

# A Theory of Consciousness

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According to William James' theory of mind (1890), our conscious mental life flows continuously like a stream in which "the transition between the thought of one object and the thought of another is no more a break in the *thought* than a joint in a bamboo is a break in the wood" (James, 1983, pp. 233-234). For this reason, he adopted the metaphor of "the stream of consciousness". The stream is formed by an unbroken series of states of mind, each one of them, however, is different from the others:

"it is obvious and palpable that our state of mind is never precisely the same. Every thought we have of a given fact is, strictly speaking, unique, and only bears a resemblance of kind with our other thoughts of the same fact. When the identical fact recurs, we *must* think of it in a fresh manner, see it under a somewhat different angle, apprehend it in different relations from those in which it last appeared. And the thought by which we cognize it is the thought of it-in-those-relations, a thought suffused with the consciousness of all that dim context" (James, 1983, p. 227).

The difference between each state of mind and the others is highlighted by James also for another reason. Each state of mind - or "pulse of consciousness" - gives rise to a unitary content, however complex it may be. If in a precise state of mind we think about, imagine, feel or perceive an object, we will always have only one thought, image, feeling or perception of that object; we will think about, imagine, feel or perceive it in a unity, as a whole. "*There is no manifold of coexisting ideas; the notion of such a thing is a chimera. Whatever things are thought in relation are thought from the outset in a unity, in a single pulse of subjectivity, a single psychosis, feeling, or state of mind*" (James, 1983, p. 268). James reaffirms and refines this hypothesis when dealing with attention:

"The number of *things* we may attend to is altogether indefinite, depending on the power of the individual intellect, on the form of the apprehension, and on what the things are. When apprehended conceptually as a connected system, their number may be very large. But however numerous the things, they can only be known in a single pulse of consciousness for which they form one complex 'object', so that properly speaking there is before the mind at no time a plurality of *ideas*, properly so called" (James, 1983, p. 383).

No doubt James' description is very realistic and convincing. But how is it possible to conciliate and explain the apparent contradiction present in the metaphor of the stream of consciousness as something flowing uninterruptedly, but which is, nevertheless, composed of single pulses of consciousness? How can we explain the quality of the conscious experience as something continuous and coherent *and, at the same time*, made of states of mind each of which is inevitably unique, different from the others, and characterized by its own qualities? And how can we relate the properties of consciousness to the way attention works, given that the latter seems to share many qualities with the former?

A solution to these problems comes from conceiving of the stream of consciousness as the outcome of a process determined by the continuous interaction of two systems: the perceptual system and the schema of self.

The perceptual system, principally based on the organ of attention, sense-organs, and somatosensory organs, enables the organism to be conscious and provides the products that will be processed by the schema of self and contribute to update and modify it. These products derive from the operations performed by the perceptual system either on the organism or on the environment.

Conversely, the schema of self, largely based on innate schemas of action, a working memory, and a long-term memory, provides the rules which make our organism perceive, move, act in general and interact with other organisms. As a consequence, it provides not only the instructions for the perceptual system but also the raw material it has to work out: in fact, the actions performed by the organism can be perceived by the perceptual system (even the very action of perceiving) and become available under the form of conscious perceptions for the schema of self. The latter in turn works on the basis of these perceptions to issue a new instruction for the perceptual system and for the organism.

The uninterrupted interaction of the two systems generates the stream of consciousness; each interaction between the two systems generates a specific and unique perception. The uniqueness of each "pulse of consciousness" is determined by the particular instructions that the schema of self gives each time to the perceptual system. These instructions in turn vary each time because of the modification of the schema of self by the conscious perceptions. The consistency and coherence of the stream is ensured by the presence of the schema of self, which tends to run the perceptual system and the organism in general according to a hierarchy of principles, goals and rules at the top of which there is one fundamental principle: the principle of survival, which can operationally be translated into the following imperative "operate in order to continue to operate".

The perceptual system acts as a monitor that continuously checks what is going on inside and outside the organism, and informs the schema of self. Without this kind of information, the schema

of self would be kept in the dark about what has happened or is happening within itself and in the environment. As we will see, what counts more is that the perceptual system provides the schema of self with the necessary information for the definition and development of a self, that is, for its differentiation from the environment.

The fact that the perceptual system monitors the organism implies that the operations and activities of the organism are consciously perceived only after they have been performed. We become aware of what we do only after we have done it. Evidence of this is given by our daily experience: sometimes, we become aware of what we wanted to say only after having said it. Neurophysiological experiments also prove it. For instance, Libet (1985) shows that a subject consciously experiences a voluntary act only several hundred ms after his/her brain has initiated it.

The fact that the schema of self is updated and fed by the perceptual system implies that conscious products play a causal role in human behavior. They not only contribute to modify the schema of self, but supply the organism with the capacity to act autonomously and voluntarily. As Cimatti (2000) points out, the only condition necessary for this to happen is that the organism has a language, and that it uses it not only to communicate its own intentions or the events happening in the environments to other organisms, as animals do, but also to communicate with itself, directing its own attention to itself and to its attentional system (and, consequently, to someone else's attentional system). In such a way, the organism is able to control its own attention and actions, and act intentionally. This is what happens when someone says to oneself that it is time to stand up, and then one stands up. This is also what happens when someone tells someone else to control him/herself, and the latter acts accordingly. By repeating these kinds of operations, the schema of self assimilates the notions of autonomy and self-regulation, thus giving the organism the ability to control and plan its own activities.

Now let us see in detail how the perceptual system and the schema of self function.

## **The perceptual system**

As Mack and Rock (1998) demonstrate, there is no conscious perception without attention. In some of their experiments, subjects' attention was engaged by a task (for instance, to report the longer arm of a cross briefly presented on the screen and centered at about 2 degrees from fixation). After some trials, an unexpected, unsearched critical stimulus (for example, a black circle) was presented at fixation, and subjects were asked whether they had seen anything that had not been on the screen on the earlier trials. Between 60% and 80% of the observers failed to detect the critical stimulus. A comparison between reports of the critical stimulus on the inattention trials (where subjects were

told to pay attention to the cross, but were not told that a critical stimulus would appear) and those on the full attention control (where subjects were told to ignore the cross, and to report only what else they saw on the screen when the cross was present), confirmed that attention is clearly implicated in conscious perception. More in general, Mack and Rock's experiments show that subjects tend to be blind to a critical stimulus that appears either at or close to fixation when they are not searching for it, when they are occupied with a task that engages their attention, and when it is located outside the boundaries of the area to which attention is directed.

