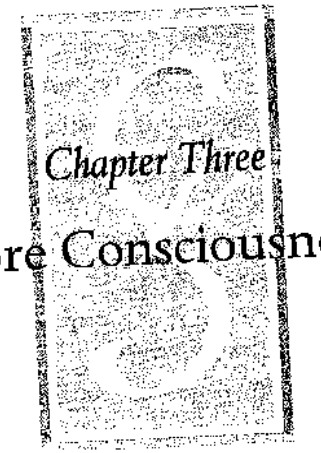
Antonio Damasio,
The Feeling of What Happens (1999)



Chapter Three

Core Consciousness

Studying Consciousness

It is fine for us scientists to bemoan the fact that consciousness is an entirely personal and private affair and that it is not amenable to the third-person observations that are commonplace in physics and in other branches of the life sciences. We must face the fact, however, that this is the situation and turn the hurdle into a virtue. Above all, we must not fall in the trap of attempting to study consciousness exclusively from an external vantage point based on the fear that the internal vantage point is hopelessly flawed. The study of human consciousness requires both internal and external views.

Although the investigation of consciousness is condemned to some indirectness, this limitation is not restricted to consciousness. It applies to all other cognitive phenomena. Behavioral acts—kicks, punches, and words—are nice expressions of the private process of mind, but they are not the same thing. Likewise, electroencephalograms and functional MRI scans capture correlates of the mind but those correlates are not the mind. Inevitable indirectness, however, is not equivalent to eternal ignorance about mental structures or about the underlying neural mechanisms. The fact that mental images are accessible only to their owner organism does not preclude their characterization, does not deny their reliance on organic substance, and does not prevent our gradual closing in on the specifications of that substance. This may cause some worry to purists raised on the idea that what another person cannot see is not to be trusted scientifically, but it really should not worry anyone. This state of affairs should not prevent us from treating subjective phenomena scientifically. Whether one likes it or not, *all* the contents in our minds are subjective and the power of science comes from its ability to verify objectively the consistency of many individual subjectivities.

Consciousness happens in the interior of an organism rather than in public, but it is associated with a number of public manifestations. Those manifestations do not describe the internal process in the same direct way that a spoken sentence translates a thought, yet there they are, available to observation, as correlates and telltale signs of the presence of consciousness. Based on what we know about private human minds and on what we know and can observe of human behavior, it is possible to establish a three-way link among: (1) certain external manifestations, e.g., wakefulness, background emotions, attention, specific behaviors; (2) the corresponding internal manifestations of the human being having those behaviors as reported by that human being; and (3) the internal manifestations that we, as observers, can verify in ourselves when we are in circumstances equivalent to those of the observed individual. This three-way linkage authorizes us to make reasonable inferences about human private states based on external behavior.[1]

The solution of the method problem posed by the privacy of consciousness relies on a natural human ability, that of theorizing constantly about the state of mind of others from observations of behaviors, reports of mental states, and counterchecking of their correspondences,

given one's own comparable experiences. As a student of mind and behavior I turned a pastime—curiosity about the minds of others—into a professional activity, which simply means that I was obsessive about it and took notes.

Curiously, compared with the specialists, the popular culture seems to have fewer problems with the private perspective of consciousness, as shown brilliantly in Woody Allen's *Deconstructing Harry*. Perhaps you have seen the film, but if not, here is my report on what happens. In the middle of a movie-within-a-movie scene, which describes the shooting of a film scene, the cameraman realizes that the image of the actor he is filming is fuzzy. Naturally, he first attributes the problem to his own error in controlling the focus, and after he fails to correct it, he begins worrying that the focusing mechanism may be out of order. But the mechanism is fine, and since there is no improvement, the cameraman now worries about the state of the lens. Could it be dirty and so cause the fuzziness? Yet, the lens turns out to be fine, too, and perfectly clean. In the midst of the ensuing commotion, everyone suddenly realizes that the problem does not have anything to do with the camera at all but with the actor in question (Mel, played by Robin Williams). It is the actor himself who is out of focus! He is *intrinsically* fuzzy, and everyone looking at him sees a blurred image; everyone looking at anything else but Mel sees a clear image. The actor of this movie-within-a-movie has been struck by a disease that makes all those around him, including his perplexed family and his physician, see him out of focus.

