

Corso di Psicosomatica

Scheda n. 9

**Il modello di Antonio R. Damasio**

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Con i suoi libri *Descartes' Error: Emotion, Reason and the Human Brain* (New York, Putnam, 1994 - traduzione italiana: **L'errore di Cartesio. Emozione, ragione e cervello umano**, Milano, Adelphi Edizioni, 1995) e *The Feeling of What Happens: Body and Emotion in the Making of Consciousness* (New York, Harcourt Brace, 1999 - traduzione italiana: **Emozione e coscienza**, Milano, Adelphi Edizioni 2000), **Antonio R. Damasio** (la cui homepage, molto deludente, è all'indirizzo <http://www.uiowa.edu/~interdis/damasio.htm>), ci ha offerto un modello omnicomprensivo circa il ruolo dell'emozione nella costruzione della coscienza e la traccia di una possibile integrazione multidisciplinare nello studio delle radici e delle articolazioni del comportamento umano ...

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Piero Scaruffi, nella bibliografia annotata che ho ricordato in precedenza, offre del primo volume la seguente recensione:

*Damasio is trying to build a neurobiology of rationality. In this book he provides a neurophysiological analysis of memory, emotions and consciousness.*

*The book has three themes:*

1. *Human reason depends on the interaction among several brain systems rather than on a single brain centre.*
2. *Feelings are views of the body's internal organs. Feelings are percepts and they are as cognitive as any other percept.*
3. *The mind is about the body: the neural processes that are experienced as the mind are about the representation of the body in the brain. The mental requires the existence of a body for more than mere support: the mind is not a phenomenon of the brain alone. The mind derives from the entire organism as a whole. The mind reflects two types of interaction: between the body and the brain, and between them and the environment.*

*The neural basis for the self resides with the continuous reactivation of*

1. *The individual's past experience (which provides the individual's sense of identity) and*
2. *A representation of the individual's body (which provides the individual's sense of a whole).*

*The self is continuously reconstructed. This is a purely non-verbal process: language is not a prerequisite for consciousness. Nonetheless, language is the source of the "I", a second order narrative capacity. Damasio's "embodied mind" is closely related to Edelman's "self imbued with value".*

*Damasio's theory of convergence zones (not presented in this book) is tackling the issue of consciousness. When an image enters the brain via the visual cortex, it is channelled through "convergence zones" in the brain until it is identified. Each convergence zone handles a category of objects (faces, animals, trees, etc): a convergence zone does not store permanent memories of words and concepts but helps reconstructing them. Once the image has been identified, an acoustical pattern corresponding to the image is constructed by another area of the brain. Finally an articulatory pattern is constructed so that the word that the image represents can be spoken. There are about twenty known categories that the brain uses to organize knowledge: fruits/vegetables, plants, animals, body parts, colors, numbers, letters, nouns, verbs, proper names, faces, facial expressions, emotions, sounds.*

*"Convergence zones" are indexes that draw information from other areas of the brain. The memory of something is stored in bits at the back of the brain (near the gateways of the senses): features are recognized and combined and an index of these features is formed and stored. When the brain needs to bring back the memory of something, it will follow the instructions in that index, recover all the features and link them to other associated categories. As information is processed, moving from station to station through the brain, each station creates new connections reaching back to the earlier levels of processing. These connections always allows the brain to work in reverse. Convergence zones may be common to all individuals or different from individual to individual, based on experience.*

*Emotions are the brain's interpretation of reactions to changes in the world. Emotional memories involving fear can never be erased The prefrontal cortex, amygdala and right cerebral cortex form a system for reasoning that*

gives rise to emotions and feelings. The prefrontal cortex and the amygdala process a visual stimulus by comparing it with previous experience and generate a response that is transmitted both to the body and to the back of the brain.

Convergence zones are organized in a hierarchy: lower convergence zones pass information to higher convergence zones. Lower zones select relevant details from sensorial information and send summaries to higher zones, which successively refine and integrate the information. In order to be conscious of something a higher convergence zone must retrieve from the lower convergence zones all the sensory fragments that are related to that something. Therefore, consciousness occurs when the higher convergence zones fire signals back to lower convergence zones.

In this book Damasio formulated the "somatic-marker hypothesis", but it was barely sketched. It will be refined as follows in following writings.

Briefly stated, the only thing that matters is what goes on in the brain. The brain maintains a representation of what is going on in the body. A change in the environment may result in a change in the body. This is immediately reflected in the brain's representation of the body state. The brain also creates associations between body states and emotions. Finally, the brain makes decisions by using these associations, whether in conjunction or not with reasoning.

The brain evolved over millions of years for a purpose: it was advantageous to have an organ that could monitor, integrate and regulate all the other organs of the organism. The brain's original purpose was, therefore, to manage the wealth of signals that represent the state of the body ("soma"), signals that come mainly from the inner organs and from muscles and skin. That function is still there, although the brain has evolved many other functions (in particular, for reasoning). Damasio has identified a region of the brain (in the right, "non-dominant" hemisphere) that could be the place where the representation of the body state is maintained. At least, Damasio's experiments show that, when the region is severely damaged (usually after a stroke), the person loses awareness of the left side of the body.

The brain links the body changes with the emotion that accompanies it. For example, the image of a tiger with the emotion of fear. By using both inputs, the brain constructs new representations that encode perceptual information and the body state that occurred soon afterwards. Eventually, the image of a tiger and the emotion of fear, as they keep occurring together, get linked in one brain event. The brain stores the association between the body state and the emotional reaction. That association is a "somatic marker".

Somatic markers are the repertory of emotional learning that we have acquired throughout our lives and that we use for our daily decisions. The somatic marker records emotional reactions to situations. Former emotional reactions to similar past situations is just what the brain uses to reduce the number of possible choices and rapidly select one course of action. There is an internal preference system in the brain that is inherently biased to seek pleasure and avoid pain. When a similar situation occurs again, an "automatic reaction" is triggered by the associated emotion: if the emotion is positive, like pleasure, then the reaction is to favor the situation; if the emotion is negative, like pain or fear, then the reaction is to avoid the situation. The somatic marker works as an alarm bell, either steering us away from choices that experience warns us against or steering us towards choices that experience makes us long for. When the decision is made, we do not necessarily recall the specific experiences that contributed to form the positive or negative feeling.

In philosophical terms, a somatic marker plays the role of both belief and desire. In biological terms, somatic markers help rank "qualitatively" a perception.

In other words, the brain is subject to a sort of "emotional conditioning". Once the brain has "learned" what the emotion associated to a situation, the emotion will influence any decision related to that situation. The brain areas that monitor body changes begin to respond automatically whenever a similar situation arises.

It is a popular belief that emotion must be constrained because it is irrational: too much emotion leads to "irrational" behavior. Instead, Damasio shows that a number of brain-damage cases in which a reduction in emotionality was the cause for "irrational" behaviour.