These findings do not imply that there is no implicit, unconscious perception, but only that there is no explicit, conscious perception prior to the engagement of attention. Stimuli to which subjects are inattentionally blind, can be implicitly, unconsciously perceived. In order to bring them into consciousness, they must be attentionally processed. Attention represents then the key to conscious perception and experience: any model that aims at explaining how consciousness works must necessarily include attention as its most important component.

Given that there is no conscious perception without attention, the question is: how is attention involved in the formation of conscious perception? What is it that makes attention the key to conscious experience?

We can start to give an answer to this question by considering what is thought to be one of the main characteristics of attention: its selective power. By attending to a certain object, we are able to isolate it from the other objects, so that our conscious mind is completely and exclusively possessed by it. Apart from the benefits that derive from this characteristic, namely accuracy, speed and maintenance of mental processing (cf. La Berge, 1995), a full possession of our conscious mind by the object of attention implies principally the possibility for that object of orientating all the actions of our organism towards a certain direction instead of towards another one. When we feel pain, for example, we will do everything to alleviate it: our actions, thoughts and behavior will be directed to the solution of the problem, and all the different energies of our organism will be absorbed by this task. This fact exemplifies what represents the most important aspect of consciousness: its power to drive the organism according to what is taking place in it.

Attention is then responsible for the selective aspect of consciousness, that is, for its capability of isolating one specific part from the whole, and "filling the mind" (La Berge, 1995) with it. Therefore, attention provides the mind with the matter that is necessary for it to control and drive the activity of the organism. It is important to observe that the conscious mind can be filled only by one attended object per unit of time, however complex it may be. We cannot attend to more than one thing, or adopt more than one observation level (cf. Negrotti, 1999) per unit of time: we cannot see the front of something at the same time as we see its back. This derives from a very fundamental

physical law: if an object occupies a certain place, it cannot occupy another place at the same time; conversely, a place that is occupied by a certain object, cannot be occupied by another object at the same time. For this reason, when somebody occupies a certain position, and observes a scene from that position, they cannot contemporaneously observe the scene from a different position: in order to look at it from a different position, they will have to change their own position. Strictly speaking, this rule is valid for all perceptive modalities. The position our body occupies in space and time equally puts a limit on the working of all our sense-organs and on the form of their products. We cannot smell something that is miles away from us, or see what is happening overseas (unless, of course, we watch it on TV). We can see and contemporaneously touch and smell an object, coordinating the different perceptions and combining them so as to form a single complex object, but each single complex object so formed cannot have more than one aspect per unit of time.

This limitation has clear adaptive advantages for the formation and development of an organism as such. It allows the organism to delimit and define itself as an “organism” in a world of organisms, that is, as something that cannot occupy more than one place per unit of time. The fact that the organism cannot consciously perceive more than one object per unit of time, implies that the behavior, the strategies and, in general, the knowledge it will develop, will be consistent with the limitations imposed on it by a physical world. As I tried to show (Marchetti, 2000), the only kind of knowledge that such an organism can develop is a procedural one, that is one based on an orderly, sequential manner of doing things. To put things in order, placing and arranging them in relation to one another, the organism cannot deal with more than one thing per unit of time. The organism can achieve this if it is ruled by only *one* single unit controlling the operations, that is, a unit working on a single, coherent, specific principle. Should it be more than one unit, they would work on different principles, unavoidably coming into conflict and originating contradiction and disorder. Order arises when a unit of control prevails over the others, and rules and coordinates the organism according to its own principle, thus resolving any conflict. The working of this single unit is regulated by the organ of attention, which assures that the condition that only one object is processed per unit of time is fulfilled.

Until now, we have seen that attention is responsible for the selective aspect of consciousness and for “filling the mind” with the attended object. However, this “filling the mind” has a special characteristic which deserves and needs to be explained: it is what philosophers call the problem of *qualia* (cf. Chalmers, 1996), that is, the fact that when we consciously perceive something, we have a subjective experience of that something, we feel it, we have some sensations. Any experience has its own special phenomenal qualities which distinguish it from all other experiences, and which we cannot avoid feeling directly.

How does this occur? How can we explain the process of subjectively and directly feeling the phenomenal qualities of our perceptions? In my opinion, an explanation can be found if we consider attention as a form of energy, namely the nervous energy that feeds our organism, and the organ of attention as an organ that supplies this energy. Until now, most models of attention describe it as something passive. The metaphors used to describe it, whether a filter (Broadbent, 1958), a zoom lens (Eriksen and St. James, 1986), a spotlight that moves (Tsal, 1983), a gate (Reeves and Sperling, 1986), or a selective, amplifying channel (La Berge, 1995), imply all that it is seen as a privileged route for events to enter our mind or consciousness, that is, as a kind of mechanism which, letting information come in and be processed by some other device, plays a marginal, passive role. In such a way, the core problem of consciousness - how can we explain the fact that we have subjective, direct experiences of objects? - is devolved to another organ, for example an operating system (Johnson-Laird, 1983, 1988), a central processor (Umiltà, 1988) or a supervisory system (Shallice, 1988). I think that this way of treating consciousness cannot provide an answer, because there cannot be a final device towards which information flows, unless we are willing to consider this final device as a conscious agent itself, or a homunculus, thus entering a vicious circle. In my opinion, these difficulties arise when a pure information-processing conception of mind is adopted, whereas a different approach should be assumed to face the problem of *qualia*. An information-processing conception of the mind can certainly explain how information is processed, the changes it undergoes, the time needed to process it, and so on. However, it does not and cannot explain what a subject feels as it processes information, that is, how its conscious states start forming, develop, and change as a consequence of what it does. This is because information is made up of ready-made symbols representing the external world, whose meaning derives not so much from the importance they have for the subject's formation and development, but from the importance they have for the researcher's investigations. The information-processing approach, in fact, is based on the assumption that the mind processes representations that already have their own meaning, independently from the history of the subject, and does not investigate how they acquire a meaning for the subject, and how the subject builds meaning<sup>1</sup>. The information-processing level of analysis

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<sup>1</sup> A similar critique has been addressed to cognitive science by Searle (1980, 1984, 1992). The basic assumption behind cognitive science is that the brain is a computer and mental processes are computational. According to Searle, this is not the best way of studying the mind. Describing mental processes by using the metaphor of a computer program, implies in fact describing them from a pure syntactic and formal level, that is, as operations performed on a set of symbols. However, a pure syntactic description cannot account for the contents of our mental states, that is, for the meaning that symbols have for us. As Searle says, syntax is not the same as, nor is it by itself sufficient for, semantics.