The reason why the audience laughs has to do with the patent absurdity of the idea, with the violation of a property fundamental to consciousness: its personal, private, first-person view of things. Fuzziness and out-of-focusness are not properties of objects—except in a metaphorical sense. Even when a screen is interposed between you and an object and modifies its perception, i.e., when the lenses of your glasses are dirty, the fuzziness is not *in* the object. Fuzziness and out-of-focusness are very much a part of our conscious perspective in perception. In normal circumstances, fuzziness and out-of-focusness

occur *within* a person's organism, due to a number of possible causes arising at a variety of physiological levels, all the way from the eye to the pathways that transmit signals to the brain, to the brain itself. Other persons in the vicinity of he-who-seems-fuzzy-to-me do not share my fuzziness and my out-of-focusness. The scene succeeds because no one can bring Mel into focus. Fuzziness has become an external property of a living being rather than the personally constructed feature of an observation.

The contemporary approach to studying the biological basis of the private human mind involves two steps. The first step consists of observing and measuring the actions of an experimental subject, or collecting and measuring the reports of internal experience offered by a subject, or both. The second step consists of relating the collected evidence to the measured manifestation of one of the neurobiological phenomena we are beginning to understand, at the level of molecules, neurons, neural circuits, or systems of circuits. The approach is based on the following assumptions: that the processes of the mind, including those of consciousness, are based on brain activity; that the brain is a part of a whole organism with which it interacts continuously; and that we, as human beings, in spite of remarkable individual traits that make each of us unique, share similar biological characteristics in terms of the structure, organization, and function of our organisms.

The limits of the first-pass solution outlined above can widen remarkably when we transfer the approach to human beings with neurological disease who develop impairments of mind and behavior caused by brain damage and selective brain dysfunction—the sort of problem that arises, for instance, as a result of a stroke. This approach, which is known as the lesion method, allows us to do for consciousness what we have long been doing for vision, language, or memory: investigate a breakdown of behavior, connect it to the breakdown of mental states (cognition), and connect both to a focal brain lesion (an area of circumscribed brain damage) or to an abnormal record of electrical activity assessed with an electroencephalogram or

evoked electrical potentials (a brain-wave test) or an abnormality in a functional-imaging scan (such as PET or fMR). A population of neurological patients gives us opportunities that observations in normals alone do not. It gives us probes in terms of disordered behavior and mind as well as probes in terms of anatomically identifiable sites of brain dysfunction with which we can study many aspects of mind, especially those aspects that are less transparent. Armed with the ensuing evidence, it is possible to submit hypotheses to test, support them or modify them according to the results, and test perfected hypotheses in yet other neurological patients or healthy controls.

The investigation of patients with neurological disease has shaped my views on consciousness more than any other source of evidence. Before I reflect on my observations of neurologic patients with impaired consciousness, however, a word about the telltale external manifestations of consciousness is in order.

The Music of Behavior and the External Manifestations of Consciousness

The consistent and predictable external manifestations of consciousness are readily identifiable and measurable. For instance, we know that organisms in a normal state of consciousness are awake, are attentive to stimuli in their surroundings, and behave in a manner adequate to the context and to what we imagine their purpose to be. Adequate behavior includes both the background emotions I described earlier as well as specific actions or specific emotions related to the specific events or stimuli occurring in a given scene. An expert observer can assess these correlates of consciousness over a relatively short period of time (perhaps as short as ten minutes if the circumstances are propitious, although I must add that experts can be fooled). The presence or absence of wakefulness can be established by direct observation of the organism—the eyes must be open, the muscles must have tone enough to permit movement. The ability to attend to stimuli can be established from the organism's ability to orient to stimuli, and we can observe eye movements, head movements, and patterns of limb and whole-body movement as the organism responds to varied sensory stimuli and interacts in an environment. The presence of background emotion can be established from the nature of facial expressions and from the dynamic profile of limb movements and posture. The purposefulness and adequacy of behavior can be assessed by taking into account the context of the situation, whether natural or experimental, and determining whether the organism's responses to stimuli and the organism's self-initiated actions are appropriate to that context.

Although all of these manifestations can be elicited by appropriate stimuli, observed, videotaped, and measured with various devices, I must emphasize that the qualitative judgments of the trained observer are an essential tool in the analysis of behavior. What confronts the observer is decomposable by expert analysis but is first and foremost a composite, a concurrence of contributions in time, played out in a single organism and connected, in some fashion, by a single goal.