Somatic markers help make "rational" decisions, and help making them quickly. Emotion, far from being a biological oddity, is actually an integral part of cognition. Reasoning and emotions are not separate: in fact, they cooperate.

Damasio believes that the brain structures responsible for emotion and the ones responsible for reason partially overlap, and this fact lends physical, neural evidence to his hypothesis that emotion and reason cooperate.

Those brain structures also communicate directly with the rest of the body, and this suggests the importance of their operations for the organism's survival.

A proposito della *somatic-marker hypothesis*, Damasio stesso così la illustra in una conferenza tenuta a Londra al Centre for Philosophy of Natural and Social Sciences il 24 gennaio 2000 dal titolo **Emotion, Consciousness and Decision Making** (il testo della conferenza era disponibile a <http://www.lse.ac.uk/events/damasio.pdf> a partire dalla [pagina di presentazione](#) della conferenza stessa, ma risulta attualmente irraggiungibile; di questa conferenza è comunque disponibile sul sito del corso una [scheda di presentazione](#), a cura delle studentesse **Barbara Fracchia** e **Elisa Castagno**:

*Let me make one other point. This one has to do with consequences for emotion in one particular area and that is decision-making and to make a very long story short and maybe some of you even know this story from articles of ours or from Descartes' Error, my previous book, and the story goes like this. If you have damage in the frontal lobe in both medial and ventral regions as you see depicted here, you are likely to remain after you incur that damage, say, in your adulthood, you are likely to remain as intelligent as you were before in terms of your IQ measurement. You are going to have normal language, you are going to have normal memory, you can acquire information, you can retrieve information. All of that is going to be fine after these lesions set in. This is a group of lesions plotted onto to same brain space. But there are two things that happen to you that are not so*

good. One is that your ability to make decisions that are advantageous to yourself personally and that accord so social convention and that are advantageous to those that depend on you is forever lost, forever lost at a good level. In other words, people in spite of their intelligence, their knowledge, their ability to manipulate logic and language and so on are no longer able to make good decisions in terms of their work, in terms of their finances, in terms of their relationships with others, so there is a profound change in personality that leads forever to a dependence on others. People like that do not lead an independent life from the moment of those lesions, in spite of this outward normalcy of their neural-psychological faculties. Now, there is one aspect that is also impaired and that is their ability to have normal emotions and feelings, especially those emotions and feelings that are more related to social aspects, for instance emotions such as guilt or embarrassment or shame and they no longer have those emotions, they no longer perceive those feelings and they look remarkably aloof in relation to situations that would make others around cringe. They no longer have empathy in relation to others and, to make a long story short, we proposed several years ago that this big puzzle, this by the way is something that has been known to exist as a disturbance for many, many years and the explanations have ranged from problems with language to problems of attention, working memory, you name it, and of course, none of those explanations fit and you can demonstrate that they would not work properly to explain the defect. So, we proposed something else and that would be that once you lose, and it is part of the story that I was telling you in relation to the amygdala, when you lose structures such as this you lose the function of a system that includes many other components and that is in fact giving you on the moment of making a decision, on the moment of confronting a situation, is giving you information about the past history of your own dealings with similar decisions. So, once you corner the category of problem that you are facing with, what I suspect is that there is a call up of information that is in fact of an emotional nature that will give you an additional signal that will help you to cope with the decision-making process.

Now, I want to make it very clear, and I think I have a slide that will help me do that. I want to make very clear that I am not saying that decisions are being made by your retrieval of past emotions in similar situations, although that does happen sometimes when you are in situations in which you profess to have a gut feeling that told you to stop doing something or engage in another thing, you are in fact calling up very overtly, very consciously some emotional signal that obviously pertains to some similar situation in the past and that is telling you on the side of your own fact analysis, is telling you that this has been good or this has been bad. I don't have any doubt that this happens to us in numerous circumstances, everybody has felt that. But I think that most of the time we don't go around making decisions on the basis of gut feelings, or at least I hope we don't, and we do, however, have ways of managing our decision-making space under the influence of some of these emotional signals that I fully expect to be largely covert. So, what I think is that once in a situation you face the facts of the situation that you call up in imagistic form and the options for decision and the representation of future outcomes. You have not only a manipulation of this in very factual terms, in other words, knowledge based deciding processes using formal reasoning strategies, but you also have this other thing that is calling up from your history of such decisions, of such confrontations with events, signals, some of which may be conscious, and some of which may be perfectly covert and appear in the form of a bias that will make you, for instance, pay particular attention to a certain future outcome, or a certain pair of decision versus future outcome that may without telling you if you do [that, you are] going to have a terrible outcome, it may be in fact enhancing your representation of that bad outcome having in effect the result that you will stay away from the option at least at the outcome.

So, what I am proposing is that together with your fact analysis, you have something that has been part of our history of dealing with things always in terms of an effect, in terms of a positive or negative classification that is going to help manage that decision-making space. My expectation is that actually when the decisions we face are filled with uncertainty in terms of the outcome and perhaps the more uncertainty there is the more systems like this maybe helpful in order to manage what otherwise would be a literally impossible problem to manage, at least in a decent timeframe. In other words, if you're asked about whether or not you want to go to dinner tomorrow with a certain person, if you really are going to do all the costs, benefit analysis of going or not going and you are really going to do that in great detail, in the same way that Darwin suggested we should choose a spouse, it may take you several days, you know you may never go to dinner. You may, however, home in on the solution somewhat more rapidly if you have recourse to some signal that in the past has dealt with such situations and has told you that going out to dinner with a person of that type may actually turn out to be terrific.

In altre parole, la ragione non è così pura come molti di noi pensano o vorrebbero fosse e le emozioni e i sentimenti non sono affatto intrusi e alieni nel mondo della ragione, ma, nel bene e nel male, fanno parte delle maglie della sua rete (*enmeshed in its networks*): ne consegue che il vero errore di *Descartes* sarebbe appunto stato quello di non intendere che la natura sembra aver costruito l'apparato della razionalità non solo al di sopra di quello della regolazione biologica, ma essenzialmente a partire da esso ed al suo stesso interno. Il processo razionale, esemplificato e prototipizzato dal prendere una decisione, è quindi condizionato dalle risposte somatiche emotive osservabili che il soggetto usa come indicatori della bontà o meno di una propria determinata prospettiva: sentimenti somatici normalmente accompagnano la nostra rappresentazione del possibile esito delle varie opzioni di una decisione da prendere, ossia i sentimenti segnano (*mark*) le varie opzioni; in tal modo i marcatori somatici ci servono come strumento automatico, che rende più rapido il compito di selezionare opzioni vantaggiose dal punto di vista biologico, facendo sì che le opzioni che sono rimaste non-marcate siano trascurate nel corso del processo decisionale.