Moreover, notions such as computation, algorithm, and program do not name *intrinsic* physical features of systems; they must, instead, be *assigned to* the physics by the researcher. This means not only that it is always possible for us to characterize a physical system from the outside in various and different ways, according to our own purposes, and that describing such a system as a computer is only one of many ways of describing it, but also that once we have chosen to characterize it in this way, we cannot avoid the consequences that this characterization implies: principally, the fact that if *we* assign certain properties to the system, we cannot expect that *it* will develop by itself those properties.

examines how some parts of a subject's organism - sense organs, attention, memory, central processor, and so on - transform information, but does not examine how a sentient subject transforms itself as it processes information<sup>2</sup>.

In order to analyze a sentient subject, we must take a different, new perspective, let us call it a "first-person perspective", which of course has to presuppose the subject's existence. Such a subject can be said to exist and be so when it can delimit and control itself, its operations, movements, intentions, and actions, according to its sensations and to what it feels. This implies that it is able to perform a kind of activity that gives it the possibility of *directly* knowing itself and defining its limits. The direct experiences it has of itself contribute to form and constitute it: for instance, if it tries to reach something unsuccessfully, the feeling it has gives it immediately the dimension of its effort, and the boundaries of its body. We could say that the form it assumes is the outcome of the activity that produces its experiences: the subject is the result of this activity. It is this activity that gives it the possibility of existing as a subject, because only by performing it can the subject take a form and differentiate itself from other subjects and objects. Therefore, describing what a subject feels and experiences is describing this activity and its course.

How can this activity make a subject have experiences and feelings? I think that an explanation can be found if we conceive of:

- a) the subject as the outcome of a special kind of activity (let us call it attentional activity) performed by an organism provided with a source of energy (let us call it nervous energy or attentional energy) capable of directing all the other kinds of energy of the organism;
- b) the attentional activity it performs as what makes its state of nervous energy change. This can happen indirectly, through the action of the organism on the world, and the subsequent re-action of the world on the organism, or directly, through the action of the organism on itself;
- c) the experience it has as the change of its state of energy resulting from performing the attentional activity.

This is a dynamic and active view of the subject, of course. It implies that the subject as such emerges from its continuously performing the attentional activity, that is, from its continuously using and applying its attentional energy; that every time the subject uses its attentional energy, the action performed affects its source of energy, thus resulting in a possible change of the state of the

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The conception of the mind as a computer and mental processes as computational has been criticized also by neurobiologists and neuroscientists such as Edelman (1989), Reeke and Edelman (1995) and Freeman (1999) on the grounds that it cannot account for the individual variability of the brain, and the continual modification of the patterns of neural activity and re-categorization of the world by the brain.

<sup>2</sup> For a similar view, see Freeman (1999).

nervous energy; that the form the subject takes is a result of the way it applies its attentional energy, that is, of the force with which it applies it and of the specific dimension (whether physical - visual, tactile, muscular, etc. -, psychological, social, or else) to which it applies it. In this view, a subject's feelings and experiences are the direct result of its applying and using its attentional energy. What it does changes its state of energy, thus immediately affecting itself, its following actions and behavior.

I then assign attention an active role: following Ceccato's proposal (1985, 1987)<sup>3</sup>, I consider the organ of attention as the source of the organism's nervous energy. Every time we direct our attention towards an object, we spend our energy on it. At this point, a change in the state of energy may occur, thus making us perceive or feel the object. Clear evidence of this can be found in very common situations. When having certain sensations, our activity tends to be slowed down or blocked: sensations of sorrow, pain, tiredness, depression, and so on, precisely *consist in* a reduction of our general activity, as if they have absorbed our energies completely, or put an obstacle in the way of our operating. Conversely, sensations of happiness, wellness, freshness, and so on, *consist in* a positive stimulation of our activity, as if they have facilitated our operations, or given us supplementary energy to continue moving and acting. Even less strong kinds of sensation give us evidence of the change that our state of energy undergoes because of the working of attention. When we have the intention of perceiving the surface of an object by touching it, we focus our attention on our fingertips: if a sensation of "hard" arises, we feel that a limitation is imposed on us, and cannot further expand our movements and energy. On the contrary, when we have a sensation of "soft", it is as if we had not yet reached a limit, and could further expand our energy. Likewise, some colors, forms, smells and sounds excite us, stimulating our organism to produce more energy, while others calm us, making us reduce our activity.

Following Paul Valéry's suggestion (1973)<sup>4</sup>, we can consider sensation as a variation of the state of energy of a closed system. During the variation, the equilibrium of the system is broken, and the organism has to spend some energy to reestablish the original conditions. The amount of energy necessary for the organism to reestablish the equilibrium represents the quantitative aspect of the sensation. Variation can be positive or negative, the former making the organism more active, the latter more passive. In both cases, when the organism gets either to the upper threshold of its capacity or to the lower one, it feels pain. Both an excessive activity requiring too much energy, and

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<sup>3</sup> According to Ceccato, attention plays this role because besides giving birth to mental life, thought, and mental categories such as "time", "space", and so on, it also regulates the working of our sense organs, and originates emotions and feelings.

<sup>4</sup> Valéry expresses his theory of sensation as follows (I translate from the Italian version): "Sensation does not consist so much in an introduction of something from the outside, as in an intervention, that is, an inner transformation (of energy) made possible by an external modification, a variation in a state of a closed system (...) sensation is due to some kind of disequilibrium (...) sensation is what occurs between two states of equilibrium" (Valéry, 1988, pp. 411-412)

a slowing down of activity hindering too much our energy, cause pain. An optimal condition of working makes the organism feel well.

Sensations originating from different perceptual modalities differ qualitatively from each other. A sensation of “hard” is qualitatively different from a sensation of “red”; sensations pertaining to different perceptual modalities can usually be correlated and combined, but not confused. We can account for this fact if we suppose that the organ of attention is divided in as many parts as the perceptual modalities are. Evidence that, during the perceptual processing stage, attention can be divided, up to a certain extent, between different perceptual modalities, seems to support this supposition<sup>5</sup>. Therefore, we can assume that if we pay attention to a specific perceptual modality, a specific area of the organ of attention is stimulated, and a specific sensation arises. The specificity of each area represents the qualitative aspect of sensation.