It may be helpful to think of the behavior of an organism as the performance of an orchestral piece whose score is being invented as it goes along. Just as the music you hear is the result of many groups of instruments playing together in time, the behavior of an organism is the result of several biological systems performing concurrently. The different groups of instruments produce different kinds of sound and execute different melodies. They may play continuously throughout a piece or be absent at times, sometimes for a number of measures. Likewise for the behavior of an organism. Some biological systems produce behaviors that are present continuously, while others produce behaviors that may or may not be present at a given time. The principal ideas I wish to highlight here are: First, that the behavior we observe in a living organism is not the result of one simple melodic line but rather the result of a concurrence of melodic lines at each time unit you select for the observation; if you were a conductor looking at the imaginary musical score of the organism's behavior, you would see the different musical parts joined vertically at each

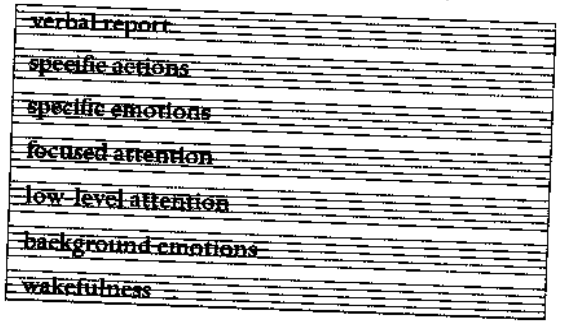
measure. Second, that some components of behavior are always present, forming the continuous base of the performance while others are present only during certain periods of the performance; the "behavioral score" would note the entrance of a certain behavior at a certain measure and the end of it some measures later, just as the conductor's score notes the beginnings and ends of the solo piano parts within the movements of a concerto. Third, that in spite of the various components, the behavioral product of each moment is an integrated whole, a fusion of contributions not unlike the polyphonic fusion of an orchestral performance. Out of the critical feature I am describing here, concurrence in time, something emerges that is not specified in any of the parts.

As we consider human behavior in the pages ahead, I ask you to think of several parallel lines of performance unfolding in time. Wakefulness, background emotion, and low-level attention will be there continuously; they are present from the moment of awakening to the moment when you fall asleep. Specific emotions, focused attention, and particular sequences of actions (behaviors) will appear from time to time, as appropriate for the circumstances. Likewise for verbal reports, which are a variety of behavior.

Now, consider an extension of this metaphor into the mind of the person whose performance we are observing. I propose that there is also an orchestral score in the private mind, only now the concurrent stacking of musical parts corresponds to mental streams of images. Those streams are largely the internal and cognitive counterpart of the behaviors we observe. Some images occur a fraction of time earlier than those behaviors do, e.g., the mental image of an idea we are about to express in a sentence. Other images occur immediately after, e.g., the feeling of the emotion we just exhibited. There are, of course, musical parts for the state of being awake and continuously making images as well as for the representation of specific objects, events, and words denoting them; there is also a part for the feelings of the varied emotions the organism is exhibiting. There is, however, one other part in the internal orchestral score for which there is no precise external counterpart: that part is the sense of self, the critical component of any notion of consciousness.

In the context of this metaphor, we can imagine the sense of self as an additional part which informs the mind, nonverbally, of the very existence of the individual organism in which that mind is unfolding and of the fact that the organism is engaged in interacting with particular objects within itself or in its surroundings. This knowledge alters the course of the mental process and the course of external behavior. Its private presence, which is directly available only to its owner, can be inferred by an external observer from the influence it exerts on external behaviors, rather than from its own flagship behavior. Wakefulness, background emotion, and low-level attention are thus external signs of internal conditions that are compatible with the occurrence of consciousness. On the other hand, specific emotions, sustained and focused attention, and targeted behaviors appropriate to the context over extended periods of time are a good indication that consciousness is indeed occurring in the subject we observe, even if we, as external observers, cannot observe consciousness directly.

Table 3.1. The Behavioral Score



Wakefulness

Wakefulness and consciousness tend to go together, although the coupling can be broken in two exceptional circumstances. One exception occurs when we are in the state of dream sleep. We are obviously

not awake during dream sleep and yet we have some consciousness of the events taking place in the mind. The memory we form of the last dream fragments before we wake up indicates that some consciousness was "on." Another dramatic reversal of the usual coupling can also occur: we can be awake and yet be deprived of consciousness. Fortunately, the latter only happens in the neurological conditions I am about to discuss.

Wakefulness is best described from watching the transition from sleep to wakefulness. The indelible picture of that transition that always comes to my mind is that of Winnie in Beckett's *Happy Days* when the bell rings at the beginning of the first act: Winnie opens her eyes to the audience and declares, "Another heavenly day." On she goes, like a morning sunrise, in a state which will permit her brain to form images of her surroundings: her bag, her toothbrush, the rustling sounds of Willie, her body, which, she tells us, does not have much pain that day, "hardly any." Wakefulness stops at the end of Winnie's day when the bell rings to close the first act.