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Per quanto riguarda il secondo volume - **The Feeling of What Happens** - che amplia e riprende le tesi del primo e le sistematizza in vista in particolare della creazione di una teoria della coscienza, può comunque essere utile integrarne la lettura con qualche ulteriore commento che ne metta in luce possibili pregi e difetti. Antonio Scaruffi, nella bibliografia più volte utilizzata in queste schede, ne scrive:

The Portuguese neurologist Damasio thinks that consciousness is an internal narrative. The "I" is not telling the story: the "I" is created by stories told in the mind ("You are the music while the music lasts").

Damasio breaks the problem of consciousness into two parts: the "movie in the brain" kind of experience (how a number of sensory inputs are transformed into the continuous flow of sensations of the mind) and the self (how the sense of "owning" that movie comes to be).

The former is a purely non-verbal process: language is not a prerequisite for consciousness. Nonetheless, language is the source of the "I", a second order narrative capacity.

Neurological research has proven that distinct parts of the brain work in concert to represent reality. Brain cells represent events occurring somewhere else in the body Brain cells are "intentional", if you will. They are not only "maps" of the body: besides the topography, they also represent what is taking place in that topography.

Indirectly, the brain also represents whatever the organism is interacting with, since that interaction is affecting one or more organs (e.g., retina, tips of the fingers, ears), whose events are represented in brain cells.

The brain stem and hypothalamus are the organs that regulate "life", that control the balance of chemical activity required for living. Consequently, they also represent the continuity of the same organism. Damasio believes that the self originates from these biological processes: the brain has a representation of the body and has a representation of the objects the body is interacting with, and therefore can discriminate self and non-self and then generate a "second order narrative" in which the self is interacting with the non-self (the external world). This second-order representation occurs mainly in the thalamus.

From an evolutionary perspective, we can presume that the sense of the self is useful to induce purposeful action based from the "movie in the mind". The self provides a survival advantage because the "movie in the mind" acquires a first-person character, i.e. it acquires a meaning for that first person, i.e. it highlights what is good and bad for that first person, a first person which happens to be the body of the organism, disguised as a self.

This second-order narrative derives from the first-order narrative constructed from the sensory mappings. In other words, all of this is happening while the "movie" is playing. The sense of the self is created while the movie is playing by the movie itself. The thinker is created by the thought. The spectator of the movie is part of the movie.

Aldo Mosca (uno psicologo e filosofo di origine italiana, che insegna alla *The New School di New York*), nella sua **A review essay on Antonio Damasio, *The Feeling of What Happens. Body and Emotion in the Making of Consciousness*** (originariamente disponibile all'indirizzo <http://homepage.newschool.edu/~moscaa/DAMASIO.htm> che risulta però attualmente inattivo) , assume una posizione decisamente critica circa le risultanze della teoria esposta nel libro, che sembra ritenere a tratti metodologicamente ed epistemologicamente confuse (specialmente per quanto riguarda il rigore e la precisione del linguaggio, che anche altri critici ritengono piacevole ed evocativo – in particolare per quanto riguarda le splendide descrizioni cliniche - ma a tratti non adeguato alle necessità della trattazione scientifica di un'ipotesi neuroscientifica) e insoddisfacenti, in particolare, dal punto di vista neuropsicologico.

*There are several problems with this account, but perhaps the greatest difficulty lies in its incapacity to situate an emotional episode in the general economy of the mind/brain. What remains unexplained is how a subject in a state of autonomic arousal, visceral contractions, and an increased heart-rate goes about devising a solution to his problem without relying on information about the nature of the relevant object, its spatial coordinates, its likely behavior, and so on. For this reason, it has been convincingly argued that the information about the object is processed as relevant to the subject's well-being. When it comes to the secondary or social emotions – Damasio speaks for example of hearing the news that a friend is dead – the situation is even worse, for one wonders how it is possible to feel grief, pride, or shame at all without having in the mind/brain the evaluative representations not only of objects, but of the complex situations these emotions are about.*

*On second thoughts, however, philosophers and psychologists fond of the "aboutness" of the emotions should be reminded that no one seems to know how a neural representational pattern might be built into an emotional state, or viceversa (see e.g. LeDoux, 1996). If Damasio and other neuroscientists are right, it may well be that in the brain the relation between representations and emotional states is not "conceptually internal", but rather externally associative. Some philosophers of mind and cognitive psychologists (though not memory theorists) almost always shun the old-fashioned relation of association, but perhaps neuroscience can teach us that all there exists in nature is associative connections through neural pathways. This is food for thought for those of us who believe that the mind ought to be thoroughly naturalized.*

*My second observation is concerned with Damasio's concept of feeling. This is described as a "sensing" of the consequences of activation in some brain regions, but only "provided the resulting collection of neural patterns becomes images 'in mind'" (p.79). This is a sudden and surprising switch to the realm of the mental (there has been some warning, to be sure; on p.42 we are told that "feeling is the private, mental experience of an emotion.") The switch is not so problematic as it stands: feeling might be physical and psychological at the same time, or perhaps it is just one and the same thing. What is problematic is the "private," because privacy presupposes an owner, a subject, or more accurately a higher-order state of the mind-brain which has exclusive "access" to, or can be uniquely affected by, a lower-order state. If feelings are private, then there must be a higher-order level of consciousness which can monitor them – this is precisely what Damasio will argue. But surely there are unconscious feelings which are not monitored by a second-order consciousness, hence contrary to Damasio not all feelings are necessarily accessible even by the person whose feeling they are.*

*Damasio believes that consciousness comes by degrees, and one of the distinctive features of his account is the proposal to withhold the title of "conscious" altogether from a number of states which are nevertheless "mental" and are often ascribed to consciousness of the first order. ... The coupling of emotion and consciousness,*

however, remains puzzling. It defies the elementary intuition that a subject may, say, react emotionally to a movie, or even scream with rage, without being aware that she is doing so. Damasio seems to have doubts, too. He acknowledges that emotions can be triggered unconsciously by unattended thoughts or unperceivable aspects of body states -- on p.42 he explicitly claims that "the basic mechanisms underlying emotion do not require consciousness, even if they eventually use it" -- but then insists on the requirement of core consciousness. (In *Descartes' Error*, too, he admitted that skin conductance changes characteristic of emotion may fail to be perceived, and also that the "body loop" may perhaps be replaced by an "as if" body loop, completely within the brain; p.156, 209). The reason for the insistence on core consciousness would be that "both emotions and core consciousness require, in part, the same neural substrates, and that strategically placed dysfunction compromises both kinds of processing" (p.100). This is true -- in part -- but are we not confusing the basic mechanisms with the sensing of their activation? The cases of absent seizures, epileptic automatism, and akinetic mutism remain puzzling, but then we need to be told how to accommodate ordinary intuitions (which may well be discarded if necessary). Besides, if the clinical evidence shows that core consciousness is necessary for emotion, and we follow Damasio in his thinking that emotion is necessary for consciousness, why would we need a distinction between the two? Isn't it perhaps the case that there can be emotion without consciousness, and consciousness (of something else) without emotion? It is unfortunate that a strong neuropathological approach should not yield the conceptual clarity that one would expect -- which by no means implies that such an approach should not be pursued. The problem calls for further exploration.

