long semiosis that we propose (Groupe μ 2015: Ch. II, §5.3): we can see that the intention in action concerns the former and the prior intention the latter.

This distinction, which is crucial at the anasemiotic level, is also crucial at the catasemiotic level. Indeed, it is clear that the semiotic function becomes more complex, diversifying and lengthening from level to level in the course of evolution. The processes involved include a greater number of sensorialities, larger memory capacities and more powerful means of comparison. Consciousness, self-perception as a subject and the development of intersubjectivity are at the (current) end of this evolution, as Fig. 4 attempts to suggest. As we can see, we are step by step moving from a short semiosis, in which the dipole – which translates the motor differences of the natural world – directly produces action, to a long semiosis, in which the intermediaries have become more numerous and more elaborate, and in which the subject is gradually constituted and complexified as a social subject, assuming an increasingly decisive role.

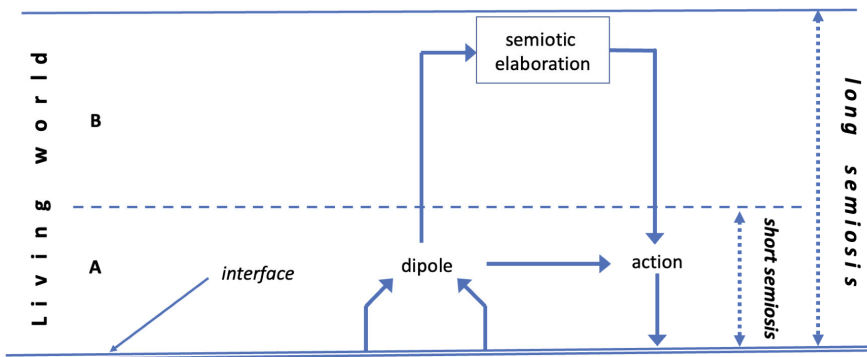


Figure 4. Short semiosis and long semiosis (A – reflex zone; B – reflexive zone).

4. Why tools?

In many metaphorical usages, the word ‘tool’, which is considered to have a primarily material meaning (underlined by expressions such as ‘toolbox’), is used to refer to operations of a symbolic nature: we thus speak of mathematical tools, pedagogical tools, and so on. We would like to reverse the perspective here, and argue that any tool, even in the most material sense, has a legitimate place in semiotics, both for the study of anasemiosis and that of catasemiosis. If the sign is a tool, it is not the only one with which semiotics should be concerned.

4.1. Semioticians at work

This is certainly not the first time that tools have been brought into the semiotic debate. A number of works on instruments and machines have appeared in recent years, not to mention the fact that the concepts of meaning and work (and therefore energy) has long been linked by Ferruccio Rossi-Landi (1983), and that semiotic activity has already been described as work by Eco (1976). Among these works, we should highlight those of Alessandro Zinna, who, together with Jean-François Bordron, organized a symposium on the semiotics of machines, held in Urbino in 2004.¹⁰

However, these works lack the interdisciplinary perspective that is essential to their subject matter. They are very often programmatic, and even more often ignore the important work being done in mechanology¹¹ and ethology.¹² Above all, the category of the tool is usually diluted in two more general frameworks: that of the semiotics of objects, in which Jean-Marie Floch’s work was a milestone (see also Landowski, Marrone 2001; Deni 2002), and that of the semiotics

¹⁰ Cf. Zinna *et al.* 2005. Because it emphasizes the technological factor, a “semiotics of machines” tends to limit its field of interest to a period beginning “with the industrial revolution and the mass production of objects” (Zinna 2004: 1). Although these historical phenomena have considerable consequences for semiosis (cf. Section 6), such a delimitation has no relevance for a general semiotics of the tool. In fact, every artefact is a tool, including artistic objects, which are sometimes excluded from this category in the name of a very outdated aesthetic conception (‘art is that which serves no purpose’).

¹¹ With the exception of Bordron (2005), who uses the work of Jacques Lafitte (1932) and that of Gilbert Simondon (2017[1958]).

¹² It should be noted that in all that follows, we will be referring to a subject, and not to a human agent. Humans do not have a monopoly on the use of tools. And it is not just the higher mammals that use them: the finch, the sea otter, the seamstress ant and the octopus are also capable of using elements of their physical environment as tools. In these activities, these animals behave as subjects capable of controlling and coordinating the phases of their actions, adapting them to the circumstances required by the environment.

of practices. These two tendencies have converged. In his *Pratiques sémiotiques* (2008), Fontanille places objects and scenarios of use of signs and utterances alongside signs and utterances, and it is between the level of the utterance and that of the practice in action that the object takes its place.¹³

This insertion, however relevant it may be (since any object can be a tool), obscures several crucial components of the tool and does not allow us to bring out its full impact on semiotic theory.