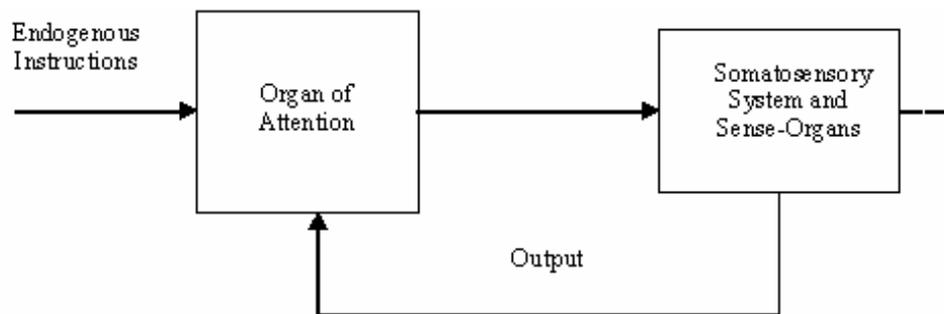
Let us consider briefly the advantages that an organism has in experiencing directly and subjectively sensations. An organism (say A) that has the capacity to feel has the capacity to build and develop its own knowledge. An organism (say B) that cannot feel does not have this capacity. Let us suppose that B is a robot that was programmed to behave in the same way as A. If it is hot, A will feel hot, and consequently will exhibit all the signs and behaviors that an organism typically shows in such a situation: sweat, thirst, tiredness, desire to find a fresh place, and so on. B will exhibit the same signs and behaviors as A, but it will not feel hot. Until the conditions for which B was programmed occur, B will behave not only indistinguishably from A, but also will seem to exhibit a sensible behavior and to act reasonably. Once the conditions have changed (for example, it may be hot not because of meteorological reasons, but because of a fire), B’s behavior may seem unpractical, paradoxical or illogical, and even cause its death (drinking water may not be sufficient to put the fire out or to avoid burning). This is because B has not changed its behavior in spite of the fact that conditions have changed. A certain kind of knowledge was installed in B, a predetermined one which is certainly useful on some occasions, but cannot be always suitable. B cannot build and develop its own knowledge by itself: it is necessary that someone else give it the new instructions to face the new situation. On the contrary, A builds its knowledge autonomously, because, for it, knowledge does not corresponds to an explicit, rigid, mediated set of data and procedures, but to an

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<sup>5</sup> In classical psychological experiments on divided attention, subjects are presented with two tasks that have to be done concurrently. Usually, each task consists in perceiving a stimulus and making a response. The processing required to perform a task can be broken into at least three stages: a perceptual processing stage, a response-selection stage, and a response-execution stage (cf. Posner and Boies, 1971, Allport et al., 1972, McLeod, 1977; for a recent review of the subject, cf. Styles, 1997). As shown by Fagot and Pashler (1992), a bottleneck occurs at a late stage of the processing rather than at the perceptual processing stage, namely when the neural machinery, after receiving the critical stimulus information from perceptual areas, has to retrieve from memory the code for the corresponding action. Therefore, it seems ascertained that attention can be divided at the perceptual processing stage. On the division of attention, see also Castiello and Umiltà (1992), who have shown that subjects can split their attention even within the same perceptual modality, namely the visual one.

implicit, flexible, direct way of reacting directly to changes and new conditions. To be acquired, this kind of knowledge need not be formalized, but only experienced. Feelings, emotions, sensations, and all the other conscious constructs are means of knowing directly, without the need for external agents to implement and install knowledge.

Further to the foregoing description of the perceptual system, I propose the block diagram of Fig. 1 as the circuit responsible for conscious perception.



*Fig 1. Conscious perception*

Fig. 1 shows a case of voluntary or endogenous attention. The organism issues instructions to itself to direct its attention toward a certain somatosensory area or sense-organ. The result of the activity of the somatosensory system or of the sense-organ (here labeled as “output”) acts directly on the relevant area of the organ of attention, making the subject have a sensation.

There can also be, of course, cases of captured or exogenous attention. Some objects, such as one’s own name (Morrays, 1959) or other meaningful stimuli (Mack and Rock, 1998), can capture a subject’s attention even though the subject does not expect them or have any intention toward them. In these cases, it seems reasonable to think that a signal coming from the somatosensory system or from the sense-organs has the power to autonomously capture attention and become conscious, independently of the subject’s intention.

The fact that some objects, such as one’s own name, can become conscious even if the subject does not pay attention to them, is interpreted by Umiltà (1994) as evidence that attention does not coincide with consciousness and that they must be considered as independent systems. In these cases, he argues, the object is perceived consciously in a direct manner, without the intervention of attention. His argument contrasts with what Mack and Rock (1998) have found. They show that

there can be no conscious perception without attention, and that by decreasing the probability that attention is paid to an object, the probability of perceiving its presence is reduced. This applies also to cases of captured attention: when the difficulty of capture is increased by reducing the attentional zone or increasing the inhibition of attention, the probability that one's own name is reliably perceived decreases, even if it continues to be seen significantly more often than other stimuli. This indicates that, contrary to Umiltà's opinion, attention is always involved in conscious perception. Even objects such as one's own name cannot be perceived without the intervention of attention: they must capture attention to become conscious. There cannot be conscious perception without attention.

In my opinion, Umiltà's mistake derives from considering consciousness from a pure information-processing level. Like many other authors, he considers mental activity as a particular way of processing information. In this view, consciousness is conceived as a central processor (for a similar view, see Johnson-Laird, 1983, 1988), and attention is a privileged route for events to enter the central processor and become conscious, even though not the only one available (Umiltà, 1988). As a consequence, attention is assigned a passive, subsidiary role in relation to consciousness. As we have seen, this way of considering consciousness cannot explain how it is possible for us to have subjective experiences of things. But it has also another major fault: it cannot account for the constructive role that subjects play in building their knowledge. This is due to the fact that its main target is to analyze how subjects process information, and not how subjects construct their knowledge. Knowledge construction is not so much a matter of processing information, time needed to process it, ways of processing it, and so on, as of why a subject has to process it. An information-processing approach neither disputes, nor addresses the question of, the necessity to process information: it simply analyzes the process, taking the presence both of information, process and subject for granted. On the contrary, a knowledge-construction approach analyzes first of all the origin of information, that is, why and how subjects assign a meaning to objects, and objects acquire a meaning for subjects. Only by addressing such questions, is it possible to understand the role played by subjects in constructing their knowledge.

Another author who conceives of consciousness as dissociated from attention is Velmans (1991). His argument, however, is different from Umiltà's. He affirms that, "in principle, it might be possible to obtain evidence of focal-attentive processing in the *absence* of awareness of what is being processed" (Velmans, p. 665). He does not claim that an object can be perceived consciously without the intervention of attention, as Umiltà does. Focal-attentive processing provides the necessary condition for conscious awareness, and there cannot be consciousness without attention: consciousness results from focal-attentive processing as a form of output. However, attention and

consciousness are not the same thing, and can be dissociated, because there can be attentional processing without consciousness.