According to Damasio, the key to self-consciousness does not lie in the cognitive processes traditionally studied by neuroscientists. The key, rather, lies in the "proto-self," a novel concept referring to "a coherent collection of neural patterns which constantly map, moment by moment, the state of the physical structure of the organism in its many dimensions" (p.154). When sensory devices perceive external objects, the organism must constantly adapt to perceptions by adjusting the position of the lens and the pupil, and the muscles of the head, the neck, and the trunk; these adjustments are detected by the somatosensory areas which constitute part of the proto-self. Most importantly, the proto-self receives neural and hormonal signals from visceral changes, such as emotional reactions. (Perhaps we have found the "location" of feeling.) It is one of Damasio's central theses that there is no such thing as "cold," uninterested perception; every perception is relevant to the well-being of the organism, and is detected as such by the proto-self. The proto-self is not conscious -- first-order consciousness does not have a place in the theory; yet for Damasio it constitutes the biological precedent of the self. ... What, then, is core consciousness? For Damasio, it is a "non-verbal account" of how the organism's state is affected by the processing of an object. The exposition, to be sure, is not always lucid, but the main ideas are clear enough. The brain forms neural maps (a) of an object, whether perceived or remembered -- this is where object-representations come back into the picture; and (b) of the organism -- this collection of maps is the proto-self. Both (a) and (b) are called first-order maps. Now, the sensory-motor maps pertaining to the object -- (a) -- cause changes in the maps pertaining to the organism -- (b) -- because the maps pertaining to the organism register the organism's responses to the object, or more accurately to the map of it. Finally, the changes in the organism-maps, and the object-maps as well, are in turn represented in, or by, second-order maps (c), which constitute the core self or core consciousness. All maps are neural patterns, and all can become "mental images," though we are not told how. So far, so good, at least if the reader manages not to get confused by expressions such as "The mapping of the object-related consequences occurs in first-order maps representing proto-self and object" (p.170) -- wasn't the proto-self the map which represents changes in the organism? In several passages Damasio uses "represent" and "representation" in the sense of "display," or even "constitute," rather than in the familiar sense of a relation between a state or object A and another object B. This in principle would be quite all right (those who know what representing means please raise their hand), but then the novel usage should be consistent (cf.: "the organism in the hypothesis is represented by the proto-self," p.170, where the usage is standard).

Where is the second-order neural pattern located? Damasio warns us that it is a mistake to think of a single consciousness center -- he is neither a phrenologist nor a "Cartesian materialist" (Dennett, 1991; Dennett and Kinsbourne, 1992) -- and suggests instead that there is a parallel simultaneous activation of different structures. Not many, however. The most important one is the familiar cingulate cortex (especially its anterior sector). This is not a novelty, to be sure. Damasio already pointed to the cingulate cortex in his 1994 book, and in any event the idea has been around for a long time: J.W. Papez postulated its function of emotional consciousness as early as 1937 (Papez, 1937). The good news is that we are now offered a rather detailed discussion of this puzzling structure which seems to have a myriad functions, both sensorial and motor-related, and Damasio also ventures some hunches about the function of its posterior sector, which is not well known (p.263). Other structures responsible for core consciousness are the thalamus and the superior colliculi (a tiny structure near the brain stem, sometimes regarded as the seat of consciousness). Damasio notably excludes the pre-frontal cortices, granting them at most a role in working memory and extended consciousness. This is indicative of his overall conception and aim, which is to emphasize the function of a transient and ephemeral core consciousness, independent from language, memory, and reason, and yet capable of what is sometimes called reflexivity. He aptly reminds us that in the history of Western thought higher levels of consciousness, linguistic performance, and rationality have been explored before and more thoroughly than the relatively simpler states which gave rise to them.

The story, then, is roughly the following. Sensory cortices (or the hippocampus in the case of memory) map an object, and normally also activate emotion-related structures: at least the brain stem, the hypothalamus, and the amygdala. These structures do three things: first, they trigger autonomic reactions in the soma; second, they send neural messages to other brain areas; and third, together with the somatosensory cortices, they also map or "represent" the somatic reactions that they have induced (together with the somatosensory areas they constitute the proto-self). Finally, the anterior cingulate cortex, the thalamus, and possibly the superior colliculi map both object-maps and the ever-changing organism-maps, and this is core consciousness. Put in this way,

*this account suggests a relatively neat distinction between orders of mapping or representation: the basic structures seem to be necessary and sufficient for emotion, but are not sufficient for the consciousness of it, which requires the activation of other areas. But this is not exactly what Damasio says; for if the cingulate and other cortices are already involved at the beginning of the process – the cingulate seems to be a "massively somatosensory structure" in its own right (p.261) -- everything happens (almost) everywhere and there is no clear second-order mapping to speak of.*

*Other observations can be suggested. At first sight, Damasio's view seems to be a variant of what is often called a representational theory of consciousness. According to this theory all states of consciousness, including those traditionally classified as "phenomenal," like sensations, are representational (see e.g. Dretske, 1995). At least in the philosophical literature, the issue then arises whether or not first-order conscious representations of external objects can account for, or explain away, the so-called qualitative properties of conscious experience. Damasio does engage in a brief discussion of Frank Jackson's famous story of Mary the neuroscientist, who knows everything about color processing but has never experienced color (Jackson, 1982), and vigorously rejects his claim that knowledge without experience shows the irreducible incompleteness of knowledge (surprisingly, and incorrectly, he also puts the arch-rivals Searle, 1992, 1998, and Dennett, 1991, in the same camp on this issue). But this is not really his main preoccupation. He discusses neither the qualia of object-maps – if any exist – nor those of the organism-maps which are at the center of his account. In other words, he may be regarded as a representationalist by default. The fact is that Damasio focuses throughout his work on second-order consciousness, which brings him to say for example that "the experience of a particular stimulus, including color, depends not just on the formation of an image [a mental pattern], but also on the sense of self in the act of knowing" (p.308). One wonders, however, if the problem does not reappear at the second-order level: Is a representation of an object-map the same thing as a representation of an organism-map? In other words, are perceptions the same thing as sensations? Damasio is silent on this.*