The first dimension that is obscured is that of energy management, a concept whose importance we have demonstrated in the context of a general theory of meaning (Groupe μ 2011: 305–307; Groupe μ 2015: *passim*). Insofar as the tool transports and transforms energy,¹⁴ it certainly deserves a special place in the category of objects. By ignoring this transformative dimension, we limit the scope of a semiotics of tools to those whose main function is to act on meaning. This is not to say, of course, that we should exclude these tools: on the contrary, we will see the advantage of eliminating any discontinuity between languages and tools.

A second source of confusion is that the main currents in semiotics study objects more for their symbolic or social values than for their agentive functions: they are seen as instruments of communication, or at least as instruments that act on subjects (Deni 2002), but not as instruments for transforming the world. Once again, catasemiosis is ignored.

Finally, the trends we have just mentioned are overwhelmingly inhabited by what we might call textualism: what counts then is above all either the figuration of the object in a textual corpus (e.g. Levy, Park 2005), or the conception that an episteme can develop of the tool (e.g. Bordron 2005). Even in the seemingly least textualist works there is still a hint of logocentrism.¹⁵

¹³ See also Fontanille, Zinna 2005.

¹⁴ At this stage, we cannot distinguish between the tool, the instrument and the simple machine, recalling the definition of the latter given by physics: “A mechanical arrangement whereby a force acting at one point is made available at another point under different conditions as to its magnitude and direction.” (Smith 1957) Strictly speaking, this definition applies to mechanical devices, but it can easily be transferred to other categories (e.g. optics). Any machine can always be articulated into simpler machines, and in this respect many tools, such as the crankshaft or the corkscrew, are already machines.

¹⁵ In Fontanille 2008, the object is seen above all as the material support for the utterance, where it prefigures a possible use. Actual practice either confirms these prefigurations, or actualizes other potentialities not foreseen by the object’s signification, but in all cases, the starting point is the meaning attributed to the object and not its action.

4.2. Tool functions

4.2.1. Tool and routines

It should be noted that the tool does not saturate the whole of catasemiosis: there are physical muscular actions that are not affected by it. On the other hand, the fact that the sign is a tool certainly gives this concept an important place in an extended semiotic theory, particularly in that it must always be interpreted, which is the main form of catasemiosis recognized by Peircean thought.

All tools are necessarily embedded in the framework of practices, where they form what are known in computer science as routine, i.e. a set of grouped operations, transposable to multiple configurations but endowed with a global specificity (with a hammer you can break, deform or drive in very different things, but you can do nothing to the perception of colours).

In the following, these routines will be called ‘functions’. This word is not neutral in that the notion of function presupposes an intentionality, however diffuse: a tool is only effective when it is incorporated into a behaviour – defined as a pattern of action directed towards a precise goal – or a given series of behaviours. This series is obviously not closed. In fact, tools often enable serendipity: for example, a magnifying glass is used to see things that are difficult to see, but it can also be used to light a fire. The set of operations is therefore not closed, but it is limited to several points of view defined by the objective. In particular, it is limited in terms of the sensoriality involved (visual, in our example), the type of physical action involved (in this case, optical), its field of efficacy (in this case, limited to a certain level of magnification) and the type of semiotic process involved (in this case, anasemiotic).

The creation of any tool therefore presupposes the identification of a task to be performed and the repetitive nature of this task. This development therefore involves a preliminary anasemiosis, during which a general model of the task is developed, highlighting its invariants (in other words, developing a general category). Once this invariant has been identified, a response to repetition can be developed in the form of a tool, which is then simply the reification of a routine (or, more metaphorically, the fossilization of a catasemiosis).¹⁶

In other words, the function of the tool is to allow the extension (amplification, facilitation, reinforcement, widening of the field of application) of a semiotic

¹⁶ This reification historically produces families of tools and fossilizations around a function. Thus, the principle of the nail is stable beyond the innumerable modifications of its form, whether these modifications are synchronic or diachronic (the relationship between ‘principle’ – general – and ‘form’ – contingent – is analogous to the relationship between ‘signifier’ and ‘support’).

action that constitutes a relevant response to a recurring task, or to replace it with another action that is considered equivalent to the first from the point of view of obtaining the effects of the behaviour in question.¹⁷ The hammer is a good example of the former situation, the wheel of the latter.