Velmans' aim is to confute psychologists' conventional assumption that "preconscious" processing is identical to "pre-attentive" processing and "conscious" processing is identical to "focal-attentive" processing. This assumption implies that "preconscious/pre-attentive" processing is involuntary, automatic, fast, and restricted to simple, familiar stimuli, whereas "conscious/focal-attentive" processing is voluntary, subject to intentional control, slow, and flexible. Velmans' confutation is based on evidences that preconscious processing is not inflexible and limited to simple, well-learned stimuli: he supplies many examples of preconscious analysis of novel and complex phrases and sentences, implicit learning, preconscious selection and choice, unconscious control of complex, novel motor adjustments, and unconscious planning. Consequently, it would be misleading to think of the preconscious-unconscious processing of stimuli as nonattended or pre-attentive: preconsciously processed stimuli, being subject to sophisticated, elaborated analysis, *are* receiving attentional resources, although they may not enter consciousness. Moreover, there is evidence (Kahneman and Chajczyk, 1983) that "involuntary, preconscious" analysis of stimuli is not necessarily effortless, and that it draws on, and competes for, limited processing resources, which confirms the involvement of attentional resources in preconscious processing<sup>6</sup>. Therefore, rather than speaking of non-attended or pre-attentive processing (vs. focal-attentive processing), it would be better to speak of *preliminary attention* (vs. focal attention) (Velmans, 1991. p. 655).

I think that Velmans' work does not demonstrate that focal attention and consciousness are dissociated, as his intention seems to be, but only that "preliminary attention", as he call it, and consciousness are dissociated. The cases he takes into consideration give evidence only of the fact that stimuli to which subjects pay limited, preliminary attention are nevertheless preconsciously processed, and therefore that preliminary attention and consciousness are dissociated. They do not show that there can be focal-attentive processing without consciousness. Whether the evidence he cites refer to dichotic listening tasks and shadowing tasks (Treisman, 1964a, 1964b; Lackner and Garret, 1973, MacKay, 1973), visual masking experiments (Marcel, 1980, 1983), Stroop effect, implicit learning (Nissen and Bullemer, 1987, Hartman et al., 1987), or control of action, what they all show is only that stimuli can be preconsciously processed on condition that they are given at least a minimal level of attention<sup>7</sup>.

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<sup>6</sup> On this point, see also Lavie (1995) who, showing that interference from an irrelevant distractor is dependent on the load of the task, confirms that focal-attentive processing and pre-attentive processing draw on the same resources.

<sup>7</sup> As observed by some authors (Neuman, 1984, Holender, 1986 and Logan, 1995), in these cases, as well as in others such as flanker compatibility effect or negative priming effect (Tipper, 1985), subjects *do* pay a certain, even if marginal, level of attention to the to-be-ignored, unwanted stimuli, despite they are instructed not to pay attention to them, or are prevented from paying attention to them.

For example, the fact that amnesic patients and normal subjects, exposed to successive exemplars of recurring patterns of which they were unaware, can implicitly learn those patterns without spontaneously remarking any repeated sequence (Nissen and Bullemer, 1987, Hartman et al., 1987), does not imply that they have used their focal attention to learn those patterns: in fact, they have been instructed to pay attention to the single items composing each pattern, and not to the recurring pattern. Therefore, it is inappropriate to affirm that there is focal-attentive processing of a pattern in the absence of awareness of that pattern, because what subjects attentively process is not so much the pattern as the single items of the pattern. Most probably instead, they have been able to learn the patterns because they have spent a marginal amount of their attentional energy on it: so marginal an amount that they could not consciously realize what they were doing, even though it was sufficient to make them learn the patterns.

Therefore, Velmans' work is certainly convincing as long as it shows that there can be a limited level of attention (preliminary attention) without consciousness, but it does not prove that there can be focal attention without consciousness.

Most probably, what leads Velmans to claim that consciousness can be dissociated from attention in general, thus overlooking the fact that only preliminary attention, but not focal attention, can be dissociated from consciousness, is the absence of a first-person perspective. As he admits, he adopts a pure information processing perspective, identifying attention with the capacity to process information and analyze stimuli. This perspective certainly gives him the possibility of considering those aspects of mental processing that are usually associated with attention - such as reaction time, accurateness in answering, etc. -, but it does not let him see the importance of consciousness for the emergence and construction of the subject. This is because information processing models systematize what can be observed only from a third-person, external observer's perspective, whereas, as we have seen, the phenomenal aspect of attention and consciousness can be analyzed only by taking a first-person perspective. Therefore, it may be that, by assuming the information processing perspective, he has been able to see only one aspect of attention, and this has led him to think that it should be the only one.

An author who, assuming a first-person perspective, does not overlook the fact that only preliminary or low-level (but not focal) attention can be dissociated from consciousness, is Damasio (1999). In his definition, consciousness is the "umbrella term for the mental phenomena that permit the strange confection of you as observer or knower of the things observed, of you as owner of thoughts formed in your perspective, of you as potential agent on the scene" (Damasio, 1999, p. 127). Throughout his work, consciousness is seen as the main reason for the feeling we have of ourselves as subject of our own actions, that is, for the fact that we sense that what we are doing is

done by us, and not by someone else. He rightly underlines that the lack of consciousness causes the disappearance of the sense of self: in fact, as we have seen, it is conscious activity that determines the emergence of the subject.

According to him, some diseases, such as akinetic mutism, epileptic automatism and advanced stages of Alzheimer's diseases, demonstrate that there can be fleeting, low-level attention without consciousness. Evidence of the dissociation between low-level attention and consciousness is given by patients who, while exhibiting some elementary signs of attention such as the ability to form sensory images of objects and execute accurate movements relative to those images, do not develop any sense of self, of an individual organism wishing, considering, wanting, of a person with a past and a future. Moreover, they do not show any sign of emotion either. Finally, Damasio points out that only a kind of attention that is high-level, extended in time and focused on appropriate objects is indicative of consciousness (Damasio, 1999, p. 91).

Despite not specifying exactly what the difference is between low-level and high-level attention, these findings seem to support anyway, contrary to Velmans' opinion, the hypothesis that focal or high-level attention cannot be dissociated from consciousness. Only low-level attention or, as Velmans calls it, preliminary attention, can be dissociated from consciousness.