*Moreover, if it is all a matter of registering physical changes – even at the level of second-order core consciousness – why talk of representations? In his Glossary, Damasio offers what he calls a "conventional and transparent" definition of the term as "a pattern," whether neural or mental, "that is consistently related to something" (p.320). Unfortunately, this is much too simple. A naturalistic account of this crucial semantic term, which Damasio also abundantly employed in Descartes' Error, is more than welcome, but there are well-known difficulties with what philosophers call a co-variational account. Briefly, a representation cannot simply be an indicator or effect of its cause, because it may be mistaken (think of phantom-pains, blindsight, various agnosias, or indeed of any illusion or hallucination, which incidentally often trigger emotions about misrepresented or even inexistent objects). From this it follows, at least according to one possible account, that we need to define the content of a representation in terms of what would be its cause in normal circumstances, and normal circumstances are those in which a correct representation has a function, defined by natural selection (Millikan, 1984; Dennett, 1996). How this account can be extended to representations of artifacts and cultural objects in general (e.g., institutions) is another mostly unexplored story, but Damasio does not even begin to discuss the central thesis. This is disappointing, given his biological orientation. The unfortunate result is that second-order consciousness is surprisingly described as a device which regularly and correctly represents first-order maps which in turn cannot be mistaken.*

*In my discussion so far I have followed Damasio in his thinking that there are two "orders," of which the proto-self and representations of external objects are the first, and core consciousness is the second. This is more or less clear, despite some statements that perhaps are slips of the pen. For example, at one point we are told that "we are not conscious of the proto-self" (p.174). This presumably means that the proto-self can sometimes monitor the state of the organism without being monitored in turn. But of course, if core second-order consciousness is to be possible at all, we'd better be able to be conscious of the proto-self to begin with! ("Of" denotes here a causal relation between two distinct objects, namely two neural maps or sets of maps.) So there are two levels or orders so far: the proto-self, which is the cause, and the core self, which is the effect. At this point, however, Damasio claims that "we are conscious of the core self" (p.174). The reader begins to suspect that he has fallen into the familiar trap of the double sense of "conscious," one of which is "active" (conscious of), while the other is "passive" (conscious as monitored by another state). Perhaps what he wants to say is simply that the core self is (actively) conscious. If not, then who is "we"? Isn't Damasio adding yet another, third level? The trouble here is that the use of first person pronouns often conceals a level of reference (or causation, for that matter). Third person discourse makes this perspicuous: Bob is conscious of his core self which is conscious of his proto-self, which represents the organism. Better still: There is an area or pattern in Bob's brain which is affected by his core-self... etc. Now there is nothing wrong with nested intentionality (or causation), but then Damasio owes us an explanation of how the third level, or third-order map, works, and where it is located. One possible answer could lie in the "autobiographical self" or extended consciousness, which is said to be constituted of memories, and hence presumably also of memories of core self states (extended consciousness, we are told, requires the operation of temporal and frontal higher-order cortices, as well as of the amygdala; see p.220). On the same page 174, however, Damasio speaks of an autobiographical self "of which we are conscious." This is again plausible, but it introduces a fourth level, of which Damasio does not seem to be aware. Indeed, one major weakness in his whole theory is that the multiplication of levels gets somehow out of hand. This is apparent when he returns to feelings, and to feelings of feelings, towards the end of the book.*

*We already know what feeling is. It is the mental experience of an emotion, and Damasio is quite clear about this point: this is not an "emotional experience," but a separate experience which happens to be of, or caused by, an emotion (remember that an emotion, on his account, is a pattern of chemical and neural responses). So a*

subject feels that she has an emotion. Accordingly, we read that "feeling an emotion consists of having mental images arising from neural patterns which represent the changes in body and brain that make up an emotion," and that this requires second-order representations necessary for core consciousness (p.280). This is clear enough. The trouble is only that at this point, within four pages (281-284), the whole construction explodes like fireworks in a cascade of concepts and relations that are an impossible challenge for the most attentive and sympathetic reader.

The storm appears over the horizon where Damasio begins to speak of "knowing that we have that feeling, 'feeling' that feeling" (p.280), which for all intents and purposes should denote a third-order state distinct from feeling. Later on the same page, he declares that "the proto-self, feelings of emotion, and the feeling of knowing feelings emerged at different points in evolution and to this day emerge at different stages of individual development" (ibid.) The principle of charitable interpretation suggests that the cryptic "feeling of knowing feelings" should be read as "feeling-of-knowing feelings," where the "of" is not representational or causal: higher-order feeling is knowledge of lower-order feeling. Anyhow, the impression is still sustained that we are talking about three levels not two. The same impression is confirmed on p.282: "When those images [constituting feelings] are accompanied, one instant later, by a sense of self in the act of knowing... they become conscious. They are, in a true sense, feelings of feelings." Well, you figure it out. One more time: "I am suggesting that 'having a feeling' is not the same as 'knowing a feeling,' that the reflection on feeling is yet another step up" (p.284).

I conclude that on Damasio's own account a third-order level seems inescapable, but unfortunately he nowhere acknowledges this. The worst consequence is that after learning from him how to think of consciousness in terms of pretty well defined brain regions, we are left in the dark about the localization of the third order as distinct from the second and the first. Notice by the way that a third-order level is very plausible from a psychological point of view: we certainly feel that we are tense or excited, and then we may feel that it is good or bad to be in such a state (ethics lurks in the wings, by the way). Hence either we add a third order above core consciousness – it might be extended consciousness -- or we take core consciousness to be the third order and then find a second order corresponding to the feeling of emotion (perhaps the proto-self is a candidate).

The situation is clearly not satisfactory, and it is worth wondering why. Damasio, like other neuroscientists, typically begins with a strictly neurobiological explication of the psychological concept of emotion, and does not attribute to these neural processes any representational or phenomenal property; then he proceeds to explicate the psychology of feeling and consciousness by investigating neural projections to structures of the second and perhaps third order, which are said to represent both external objects and first-order reactions. Neuropsychology begins indeed with psychological categories, although it must leave open the possibility that neurological findings might force us to revise or abandon psychological hypotheses, like for example the representational nature of emotions. The result is often a fruitful interaction between levels of analysis, but only if there is a minimum of consistency and transparency in the psychological picture that is "tested," and this we have found wanting. Consequently, it is difficult to tell whether the psychological story is confirmed by the neurological evidence, or whether it simply clashes with it and must be discarded. This leaves the reader with a feeling of dissatisfaction – whatever that means.

Antonio Damasio has offered a thought-provoking view of consciousness centered on feelings, and feelings of feelings, of neural and chemical reactions that he calls emotions. We have followed him through his argument, and we have found that there is much to learn from neuropathology about different levels of consciousness, while there is more work to do on psychological levels and the corresponding neural structures. The time has come, however, to wonder about the limits of the whole project.

There is no doubt that the overwhelming part of research in cognitive neuroscience and psychology has been oblivious to emotional processes, as if the brain were an "epistemic engine" and nothing else. But it does not take a seventeenth century rationalist to see that many first- and second-order representations, at least in some contexts, are merely epistemic and emotionally irrelevant -- think of the copy-machine in your office. From this it follows that second (or third?) order structures such as for example the cingulate cortex, which seems to be crucial to the consciousness of emotion, would have to be shown to be equally crucial to non-emotional core consciousness as well; or else, we still wish to know what makes sheer epistemic consciousness possible. Only then will we have a viable theory of consciousness as a whole.