In the name of this principle of equivalence, it is clear that signs are fully tools, in the literal sense and not in the figurative sense. Indeed, thanks to the function of referring, they make it possible to act on substitutes rather than on things, as mentioned above. This instrumental nature is further confirmed when we compare the sign with the organs of living beings. However, before doing so, it is of course necessary to discuss the utensilary nature of these organs (which we will do in Section 4.2.2 below) and to establish the semiotic specificity of the tool's function (4.3.1 and 4.3.2).

4.2.2. Tools and organs: a continuum?

Some people will not hesitate to use the word 'tool' to designate the organs developed in the process of evolution. And it is true that there is a strong similarity between the two categories of objects.

The similarity lies primarily in the function of these objects, if we give the word 'tool' the broad meaning of any device, material or symbolic, that serves a purpose on a recurring basis. From this point of view, we can immediately see the similarity between the eye and the magnifying glass, and every student is used to comparing this organ with the darkroom. The same is true of the structure of these objects: the first hammer is the fist, the first lever is the jaw. However, it is even more true of their tendency to be arranged in sequences in which processes follow one another: in the case of tools, we might think of the application of a chemical reagent followed by observation of it under the microscope, or the breaking off of the leg of an edible crustacean with forceps, followed by the extraction of its flesh with a hook. In the case of organs, we might think of the propagation of a nerve impulse along a chain of synapses, axons and dendrites, or of metabolism, which links together spectacularly more differentiated operations. Yet this sequentiality already operates at a fundamental level: each organ can be described as a triad, with an input, a process and an output.

Ultimately, there is a continuous chain, from nerve endings to a particle accelerator. In the name of this continuum, we may admit, for example, that tools do not necessarily have to be artefacts, but can be a part of the acting body (the hand shaped like a cone in front of the ear) or another body ('to give a leg up').

¹⁷ For example, Eco (1999[1997]) distinguishes between substitutive, extensive and multiplicative prostheses.

However, can we use this continuity as an argument for calling any structure that enables sequential data processing ‘a tool’? If so, everything would be a tool, from an enzyme to a chemical messenger (and this is the position taken by Wagner 1997).

However arbitrary and gradual, the boundary between organs and other devices has obvious relevance in semiotics, ethology and developmental psychology. In particular, from a semiotic point of view it should be noted that continuity concerns only structures and functions. As soon as meaning is involved, a continuity solution is observed. The referential function, with its experiential value, makes it possible to entrust another entity with the function performed by the organ. This is what we call externalization of function.

Consequently, we will choose to maintain the distinction between body and tool (and we will avoid using the word ‘tool’ to designate, for example, parts of the body that are conceived in terms of their own functionality: the pinna of the ear, which facilitates hearing far more than a simple orifice; the elephant’s gigantic ear, which enables it to perceive infrasounds; the hand, which is more skilful than a simple stump...).¹⁸ Yet this distinction will be gradual, and based on three criteria: we will say that the status of tool will be clearer the more the object is *an artefact*, the more its function is *externalized* and the more it is *consciously appropriated*.

4.3. Anasemiosis, catasemiosis and mediation

4.3.1. Anasemiotic tools and catasemiotic tools

Tools work on both sides of semiosis and are therefore of two types: anasemiotic and catasemiotic. The anasemiotic tools – for example, the magnifying glass, the electron microscope, the antenna, the ear trumpet, the bubble chamber... – are involved in assigning meaning to segments of the world and in shaping that meaning. This is well known in the case of signs, but this shaping is also the function of, for example, scientific instruments which are set up to take account of a precise range of phenomena. The second type of tool – hammer, drill, syringe, printer, neutron cannon, performative discourse and, more generally, utterances considered in their illocutionary and perlocutionary aspects (*How To Do Things with Words...*), etc. – participate in the action on segments of the world, according to the meaning given to these segments and the objectives pursued.¹⁹

¹⁸ In support of this position, Elizabeth Harkot de La Taille (personal communication, 2013) notes that describing the brain as a tool for, among other things, cognitive operations is unacceptably simplistic. When a disease affects this organ, it is the whole system that malfunctions, not a specific function.