Summarizing the content of this section, we can say that attention is not only responsible for the selective aspect of consciousness, but also for its phenomenal quality. To explain the latter aspect, it is necessary to see the organ of attention as the source of the organism's nervous energy (a kind of energy that directs all the other kinds of energy of the organism), and attention as the nervous energy that gives the organism the possibility of performing actions capable of directly affecting the organism's state of nervous energy. The attentional activity performed by the organism involves a variation in the state of the nervous energy. It is precisely this variation that constitutes the phenomenal aspect of consciousness. When acting, the organism can experience and feel directly its actions and the results of its actions, thus making possible the delimitation and emergence of the subject. Finally, it has to be observed that when occurring under a certain level or threshold, attention does not give rise to consciousness, even if it can occasion unconscious processing.

## **The schema of Self**

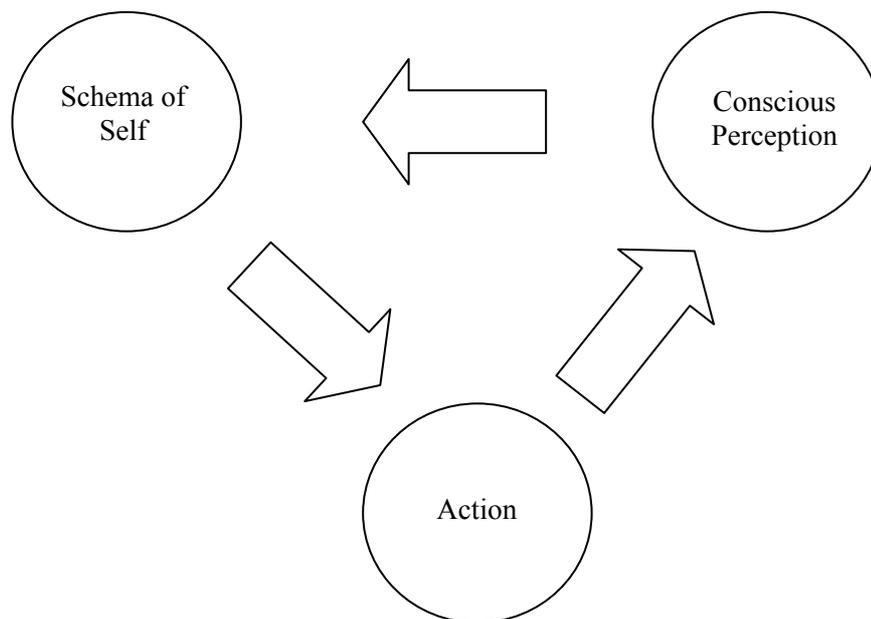
The perceptual system provides the necessary raw material for the subject to emerge and form. But this is not sufficient. There must also be a device that guides and controls the formation of the subject. This device is represented by what I call the schema of self. The schema of self runs the perceptual system and the organism in general according to a hierarchy of principles, goals and

rules at the top of which there is one fundamental principle: the principle of survival. Operationally, the principle of survival can be expressed as follows: “operate in order to continue to operate”. This is the algorithm of life, the vital instinct, which regulates all the other instincts of the organism and its actions.

The schema of self not only incorporates and coordinates all the innate or learned schemata that are necessary to keep the organism alive, but also provides all the rules necessary to guarantee the existence, formation and preservation of the subject. To this end, one of the main activities it ensures is defining the subject’s boundaries, and consequently the differentiation of the subject from other organisms, subjects, and from its environment. The organism defines its boundaries by continuously monitoring its activity and consciously perceiving its own movements, operations, gestures, and so on. The conscious perception of its activity informs it immediately about the dimension, limits and possibilities of its body, and adjusts the rules and components of the schema of self.

The definition of the subject’s boundaries is made possible by the sensations and feelings the organism has. Until its action can flow undisturbed and is not hindered by anything, the organism feels free, well, pleasure, positively stimulated, etc. Whenever something hinders or blocks its activity, it has to make efforts to overcome the difficulty. These efforts cost it energy, time, pain, frustration, and so on. It is precisely the threshold of effort and pain that marks the limits of the subject, and differentiates it from its environment. The boundaries of its body are determined by the feelings of pain or frustration it has when acting. The subject coincides with its action: it is its action.

Any conscious perception of the organism helps to form and mould the subject. The subject is the outcome of the uninterrupted conscious perceptions of the organism. The process that leads to the production of the subject can be divided into three main components, and can be represented as in Fig. 2.



*Fig. 2. The process that leads to the production of the subject*

The schema of self, and all the other schemata it incorporates and coordinates, embodies all the kinds of competence and abilities - linguistic, social, physical, and so on - the organism innately possesses or has acquired during its life up to that time. It regulates the activities of the organism according to the hierarchy of principles and goals it incorporates, and the rules specific to each kind of competence. Every action the organism performs is caused by the goals of the schema of self - at the top of which there is the principle of survival -, and generated and structured by the rules expressed by each kind of competence.

Every action of the organism - whether it be a single movement, a coordinated sequence of movements, the production of a sound or a word, an inner silent speech, or else - as well as the consequences of the action, can be perceived by the organism. They become the raw material the perceptual system works out. Since every action unavoidably entails sensations concerning the body and the environment, and the body related to the environment, the organism is able, through them, to understand and define its limits and the limits of the objects of the environment.

Once the organism has consciously perceived its action or the consequence of its action, the information concerning its body, the objects of the environment or the relation between its body and

the objects, becomes available for the schema of self, and can be adequately used to update it and adjust the rules of the relevant competence<sup>8</sup>.

It has been observed by Baars (1988) that the language of consciousness is preeminently based on a perceptive, imaginal, spatio-temporal *lingua franca*, and that this is probably due to the fact that the consciousness system is overlaid on an earlier function that is primarily sensory. This implies that whenever we think about, or form a conscious idea of, something, we can do this only through images, sounds, colors, sensations. We always think by means of perceptible objects and things. What cannot be represented, symbolized or described by a perceptible object, cannot be thought about or thought of. Even the most abstract ideas, concepts and categories, such as the conjunctions “and”, “but”, or the prepositions “of”, “to”, that have, so to say, a pure mental content<sup>9</sup>, can be thought about only by means of their sound or visual image. Without that physical, perceptual support, we would not be able to pay attention to them, and their mental content could not become conscious. Moreover, the conscious form their mental content assumes is still a perceptive one. When we think about the word “of”, it is a particular instance of its use that occurs to our mind, such as the sentence “bottle of wine”, or its visual image. We are not able to think about its abstract meaning without imaging the context in which it is used.