Quanto a Damasio stesso, nella sua conferenza londinese sopra menzionata, sembra così riassumere le tesi del suo libro:

You may think it's a big jump from emotion to consciousness but it isn't, it happens to be very simple and very direct. My idea being, and this is the sort of idea that I have been proposing in articles and now in the *Feeling of What Happens*, the new book, and that is that consciousness turns out to be at its basic level one more aspect of the regulation of our life. In quite intriguing ways the fundamental mechanisms for the achievement of consciousness happen to depend very strongly on precisely the same structures that I have just illustrated for you as being important for emotion and being important for basic life regulation. In other words, what we have in these structures is a spectacular overlap of functions which would be very hard to imagine would be by chance alone. It is something that points to a major devotion of all these structures to the process of regulating life in different kinds of environment with different kinds of demand and challenge from a more and more complex environment. So, what I am proposing for emotion and ways in which I think the proposal is different is: 1) an insistence that we have different kinds of emotion, one of which I think is extremely simple and I suspect is shared with non-human creatures, and that is what I call core-consciousness with a central protagonist that is

*the core self. Then another kind of more complex consciousness which is extended consciousness where the protagonist is the autobiographical self or extend self. Now, the way I look at consciousness is also different in the sense that I don't think we can limit the project of understanding consciousness to the understanding of how we make images, how we make mental images alone. I'm sure many of you know that this has been the tendency among several neuroscientists is to look at the problem of consciousness as the problem of how the brain makes images, for instance, visual images and that once we have solved how the brain makes images we will know how consciousness appears. Well, of course, that is part of the problem but I don't think it gets at the heart of the problem and the heart of the problem for me is not how we construct what I call the movie in the brain, this tremendous multimedia show that we all have right now in our brains which includes visual information, auditory information, many other aspects of sensory signaling that is fully integrated in time. Now, of course, that is critical to understanding consciousness but that is in the end nothing more than what we normally designate as mind. What we want, if we want to understand consciousness is understand that conscious mind and what distinguishes the conscious mind is not having that movie or that set of wonderful images but knowing that those images pertain to us, knowing that the images belong to us alone in our first person perspective. If you don't deal with the issue of ownership of the movie in the brain which I designate as the problem of self then you don't deal with the heart of the problem and in the end your project is no different from the project of the remarkable visual physiologists or other sensory physiologists that have been studying how the brain makes images. That's wonderful and quite laudable but if we are to understand how we are conscious in neurobiological terms we need to understand how we come to own the movie in the brain, that problem of self. That problem of self I think appears in these two levels, the very simple self, the core self that has to do with the here and now which goes actually very closely with the descriptions one gets about simple awareness in which without any issue with time before or after an organism keys into the fact that a certain stimulus is related to it from the internal perspective. But there is this other self that we all have in this room which is an autobiographical self which is a much more complicated matter, but I think is rooted in the previously, and that is the sense we all have, given our memory of our invariant past and the memory of our anticipated future, this notion we have of personhood and identity and even the name that we have to signal identity and personhood and that is a much more complex self that, of course, relies on abundant memory of the past, on abundant memory of scenarios of the possible future and also on the language that allows us to organise all this knowledge. But I see that autobiographical self as very rooted on the core self and to close I see the core self as rooted in something fundamental which is the representation of the changing organism states. I think that the reason why we have one self and not more, the reason we have one mind and not two or three is the same reason why we have one body and not two or three. We have one mind, one self per customer and it is rooted in representations of the organism as it is now and on the very interesting fabrication of a representation of the body as it becomes, moment by moment, when it is transformed by interaction with a particular object, be that object external or coming from our minds.*

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La teoria di Damasio - e le teorie monistiche come la sua, in generale - pongono numerosi problemi di ordine superiore concernenti da un lato il ruolo e l'ambito applicativo delle scienze umanistiche (a partire dalla psicologia stessa) e dall'altro il senso e la collocazione di 'alti' come la morale ed il libero arbitrio. Damasio è certamente consapevole di queste 'complicazioni' (come numerosi passi del libro stesso attestano) se, per esempio, inizia la conferenza londinese precisando che

*I would like to start by saying that, of course, all of these topics, emotion, decision-making, consciousness are very old in terms of their studies in neuroscience, cognitive science and philosophy, but there's something new that is happening now – by now I mean recently – that allows us to take a new look at these topics and that is really the developments in neuroscience in terms of the different technologies, the different findings that those new technologies allow us to gather and, of course, the remarkable changes in theory and hypothesis that result from all the new findings that we have been able to gather, especially over the past decade. ... it's quite obvious that any problem of neuroscience, any problem of neurobiology included, of course, all the problems that have to do with a relation between mind and brain can be tackled at many levels, and those levels really span all of the levels of structure and organisation of biological organism, all the way from molecules and cells to microcircuits and large circuits and very importantly also to the levels of organisation that I like to call social and cultural because you can not really make sense of what is going on in that biology a good part of the time if you don't bring in the effects that come from society and from a culture. But one point that is very important to make at the outset is that anything we can talk about in the realm of mind and brain, be it emotion or vision or motor system or consciousness cannot be properly understood if an appeal is not made to all of those different levels. In other words we're not likely to produce comprehensive and reasonable explanations of the neurobiology of, say, consciousness or memory if we do not intervene at different levels and if we don't bring to bear on the problem all the knowledge that is being gathered at all those levels. Now, needless to say, none of us as researchers, or even as entire research groups, ever control all of those levels in terms of hypothesis and experiments and appropriate their togethering which means that what we're facing is a co-operative job that will require the work of many, many different investigators from many different perspectives.*

e, nel corso del dibattito, rispondendo a delle domande, precisa che

*... it's interesting to talk about that point again. First of all, the reason why you need to make those distinctions, my first reason is for being able to plan experiments clearly and to try to segment very complicated processing*

time. That's the first reason, you want to separate different stages in a process. The second is that you are assuming that the process of emotion and feeling happens in a fully conscious individual all the time and even in humans I don't think that that's the case and it's probably is not the case in many non-human species who, on the face of it, have emotions and may have feelings. To give you an example, you may, I'm sure this happened to you, you may have caught yourself at a given point in the day feeling in a particular way, without noticing what caused that feeling and it is quite likely that that feeling is the result of an emotion that you may have been totally unaware of and even of a trigger that may have come out of something you saw or heard but did not pay attention to immediately, or something that you thought that is preoccupying you. So, even in our situation in which we are prisoners most of the time of our consciousness and we have a process that is so rich that it sort of screens from our view the underpinnings of the process, even in our situation we can have situations in which we do not know of the source of an emotion, do not even know that we are processing a feeling at a given time. So, all of these things are possible and I think that the separation of these steps along the way is helpful as you engage in the description, as you engage in the study of the phenomena. You know, I'm not saying that we should preserve it for ever, you know, it may well be that in a few years we will not even preserve the terms emotion and feeling and it might be found obsolete. That may come if the descriptions get so rich and in such different terms that you just do away with those.