¹⁹ When the word ‘tool’ is used, it is more likely to refer to catasemiosis: everyday language uses the word ‘instrument’ to refer to anasemiotic tools (cf. Simondon 2017). However, since

The tools seem to be resolutely specialized in one or the other of these families of functions, even if, *de facto*, the same tool can play both roles, separately or simultaneously (a USB key can be used not only to read an article, but also to make it known), or if the different aspects of the tools can be involved in complex processes or procedures in which the two functions are inextricably linked, sequentially or not. We may recall the fine example of microwaves, which were initially mobilized as part of anasemiotic procedures, but which happened to have an interesting catasemiotic effect: the production of heat. Articulated language is a similar case: on the one hand it formalizes the meaning of experience, but on the other it is capable of exerting an action on the world; this is very visible in the case of its performative functions, but its effectiveness is no less when it serves rhetorical *pathos*. Nevertheless, *de jure*, the two aspects of the tool are clearly distinct. In the course of a sequence of actions that is considered to be homogeneous from the anthropological or social point of view – what ethologists call an ‘action chain’ – it is not difficult to distinguish the two types of families of functions at work: the fossil researcher’s hammer, chisel and brush play a catasemiotic role – they modify the environment in order to make some of its components observable –, but this observation itself, which is only possible after the fossil has been cleaned, remains ocular in nature and may also involve other tools, such as a magnifying glass; the particle accelerator has a catasemiotic effect, but the result of this action is made observable by other tools, such as a bubble chamber.²⁰ The tools or parts of tools are therefore strictly defined by their participation in anasemiosis or catasemiosis.

It is also important to distinguish between the two types of tools because they serve different purposes: the former are manifestations of the interpretive impulse, which is crucial in the process of anasemiosis (cf. Groupe μ 2015: Ch. VI), the latter of the actional or transformative impulse (§1.3.)

The reader of our examples will have noticed that we are definitely not separating language from the other tools: an insertion that does not give it any privilege here.²¹

anasemiosis and catasemiosis are closely associated, there is no need here to specialize the meaning of the term here.

²⁰ The fact that the two types of tools appear in sequence in the same action chain is perfectly normal, since anasemiosis and catasemiosis are cyclically related. The search for fossils and experiments with a particle accelerator illustrate the sequence catasemiosis > anasemiosis; launching missiles after detecting an enemy or closing valves after a measurement are examples of the sequence anasemiosis > catasemiosis.

²¹ It should be noted that ethology has mainly described catasemiotic tools: objects used to transform another object (cf. e.g. Beyries, Joulian 1990); however, there are undeniable examples of anasemiosis: when a member of a herd is designated as a lookout, he (or she? it?) is instrumentalized in this sense. The important thing is to see that there is an evolutionary pathway that shows the interest in developing intermediates that lengthen semiosis.

4.3.2. The mediating role of the tool²²

Sometimes situated on the anasemiomatic side, sometimes on the catasemiomatic side, the tool plays a mediating role between living agents and objects (whether they belong to the natural world or not), between which it interposes itself. As Simondon (2017) has shown, this mediating power can be observed at the most elementary stage of the instrumentalization of nature (for example, the cliff used to corner hunted animals). Mediating power is thus not the exclusive property of tools that have an immediately perceptible semiotic nature, such as verbal or iconic language.

A tool cannot therefore be a monolithic object; it always has at least three components: its central core (of any kind – a solid body in which vibrations are propagated, or a sophisticated mechanism), but also two “ends” or faces, one turned towards the subject, the other towards the object – in other words, an input and an output, as Zinna (2004) has clearly pointed out.

This is shown in the diagram (Fig. 5), where the two lines distinguish between anasemiomatic and catasemiomatic tools (or parts of tools).

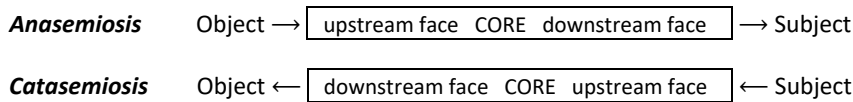


Figure 5. The tool as a mediating device.

The handle of a hammer, held in the hand, and its head, in contact with the object to be broken or driven in, offer a simple but striking (if we dare say so) catasemiomatic example of this necessary polarity; the microscope is another, anasemiomatic one; and its terminology gives a good account of its duality: at one end we have the eyepiece, to which the unequipped eye is applied, and at the other the lens, through which the light rays bouncing off the object pass to the other end. As for the particle accelerator, there is the inseparable pair of a physicist who launches the apparatus and a chosen particle.

This observation suggests that the concept of articulation – the property of a semiotic unit to be divided into smaller combined units, or to be combined with other units to produce new units of a higher rank – applies perfectly to the tool.

On the one hand, mediations can take the form of chains: if the hammer has an upstream and a downstream face, the nail it drives in has an upstream and a

²² On the concept of mediation, see Lévi-Strauss 1963; Groupe μ 1977: Ch. II, 3; Groupe μ 2015: Ch. VIII, 3; Klinkenberg 2000: Ch. IV, 7.

downstream face itself. This simple observation confirms that mediation is generally a transitive relationship. On the other hand, cores are often themselves assemblies of parts, and these parts are not disjointed, as the expression ‘spare part’ would suggest, but integral.²³ Simondon (2017) notes that the weak point of a tool is always the point at which the parts are connected; hence the importance of ‘internal self-correlation’, without which the tool cannot function.