Once a thing or object is perceived, it becomes available for the schema of self, which processes it. What takes place inside the schema of self is unconscious. When we hear a certain word, or see a certain scene, it is unknown to us how these facts affect our subsequent behavior, thoughts and attitudes, in the sense that we are not aware of what is happening inside us. It simply happens. After having heard a sentence, some thoughts or images appear unexpectedly, but we do not know where they have come from and why only they have appeared, instead of something else. We can suppose that this job is done by some mechanism, such as the collections of specialized unconscious processors described by Baars (1988), and that the job is done following a certain sequence of steps, such as that described by Piaget (1967), but we are conscious neither of the mechanism, nor of its job.

The fact that the schema of self is updated and fed by the perceptual system implies that what the organism consciously perceives plays a causal role in its behavior. *This is the most important feature of consciousness: it gives the organism the possibility of setting its own aims and objectives, and modifying autonomously its own schema of self.* The schema of self, once it has learnt and

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<sup>8</sup> This process is variously and differently termed and described by some other authors. See, for instance, Damasio’s description of the forming in the brain of *first-* and *second-order maps* representing both the organism, the object perceived, and the relationship of object and organism (Damasio, 1999); or see Edelman’s description of the *reentrant mechanisms* allowing categorization and learning (Edelman, 1989).

<sup>9</sup> On this point, cf. Ceccato and Zonta (1980) and Vaccarino (1974, 1981). On some tentative analyses of pure mental categories, cf. also Marchetti (1993) and Weinrich (1988).

embodied the notion that the organism, by means of conscious perceiving, is able to affect the course of its own actions, provides the organism with a new degree of freedom that gives it the possibility of directly controlling itself. Without this further degree of freedom, the updating of the schema of self would take place only in consequence of the actions that the organism performs because of its innate instincts. Thanks to this new degree of freedom, the schema of self is updated by the actions that the organism voluntarily and autonomously takes. This means that the schema of self, whose main goal is to keep the organism operating, succeeds in equipping the organism with the capacity to self-regulate itself, and consequently find by itself the best ways and means to assure its survival and create new strategies and aims. This constitutes the fundamental passage from consciousness to self-consciousness. The organism's attitude can then change from a pure reactive one to a proactive one.

From that moment on, the schema of self runs the organism in such a way that its actions are primarily and directly governed not so much by its innate instincts as by what happens in its consciousness, even though the latter can be occasioned by the former. Every action the organism performs is a direct consequence of its previous conscious experience. The existence of an uninterrupted and consistent sequence of single units of conscious perception, the Jamesian stream of consciousness, is secured precisely by the fact that the previous units play a direct, causal role in the production of the following ones.

One of the easiest ways an organism has to control itself and autonomously modify its own schema of self, or at least the easiest way from a human being's point of view, is by using language. Language can be considered as the most effective and economic way of exploiting the opportunities offered by self-consciousness. Some authors think that self-consciousness could not even be attained without language. According to Cimatti (2000), for instance, what differentiates animals from human beings is precisely the fact that the latter use language not only to communicate their own intentions or the events happening in the environments to other organism, as the former do, but also to communicate with themselves, directing their own attention to themselves and to their attentional system. By speaking to itself, the organism can "listen" directly to itself, in the sense of listening to its body, mind, intentions, aims, and eventually to its schema of self, without having to wait for the usual physical manifestations - such as coordinated movements of arms, legs, body, and so on - that the schema of self can occasion. Therefore, within certain limits, the organism need not perform actual physical actions in order to perceive itself, its body, the environment, the relations between itself and the environments. The inner speech functions as an artificial behavior that gives the organism the possibility of consciously perceiving itself. In turn, these perceptions continuously modify the schema of self.

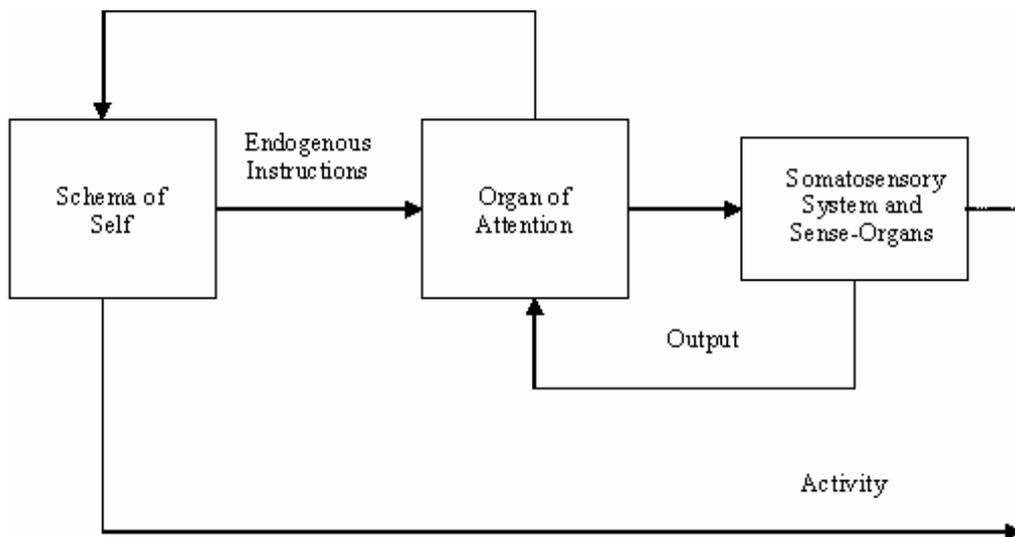
Language is not the only way the organism has to exploit the possibilities offered by self-consciousness. Other perceptive modalities can be used as well. Images, sounds, and smells all represent alternative means the organism has to artificially represent itself. However, due to its form and structure, language is no doubt the most common and exploited one. As Vygotskij (1973) pointed out following N. Ach, the original function of words is to direct attention toward something. They serve to isolate certain aspects of objects, and attract attention towards them: as Logan (1995) puts it, semantics specify the computational goals that the attention system must satisfy. Through language, adults guide and influence children's attention, thus getting them learning how to autonomously master their own attention. But if, as we have seen, attention is the mechanism responsible for consciousness, then learning how to master one's own attention is tantamount to learning how to master one's own consciousness.

Languages have many expressions that serve to address the subject's attention not only towards something in general, such as "Look at it", "Watch me carefully", "Try to do so and so", but also towards the very mechanism of the subject's attention or consciousness, such as "Pay attention to what you are saying", "Are you aware of what you have done?", "Try to remember what you have done". By means of these expressions, the subject can control itself and its attention, and consequently modify its own schema of self. The subject can then assume new attitudes and view things under a different light. In turn, the modification of the schema of self entails a new course of actions, thoughts and speeches, which being consciously perceived can further modify the schema of self, and so on. The uninterrupted interplay between the schema of self and what is consciously perceived constitutes the stream of consciousness: the subject's schema of self is continuously modified according to what the subject consciously perceives, and, conversely, it consciously perceives what its schema of self occasions.