... let me just try to answer your question by invoking a couple of facts. One is that the connection between emotion and memory is obviously a very powerful one and we could bring up numerous facts that indicate that memory is highly influenced by presence or absence or absence of emotion and up to certain degrees emotion can be actually a wonderful help in acquiring for instance the memory of a fact and beyond certain degrees it may be detrimental and in fact the acquisition may be impaired. So, the fact that there is a relation between emotion and memory which is rather intuitive is in fact borne out by scientific work. The second is about the relation between emotion and reason and I think there's one way in which it seems apparent that certain kinds of emotional signal that relate to a past experience have an influence on the decision process, I don't think there's much doubt about it. But there is something that is even more interesting is that if you look at other creatures, for instance, creatures that are not famous for their amounts of knowledge and for their reasoning abilities what you find is that a lot of very good decisions, in other words, a lot of very good practical reasoning is in fact enacted by emotions. So, you have species that do not know much about the world, certainly do not have our kind of knowledge and our kind of reasoning strategies and yet they will take cover, they will protect themselves or they will endorse going in a certain way or making something, availing themselves of something or finding a mate or food or what have you, that are very complicated decisions and those decisions are in fact being run by an emotional system. They very link directly to how good a thing may be and to how needed that thing is at that point in that organism and it is not a system of, you know, finding out which kind of grape you're going to eat, it's really about whether or not you are going to go for it right now in that particular place. So, there is a way in which you could say that a lot of the rational mechanisms of non-human species are in fact in the realm of the emotion. The emotions are one way into reason within a certain environment that is relatively well prescribed and embodied in a brain. So, it's one more reason not to make splits between emotion and reason, it's part of the evolution of what we call reason is high reason, you know, it's something that has now availed itself of a tremendous amount of knowledge and strategies to think over that knowledge, but creatures were reasoning before, they were making very adaptive decisions that were critical for their success long before they could think about specific facts.

Su temi analoghi si era intrattenuto anche (ai tempi del suo primo libro) rispondendo alle domande di un'intervista, Entretien avec Antonio R. Damasio, a cura di Jean-François Duval (Construire No 44, 27-10-98), in cui, per esempio, dice:

*Je considère l'âme et l'esprit comme la partie la plus sophistiquée, la plus complexe, la plus admirable de l'être humain. Et je pense que, dans une large mesure, ce que nous appelons âme et esprit est un mélange des meilleures qualités de la pensée, alliées à la plus belle qualité d'émotion et de sentiment. Dans le sens où tous ces processus dépendent clairement d'un organisme très complexe, je ne vois pas d'inconvénient à être appelé matérialiste.*

*Je n'aime pas cette idée selon laquelle le fait de penser que l'âme est générée par un processus biologique aurait quelque chose de bas. Les personnes qui se disent non matérialistes jugent en somme que la part matérielle de l'univers est trop simple, trop vulgaire pour porter toute la beauté, toute la dignité de cette chose merveilleuse que nous appelons âme ou esprit.*

*Elles ont tort: la biologie, la complexité de ces processus est si riche qu'elle peut bien, en réalité, être porteuse de quelque chose d'aussi digne et élevé que l'âme humaine. Ne pensez-vous pas?*

e, a proposito della psicoanalisi, afferma

*Je dirais que nos recherches montrent qu'il existe des processus en deçà de notre niveau de conscience qui corroborent en effet l'idée d'un inconscient. Disons que, de façon générale, ce que nous observons est compatible avec la pensée de Freud.*

*Puisque nous postulons que certaines actions des marqueurs somatiques peuvent rester entièrement dissimulées, rester entièrement inconscientes, et que nos émotions passées, c'est-à-dire la façon dont nous avons appris au cours de notre vie à réagir à certaines situations, peuvent influencer la façon dont nous les*

envisageons, l'hypothèse d'un inconscient me semble pertinente.

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Successivamente a **The Feeling of What Happens**, Damasio ha pubblicato alcuni altri lavori di grande interesse ampliando il campo delle riflessioni a proposito del meccanismo neurobiologico delle emozioni e dei sentimenti e chiamando in causa altre regioni del cervello:

1. In **Subcortical and cortical brain activity during the feeling of self-generated emotions** (Antonio R. Damasio, Thomas J. Grabowski, Antoine Bechara, Hanna Damasio, Laura L.B. Ponto, Josef Parvizi & Richard D. Hichwa) comparso su *Nature Neuroscience* (October 2000 Volume 3 Number 10 pp 1049 - 1056), il discorso sulla neurobiologia delle emozioni supera il confine della paura per indagare altre tipologie di sentimenti:

*In a series of [15O]PET experiments aimed at investigating the neural basis of emotion and feeling, 41 normal subjects recalled and re-experienced personal life episodes marked by sadness, happiness, anger or fear. We tested the hypothesis that the process of feeling emotions requires the participation of brain regions, such as the somatosensory cortices and the upper brainstem nuclei, that are involved in the mapping and/or regulation of internal organism states. Such areas were indeed engaged, underscoring the close relationship between emotion and homeostasis. The findings also lend support to the idea that the subjective process of feeling emotions is partly grounded in dynamic neural maps, which represent several aspects of the organism's continuously changing internal state.*

2. In un successivo studio **Single-neuron responses to emotional visual stimuli recorded in human ventral prefrontal cortex** (Hiroto Kawasaki, Ralph Adolphs, Olaf Kaufman, Hanna Damasio, Antonio R. Damasio, Mark Granner, Hans Bakken, Tomokatsu Hori & Matthew A. Howard III), esso pure comparso su *Nature Neuroscience* (January 2001 Volume 4 Number 1 pp 15 - 16)

*... we investigated single-neuron responses to emotional stimuli in an awake person with normal intellect. Recording from neurons within healthy tissue in ventral sites of the right prefrontal cortex, we found short-latency (120–160 ms) responses selective for aversive visual stimuli.*

un risultato ulteriormente rielaborato in successivi studi, come riferisce Damasio stesso durante il World Congress of Neurology (London, 18-22 giugno 2001):

*But the bigger story is just unfolding, Damasio said. "After publication of this paper, we now have data that totally violates our prediction," he said. "In fact, on the left side, in rather symmetrical regions, you have a response of neurons to pleasant stimuli," Damasio said. While neurons on the right side change their firing pattern following negative stimuli, neurons on the left responded to positive stimuli. Damasio's team plotted responses from over 90 individual neurons from left and right regions of the prefrontal cortex for comparison. "You get quite remarkable results. This is not a trivial finding," he said. "Although the number of subjects is very small, there is so far a very clear separation of aversive versus non-aversive stimuli." "This really surprised me. I would not have predicted that," he continued. Damasio is a self-proclaimed skeptic of left-right brain asymmetry theories. In general, differences tend to be exaggerated, he said. "But here, the differences between left and right was so powerful," he told BioMedNet News. There are some real left-right differences, Damasio acknowledged. "What this means is that one of [these differences] is this basis for feeling."*