4.4. Tool, meaning and sign

Once all these precisions have been made, we can return to the comparison between radically externalized tools, organic tools and signs.

The foregoing allows us to bring the tool and the organ closer together (this time without being tempted to confuse them). Both can be described as a triad, with input, processing and output. In the tool, these three terms are the core, the upstream face and the downstream face.

Even better, the link can now also be made with the bodily substratum of meaning and the signs that can express it. Cognitive neuropsychology confirms the idea that meaning is processed in the form of sequences of tools, with inputs and outputs:

Classic cognitive models consider cognition in the terms of a general system that pursues goals and manipulates symbols. These symbols are subject to various processes that manipulate them and transform them into other symbols. The aim of cognitive psychology is to specify the nature of the symbols and representations that underlie performances. This processing system has a limited capacity and, if we postulate that certain processes are organized in sequence, the study of the time taken to complete a performance [...] allows us to approach its complexity. (Seron 1993: 115)

This ternary processing of meaning is particularly emphasized by the modularist cognitivist paradigm. To the question of “how this algorithm and its representations are implemented in the brain [...] how the information processing processes are physically carried out and what is the material support of the representations on which they operate” (Seron 1993: 9), Xavier Seron answers that “human cognition is made up of a finite set of more or less autonomous subsystems, and each subsystem can itself be broken down into a set of subcomponents” (Seron 1993: 10) or that

²³ For Bordron (2005: 19), the notion of ‘spare parts’ is essential to defining the machine. For him, this is because neither living beings nor works of art have this characteristic. This, however, is debatable: the pacemaker, HeLa cells and fragments in art monographs are good counter-examples.

human cognition is made up of different specific and autonomous information processing systems. [...] From a neurophysiological point of view, the modules correspond to fixed, pre-wired neuronal structures in the central nervous system [...] modular processing escapes consciousness and we have access only to the products of the processing carried out and not to the operations themselves [...]. Modular systems are characteristic of the processes that process input signals (input module) and those that control action (output module). (Seron 1993: 18–21)

So the ternary schema also applies to connectionist models. This model, of course, describes cognition in terms of networks of interconnected units operating in parallel, with no linear hierarchy. Again, we see that while these networks have a number of layers, we must always distinguish between an input layer, one or more intermediate layers, and an output layer.

5. Semiotic typology of the tool

The development of tools, both in the evolution of species and in the history of technologies, makes it possible to observe, as expected, the gradual sophistication of mediation. At the same time, beyond the distinction between anasemiotic and catasemiotic tools, it suggests a typology of tools based on the variables affected by these developments and which are semiotically relevant. We refer the reader to the work in which we present this typology in detail (Groupe μ , 2013). It takes into account four variables that will be briefly presented here: the type of energy involved in the tool, its form, its status and its field of application.

5.1. Energy

It is well known that meaning and energy are linked, both in the anasemiotic and in the catasemiotic phases (cf. Groupe μ , 2015, Ch. II). And it is also too obvious that the tool requires the intervention of energy. For a force, it is always a question of changing its point of application, its intensity and its direction. A machine never creates work: on the contrary, the ratio between the work done and the force applied is always <1 .

This first variable can in turn be described as the product of three factors.

The first is the opposition between potentialized energy and actualized energy. There are tools that function thanks to the potentiation of energy (a spring that is stretched, a bow that is bent, 'language' in the Saussurian sense of the term) or whose function is precisely to produce this potentiation (an accumulator, a water tower, a dictionary). Conversely, other tools trigger expenditure and actualize

energy: the hammer, the neutron bomb, the ‘speech’, in the Saussurian sense.²⁴ The second factor is the relationship between the energy expended by the tool and the energy mobilized for the same function when the tool is not used. We can therefore distinguish between homoenergetic tools (the bow uses the energy of the arm directly) and heteroenergetic tools (to obtain a ballistic effect of the same family, the harquebus uses a separate source of energy, stored in the gunpowder). The third factor is transformation. As we have seen, the tool never creates energy, but uses it differently. It can concentrate energy or, on the contrary, dilute it.²⁵

Describing a tool means situating it in a particular configuration of these three factors, as the following examples show:

untransformed actualized homoenergy	spear-thrower
transformed actualized homoenergy	hammer
untransformed potentiated homoenergy	crossbow
transformed potentiated homoenergy	hammer of a firearm
untransformed actualized heteroenergy	tap
transformed actualized heteroenergy	violin
untransformed potentiated heteroenergy	accumulator
transformed potentiated heteroenergy	gunpowder

5.2. Shape

Shape here refers to the spatial arrangement of the device, which can vary without changing the function of the tool.