The block diagram of Fig. 3 represents the circuit responsible for the stream of consciousness. The schema of self makes the organism act according to the fundamental principle of survival "operate in order to continue to operate". The organism can consciously perceive the activity so occasioned, whether it is a movement, a speech, or other, through its organ of attention, sense-organs and somatosensory system. The result of the conscious perception updates the schema of self, which in turn issues new instructions to act and perceive.

It is important to underline the fact that, once the organism has attained self-consciousness, its behavior will be primarily determined by the events taking place in its consciousness. From that moment on, the fulcrum of almost all the organism's decisions, strategies and choices moves from its schema of self to its conscious side. It is its conscious activity that will direct its following actions. Consciousness alone, without self-consciousness, would certainly provide the organism

with certain capabilities, such as those animals possess, for instance, detecting and signaling dangers, satisfying innate needs, and so on. However, it would not give the organism the possibility of facing new, unexpected situations, still less preventing them, imaging alternative scenarios or designing new solutions. The information provided by consciousness could be used only by genetically programmed automatisms, and not be utilized to develop new strategies, and implement new automatisms.



*Fig. 3. The circuit that generates the stream of consciousness*

Thanks to self-consciousness, the organism is able to exert voluntary attention, analyze its own responses and acts, find alternative ways of solving problems, in a word, autonomously and voluntarily learn. Automatic, “reflexive” attention can involve learning only as long as innate programs afford it, and animals certainly give evidence of this fact. However, an organism provided only with consciousness cannot learn to learn. Only self-consciousness gives this possibility to the organism. Self-consciousness implies for the organism being conscious of its own operative limits, understanding its own boundaries, becoming an autonomous and responsible subject, reflecting on its own past, deciding how and what to learn, and determining its own future.

If consciousness gives the organism the possibility of producing certain results and attaining certain goals that are usually genetically determined, self-consciousness gives it the possibility of autonomously determining what goals to attain and what results to produce. This is the fundamental

difference between consciousness and self-consciousness: while the former lets the organism produce some results, the latter lets it control the operations necessary to produce results.

The difference between consciousness and self-consciousness could be highlighted also in terms of means and ends. As we have seen, studying consciousness means taking a new perspective that considers how a subject emerges from an organism's continuous use and application of its nervous energy. This perspective implies seeing the subject as an active agent personally and directly involved in constructing not only itself but also its own knowledge. It becomes a subject because it acts, and, by acting, it differentiates itself from the environment and the other beings, thus getting to know them. An object becomes an object and acquires a meaning for the subject only as long as the subject can relate in some way the object to itself. Therefore, every object can be defined in terms of the subject's activity, where "subject's activity" means the activity a subject has to perform in order to emerge as such. An object exists and has a meaning because a subject exists that gives it a meaning, and a subject exists because by acting it has been able to differentiate itself from that object. It is precisely through this activity of differentiation that objects come into existence and acquire a meaning for the subject: they become objects and acquire a meaning because by them a subject can take shape. Defining an object in this way is viewing it instrumentally, as something that takes part in the construction and definition of the subject. In this view, an object is a means a subject has to come into existence. Every object serves the purpose of forming the subject, or is somehow associated with this process.

Consciousness, making the subject experience directly what it is doing and the results of its activity, is the privileged way a subject has of constructing itself, its knowledge, objects, and the relation between itself and objects. It is through consciousness that a subject understands how an object relates to itself, learns how to use it, and gets to know it. Consciousness gives the subject an immediate understanding of the object and of its meaning. The meaning of the object emerges when the subject becomes conscious of it. At that moment, the subject understands what relation exists between itself and the object, and gives a meaning to the object. At the same time, understanding this implies for the subject taking a particular shape, namely the shape that the relation makes possible. Therefore, consciousness is the fundamental device by which objects, becoming the means that makes the subject take shape, acquire a meaning.

If consciousness gives the subject the possibility of assigning a meaning to objects, self-consciousness gives it the possibility of assigning a meaning to itself. Self-consciousness makes it possible for a subject to see itself as an object, and consequently to become a means to an end. By seeing itself as an object, a subject can set an end for itself, and consider itself as an instrument for

achieving it. The subject acquires then a meaning: the meaning determined by the end it has set for itself.

## **Conclusion**

In this article I have tried to give an answer to some of the fundamental questions concerning consciousness. How is it possible to conciliate and explain the apparent contradiction present in the metaphor of the stream of consciousness as something flowing uninterruptedly, but which is, nevertheless, composed of single pulses of consciousness? How is attention involved in the formation of conscious perception? How can we explain the phenomenal quality of our conscious perceptions?

To answer these questions, I resorted to two basic concepts: the perceptual system and the schema of self. The perceptual system makes it possible for an organism to be conscious, whereas the schema of self provides the rules that make an organism perceive, move, act, behave, and live in general. We have seen that the stream of consciousness arises from the uninterrupted interaction of the schema of self and the perceptual system. Every conscious perception affects the schema of self, modifying and updating it. Every modification of the schema of self implies a new particular instruction to the perceptual system, and in general to the organism. The uniqueness of each single pulse of consciousness is determined by the particular instruction that each time the schema of self gives to the perceptual system.

Attention, which can be considered as the core part of the perceptual system, is not only responsible for the selective aspect of consciousness, but also for its phenomenal quality. The organ of attention can be seen as the source of the organism's nervous energy, and attention as the nervous energy that gives the organism the possibility of performing actions capable of directly affecting the organism's state of energy. The attentional activity performed by the organism involves a variation in the state of the nervous energy. It is this variation that constitutes the phenomenal aspect of consciousness. When acting, the organism can experience and feel directly its actions and the results of its actions, thus making possible the delimitation and emergence of the subject.

Finally, we have seen that the schema of self, once it has learnt and embodied the notion that the organism, by means of conscious perceiving, is able to affect the course of its own actions, provides the organism with a new degree of freedom that gives it the possibility of directly controlling itself. The schema of self, whose main goal is to keep the organism operating, thus succeeds in equipping the organism with the capacity to self-regulate itself, and consequently find by itself the best ways

and means to assure its survival and create new strategies and aims. This constitutes the fundamental passage from consciousness to self-consciousness.

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