3. In **Pathological laughter and crying. A link to the cerebellum** (Josef Parvizi, Steven W. Anderson, Coleman O. Martin, Hanna Damasio and Antonio R. Damasio) pubblicato su *Brain* (Vol. 124, No. 9, 1708-1719, September 2001) viene inaspettatamente chiamato in causa il cervelletto:

*Patients with pathological laughter and crying (PLC) are subject to relatively uncontrollable episodes of laughter, crying or both. The episodes occur either without an apparent triggering stimulus or following a stimulus that would not have led the subject to laugh or cry prior to the onset of the condition. PLC is a disorder of emotional expression rather than a primary disturbance of feelings, and is thus distinct from mood disorders in which laughter and crying are associated with feelings of happiness or sadness. The traditional and currently accepted view is that PLC is due to the damage of pathways that arise in the motor areas of the cerebral cortex and descend to the brainstem to inhibit a putative centre for laughter and crying. In that view, the lesions `disinhibit' or `release' the laughter and crying centre. The neuroanatomical findings in a recently studied patient with PLC, along with new knowledge on the neurobiology of emotion and feeling, gave us an opportunity to revisit the traditional view and propose an alternative. Here we suggest that the critical PLC lesions occur in the cerebro-ponto-cerebellar pathways and that, as a consequence, the cerebellar structures that automatically adjust the execution of laughter or crying to the cognitive and situational context of a potential stimulus, operate on the basis of incomplete information about that context, resulting in inadequate and even chaotic behaviour.*

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Da ultimo (a quanto ne so ...!), Damasio si è occupato anche delle possibili conseguenze cliniche delle sue indagini, con particolare riferimento al problema della sociopatia-psicopatia. Come ricorda *Alison Abbott* (*Nature* 410, 296 - 298, 2001)

*The brain imaging techniques of positron emission tomography (PET) and magnetic resonance imaging (MRI) provide the opportunity to investigate psychopathy further. They might allow researchers to discover whether psychopaths' physiological and emotional deficits can be pinned down to specific differences in the anatomy or activation of the brain.*

*Among researchers who are starting to explore this area, there are two main theories of psychopathy. One, championed by Adrian Raine of the University of Southern California in Los Angeles and supported by the work of Antonio Damasio of the University of Iowa, gives a starring role to a brain region called the orbitofrontal cortex (see diagram, right). This is part of an area of the brain, known as the prefrontal cortex, involved in conscious decision-making. Damasio has shown, for example, that patients who have suffered damage in this area early in life have severe social behavioural problems and can be very aggressive.*

*The other theory, promoted by James Blair of University College London, holds that the fundamental dysfunction lies within the amygdala, a small almond-shaped structure that plays a critical role in processing emotion and mediating fear. Recently, using PET scanning, Blair has shown that activation of the amygdala in normal volunteers is involved in responding to the sadness and anger of others, and he hypothesizes that amygdala dysfunction could explain the lack of fear and empathy in psychopaths.*

*The two theories may not be mutually exclusive, Blair points out, as the orbitofrontal cortex, which does the 'thinking', and the amygdala, which does the 'feeling', are highly interconnected.*

Sugli *Archives of General Psychiatry* (Vol. 57 No. 2, February 2000), scrivo in proposito Damasio:

*THE IDEA that the structures of the frontal lobe play a critical role in normal social behavior is now well established. ...*

*Curiously, the contemporary reconstruction of Phineas Gage's brain using modern neuroimaging techniques suggests that his brain lesion encompassed medial and orbital territories. In short, there is now abundant evidence that adult-onset lesions in the human prefrontal cortices lead to maladaptive social behavior characterized by systematic violations of social conventions and even moral rules. Prior and proper acquisition of social knowledge, as well as normal exercise of such knowledge up to the time when lesions occur, does not preclude the onset of abnormal social behavior, provided the requisite prefrontal regions are rendered dysfunctional.*

*The evidence from brain lesions has contributed to the fundamental elucidation of the functions of the prefrontal cortex and has had an important practical consequence: the development of a workable hypothesis concerning one possible origin of sociopathic behavior, and more specifically, the neural basis of antisocial personality disorders. While it is true that the social inappropriateness of patients with adult-onset prefrontal damage tends not to include violent and criminal behavior, it is apparent that the altered social profile seen in the neurological patients resembles, in many respects, the features noted in lifelong developmental sociopathic individuals. It is thus reasonable to hypothesize that the symptoms of developmental sociopathic individuals are related to the malfunction of neural systems, which include critical components in the prefrontal cortex.*

*... Based on systematic measurements of gray and white matter volumes obtained from magnetic resonance studies, Raine et al demonstrate that men with a diagnosis of antisocial personality disorder have a significantly reduced amount of prefrontal gray matter when compared with normal men or with drug- or alcohol-dependent men without antisocial personality disorder. Although the authors do not trace the significant reduction to a specific prefrontal sector, the mere fact that the reduction is related to the prefrontal region is valuable and suggestive. It may be possible to inquire in follow-up studies if the reduction is in fact due to a disproportionate diminution of prefrontal sectors, such as the orbital and medial territories. Be that as it may, the current result does identify a potential neuropathologic signature consonant with the neurological results. Should other authors replicate the presence of this anatomical trait in comparable subject groups, the finding will indeed be remarkable. ...*

*It would not be prudent to conclude from this study and from previous neurobiological studies that inappropriate social behavior is solely a consequence of prefrontal dysfunction caused by acquired lesions or a consequence of structural and functional defects caused by genetic factors, development factors, or both. But the evidence presented in the study by Raine et al, along with the neurological evidence from adult-onset lesions and, quite recently, the demonstration that early-onset prefrontal damage leads to a condition nearly indistinguishable from developmental antisocial personality, indicates that malfunctioning circuitry in certain prefrontal sectors can cause these behavioral manifestations. One must be careful, however, not to fall in the phrenological trap set behind every new identification of a brain area with some putative role: the normal or pathologic effects associated with that certain area can be properly understood only in the context of multicomponent neural systems. As a consequence, the normal or pathologic effects related to a given area are quite often the result of actions elsewhere in the brain. In the case of antisocial personality disorder, the malfunction of prefrontal circuits is probably accompanied by malfunction in varied subcortical territories (eg, in amygdala, in brainstem nuclei, in certain sectors of basal ganglia and basal forebrain), and in higher-order association cortices outside of the frontal region. Whatever comprehensive explanation we may formulate for such disorders will have to not only take into account the operation of these large-scale systems but also consider the many factors likely to shape the assembly and eventual operation of these systems. Those factors range from the level of molecules*

*and neurons to the level of social and cultural phenomena that impinge on the life of whole individuals.*

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