The spear-thrower, whose function is to launch, is an extension of the human arm, whose shape it also has; but this relationship disappears in the crossbow, which has the same function.

If this relationship between expression and content has been verified for signs, it must apply to the whole category of tools to which they belong – and so it is. In so far as the spear-thrower resembles an arm and is an extension of it, we can see in it a double motivation of the form of the content in relation to that of its expression. Yet we will find nothing similar in the mixture of propellants used to propel a rocket, which is its distant descendant; and a computer obviously has no form motivated by those of its many and varied functions.

Independence of form is therefore also a factor in lengthening semiosis.

²⁴ There is obviously a sequential relationship between actualization and potentialization (as is well known for the language–speech dyad): we can only actualize what has been potentialized. Ultimately, all action is based on previously stored energy, for example, sugars in the body.

²⁵ It is these movements that we observe with tools that have an immediately obvious semiotic status: an abstract or keywords are energy-concentrating devices; conversely, many texts are dilutions or expansions of other texts.

5.3. Status

Numerous technical innovations are gradually moving the tool from the status of an extension to that of a mere substitute. To point this out is another way of highlighting the lengthening of semiosis: the spectacle lens is an extension of the eye, which a radio telescope also is, but less directly. In the field of signs, a typology of referential functions ranging from the index to the symbol allows us to see how the sign acquires the role of an increasingly simple substitute, with the arbitrariness.

5.4. Field of action

Above all, however, the development of tools affects the field of application of the function, either by extending it, or by circumscribing it in a new way, or even by shifting it.

A simple example of this mutation would be a tool for listening to ultrasound, because it converts these vibrations into audible sounds. In general, scientific instruments, but not only them, have the characteristic of modifying the results of the behaviour of unobservable objects in such a way as to make them observable. The manifestations to which we seek to give meaning are ultimately brought back into one of our sensory windows. This can be achieved by working on the original window, enlarging or shifting its dimensions (as in our example), but it can also be achieved by transforming data from outside the sensory window: ultrasound can be made visible and infrared can be made audible. The same phenomenon of transposition applies to catasemiotic tools: they change the dimensions or nature of the windows of our catasemiotic practices, allowing us to act outside the constitutive window. Examples are the ultrasonic whistle used to hunt birds, or the particle accelerator that launches previously unthrowable objects.

All these semiotic variables of the tool can be summarized in Table 1:

Table 1. Semiotic variables of the tool.

<i>Energy:</i>	homoenergetic actualized untransformed	heteroenergetic potentialized transformed
<i>Shape:</i>	homomorphic	heteromorphic
<i>Status:</i>	extension	substitute
<i>Field of action:</i>	maintaining the original window	shifting or changing the window

6. Back to the lengthening and socialization of semiosis

6.1. Externality and permanence: the lengthening of semiosis

The list provided in Table 1 is for mnemonic purposes only, not for matrix purposes. In some cases, it presents pairs of opposites: homoenergy and heteroenergy know no intermediaries. In other cases, we are dealing with axes along which a tool can take any position: it can be weakly or strongly heteromorphic, its energy can be weakly or strongly transformed, its field of action can be imperceptibly or spectacularly shifted, and so on.

Nor is there any solidarity between the terms in each row, each variable being independent of its neighbour. However, the list suggests that the tool serves the lengthening of the semiosis: all the characteristics on the right of the row point in this direction. Without suggesting any teleology here, we would like to emphasize that many of the innovations observed in the history of technologies (increased potentialization, multiplication of heteroenergy, distance from bodily structures, change of window) follow the same trend. A historian would also show that the evolution of tools has made them more effective, by improving one or more of the characteristics of the force used, or by increasing precision and safety, but also by making them more and more external to the body (see the transition from the palm of the hand placed behind the ear to the ear trumpet and then to the hearing aid) and more and more permanent: permanence thus constitutes a memory of routine.

6.2. Tools in diachrony: a teleology?

If we relate the above distinctions to historical time and include the movements we have just alluded to, we can see that these developments are linked to the existence of the interpretative or actional impulses, and that these have a cumulative effect. Thus, the development of new tools for scientific observation responds well to the anasemiotic impulse. The new tools in their turn make it possible to formulate interpretations, some of which may not be satisfactory, and therefore require the creation of new tools. As we have been able to divide matter into molecules, atoms and particles, new demands have been placed on both anasemiotic and catasemiotic tools at each stage. As interpretation becomes richer, it requires more and more tools, in an infinite, perhaps exponential process.

The evolution of human tools has been described and commented on by many authors (e.g. Frémont 1913; Lafitte 1932; Simondon 2017). They all emphasize a gradual refinement, culminating in a stabilization of forms that would represent an ideal state. On closer inspection, evolution would appear to be asymptotically tending towards this perfect form: as we progress, changes would affect increasingly minimal details.

This linear pattern can be challenged (which brings us closer to the Piagetian model with its two types of novelty). A first series of innovations in the shape of a tool is carried out while respecting a basic principle that remains unchanged: they give rise to the asymptotic evolution mentioned above. If the basic principle is changed, the evolutionary process takes a new direction. The history of the typewriter is a perfect illustration of this dual mechanism: as we moved from lever-operated machines to typeball and daisy-wheel machines, then to matrix machines and computers, each time we abruptly interrupted an evolution of the first type and rendered it definitively obsolete. It is then the evolution of the basic principle that needs to be considered. For example, the answer to the problem of ‘how to communicate at a distance and at high speed’ has changed paradigms several times: first it was to improve the range of the voice, then to use visual codes such as flags or the Chappe system, then to use electricity with Morse code, and finally to downgrade all these solutions with Hertzian waves and then with electronic networks. In the meantime, each of these basic principles has been progressively improved.

6.3. From the individual body to the social body

In addition to lengthening the semiosis, as heteromorphism, substitution and change of window do, exteriority and permanence allow us to improve the tool, but above all to strengthen the sociality of its use.²⁶ This is particularly true of the longest semioses, such as signs.

We are thus led to go beyond the narrow framework of the individualized relationship between subject and object, in which neither anasemiosis nor catasemiosis can be confined.

In the case of the latter, we can see that the more complex tool has increasingly become a collective tool. To use an example from Paolucci (2012: 306),

the ability of a team of surgeons to solve problems does not lie in their representations or in the actions of individual team members. On the contrary, it is

²⁶ This social character of the tool is at the origin of the postulate of the semiotics of objects (e.g. architecture), which states that the tool signifies and communicates its function. This brings us back to the concept of affordance developed by James J. Gibson (1979) and popularized in cognitive psychology, ergonomic psychology and the field of design. However, this is no more than a banal application of the anasemiotic process, in which the referent function is not necessarily mobilized, so that the phrase ‘signifies and communicates’, however seductive, must be treated with caution. Michela Deni’s (2002) position is more elaborate and recognizes catasemiosis: she shows that objects structure action processes and determine a typical user, what she calls their ‘factivity’.

distributed more globally in the intersubjectivity of the team, in the material artefacts of the laboratory that determine the perceptions of each individual, in the repertoires of procedures and protocols that regulate the team's know-how, and finally in the inferences that the team makes during the operation on the basis of previous experiences. Cognition and thought are no longer considered as part of the mind and no longer dependent on the conclusions of a specific individual, but are distributed within more complex systems, which we must therefore analyse as *Gestalten* that are irreducible to the sum of their parts.

We must therefore think of instances like users and tasks as “nodes of a functional system that is entirely supra-individual, in which cognitive activity takes place because it is distributed among instances that are co-participants in the activity in progress” (Paolucci 2012: 306). A socialization in which routines, individuals and tools are closely linked.

This interdependence is particularly evident in the products of technical complexity: the launch of an interplanetary mission undoubtedly involves a chain of innumerable tools, both anasemiotic and catasemiotic, as well as a large and close-knit community of diverse participants who are jointly responsible for the operation. And it is a fact that many tools are structuring social relations (the laboratory, the cockpit of a plane, but also the library or the bus). But we must be wary of a new teleological perspective that would reserve collective intelligence for the most historically recent tools: it is the characteristic of all complex tools and has been perceptible since the beginnings of social life, whether animal or human. Group hunting and warfare are good examples, as is the work of the collective *Groupe μ*, *si parva licet componere magnis*. Any group involved in a task can therefore be seen as a tool and, to put it more figuratively, it is itself an integral part of the tools it uses. Ultimately, a state can be seen as a tool, as can a philosophy or an ideology: Christianity or Islam, in some of their historical manifestations, can be described as such.

We must therefore add to the description of the continuum between body and tool, given in Section 4.2.2 above, of which only the individual manifestation has been commented on. It is now clear that an important continuum links the tool to another body: the social body.

6.4. Catasemiosis is everywhere

It is not only the social body that is deeply affected by the tool. It is the whole universe that is now incomprehensible without it.

The extent to which tools have multiplied in number and diversified in application cannot be overestimated. The animal world itself has become a tool: the

dairy cow, the carrier pigeon, the honey bee (not to mention, on a microscopic scale, the brewer's yeast, the precious *Penicillium* and the no less precious *Botrytis cinerea*). Thus, from the discreet instrumental catasemiosis witnessed by birds' nests and medieval burns, we have moved on to a total takeover of the environment, of which there is hardly a landscape that does not bear the traces: chimneys, roads, dams, heaps, embankments, hedges, etc.

It was perhaps because he saw this profoundly transformative function of the tool that Umberto Eco, with a somewhat romantic enthusiasm, sought to distinguish mere prostheses from real tools that “produce something that did not exist before” (Eco 1999[1997]: 505 fn. 1). This idea of a radical novelty ignores the continuum between prosthesis and tool and blithely overlooks the fact that the tool does not create energy but transforms it. But the fact is that the relationship between the natural world and the catasemiotic world has gradually been reversed, and not least of the paradoxes generated by this evolution is that our practices of interpretation have in turn been turned upside down: they are now applied by building anasemiosis on the very results of previous catasemiosis.

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Del sentido al mundo: la catasemiosis

Ahora se sabe que el sentido surge de una interacción inicial entre los cuerpos de los seres vivos y los estímulos del mundo exterior. Este proceso, que conduce al desarrollo de estructuras semióticas, se conoce como anasemiosis. Sin embargo, la descripción de la semiosis estaría incompleta si no tuviéramos en cuenta un segundo movimiento en el que el cuerpo participa en una segunda interacción con el mundo: la acción ejercida sobre este mundo por el significado. Este movimiento puede denominarse catasemiosis (si *ana-* se refiere al prefijo griego que denota un movimiento de abajo hacia arriba, *cata-* se refiere a un movimiento de arriba hacia abajo), y la semiosis completa está constituida por este ciclo interactivo anasemiosis–catasemiosis.

Tras esbozar las razones por las que el estudio de la catasemiosis ha sido en gran medida descuidado por las ciencias del lenguaje y del sentido, este artículo sitúa la catasemiosis dentro del proceso general de la semiosis, establece la naturaleza complementaria de los procesos de anasemiosis y catasemiosis, y demuestra que sus estructuras son comparables, basadas como están en el mismo principio de oposición –o dipolo–. Asimismo, destaca la existencia en los organismos vivos de una pulsión de acción, complementaria de la pulsión interpretativa, y demuestra que la rutinización es el equivalente catasemiótico de la categorización a nivel anasemiótico. Considerando el signo como herramienta, y subrayando la importancia del concepto de energía en semiótica, dedica especial atención a las herramientas, concebidas como prolongación de los cuerpos, y a su función mediadora.

Tähendusest maailmani: katasemioos

Teame, et tähendus tekib elusolendite kehade ja välismaailma stiimulite vahelises algses koostoimes. Seda protsessi, mis viib semiootiliste struktuuride kujunemiseni, nimetatakse anasemioosiks. Semioosi kirjeldus oleks aga puudulik, kui me ei võtaks arvesse liikumist, milles keha osaleb teises interaktsioonis maailmaga: nimelt tegevust, mis mõjub maailmale tähenduse kaudu. Seda liikumist võib nimetada katasemioosiks (kreeka eesliide *ana-* viitab liikumisele üles-, *kata-* aga allapoole), mis läbi terviksemioosi koosneb anasemioosi-katasemioosi interaktiivsest tsüklist.

Pärast põhjuste väljatoomist, miks keele- ja tähendusteadustes on katasemioosi käsitlemine suure osas tähelepanuta jäänud, paigutatakse katasemioosi käesolevas artiklis üldisesse semioosiprotsessi, tuvastatakse anasemioosi- ja katasemioosiprotsesside teineteist täiendav olemus ning näidatakse, et nende struktuurid on kõrvutatavad, sest lähtuvad ühest ja samast kahepoolsuse või vastandamispehimeest. Rõhutatakse, et elusorganismidel on ajend tegutseda, mis täiendab tungi tõlgendada, ning näidatakse, et rutiiniks muutumine on anasemiootilisel tasandil toimuva kategoriseerumise katasemiootiline vaste. Vaadeldes märki kui tööriista ja rõhutades energia mõiste olulisust semiootikas, pööratakse seeläbi tähelepanu tööriistadele, mida mõistetakse kehade laiendustena, ja nende vahendavale funktsioonile.