When wakefulness is removed, dream sleep aside, consciousness is removed. Examples of this pairing are dreamless sleep, anesthesia, and coma. But wakefulness is not the same as consciousness. In the wakeful state the brain and mind are "on," and images of the organism's interior as well as the organism's environment are being formed. Reflexes can be engaged, of course (neither consciousness nor wakefulness is needed for reflex activity), and low-level attention can be driven to stimuli that conform to the basic needs of the organism. And yet, consciousness may be absent. Patients with some neurological conditions discussed in this chapter are awake and yet lack what core consciousness would have added to their thought process: images of knowing centered on a self.

Attention and Purposeful Behavior

There is more to Winnie's behavior than just wakefulness. She orients herself toward objects and concentrates on them as needed. Eyes, head, neck, torso, and arms move about in a coordinated dance which

establishes an unequivocal relationship between Winnie and certain stimuli in her surroundings: the bag, the toothbrush, Willie's rustling behind her. Presence of attention toward an external object usually signifies the presence of consciousness, though not necessarily. Patients in so-called akinetic mutism, who have abnormal consciousness, can pay *fleeting* and low-level attention to a *salient* event or object, for instance, an observer calling their name. Attention only betrays the presence of normal consciousness when it can be *sustained* over a substantial period of time relative to the objects that are necessary for appropriate behavior in a given context—this means many minutes and hours rather than seconds. In other words, extended time and a focusing on appropriate objects define the sort of attention that is indicative of consciousness.

Lack of manifest attention toward an external object does not necessarily deny the presence of consciousness and may instead indicate that attention is directed toward an internal object. Absentminded professors and daydreaming adolescents exhibit this "symptom" all the time. Fortunately, the condition is most transient. Complete and sustained failure of attention is associated with the dissolution of consciousness, as happens in drowsiness, confusional states, or stupor.

Conscious creatures concentrate on certain objects and are attentive to certain stimuli, something that matches quite well our own view from within when we think about what goes on in our mind in comparable situations. We can all agree that attention and consciousness are related, but the nature of the relationship is a matter for debate. My view is that both consciousness and attention occur in levels and grades, they are not monoliths, and they influence each other in a sort of upward spiral. Low-level attention precedes core consciousness; it is needed to engage the processes that generate core consciousness. But the process of core consciousness results in driving higher-level attention toward a focus. When I attend to an acquaintance who has just turned up in my office, I do so under the influence of core consciousness. I could only have generated that consciousness because my organism was directed by low-level automated

attention to process certain features of the environment that are important for organisms like mine, namely, moving creatures with human faces. As the processing continued, core consciousness helped focus attention on the particular object that engaged the organism in the first place.

But back to Winnie. Next you notice that she behaves purposefully toward the stimuli on which she concentrates. She might not—Winnie being a character in a Beckett play—but she does. In effect, her behavior is part of an immediately recognizable plan that could only have been formulated by an organism knowledgeable about its past, present, and anticipated future. The behavior is consonant with such a plan over a long period of time—hours, in fact. The sustained purposefulness and adequateness of her behavior require the presence of consciousness even if consciousness does not guarantee purposeful and adequate behavior: perfectly conscious idiots may behave quite inadequately.

Something especially noteworthy about such sustained and adequate behaving is that specific behaviors are accompanied by a flow of emotional states as part of their unfolding. The background emotions that we discussed in the previous chapter continuously underscore the subject's actions. Telltale signals include the overall body posture and the range of motion of the limbs relative to the trunk; the spatial profile of limb movements, which can be smooth or jerky; the speed of motions; the congruence of movements occurring in different body tiers such as face, hands, and legs; and last and perhaps most important, the animation of the face. Even when the observed subject speaks, emotional aspects of the communication are separate from the content of the words and sentences spoken. Words and sentences, from the simple "Yes," "No," and "Hello" to "Good Morning" or "Good-bye," are usually uttered with a background emotional inflection. The inflection is an instance of prosody, the musical, tonal accompaniment to the speech sounds that constitute the words. Prosody can express not just background emotions, but specific emotions as well. For instance, you can tell someone, in the most loving

tone, "Oh! Go away!" and you can also say, "How nice to see you" with a prosody that unmistakably registers indifference.

Moreover, specific emotions often succeed stimuli or actions that seemingly motivate them in the subject, as judged from the perspective of the observer. In effect, normal human behavior exhibits a continuity of emotions induced by a continuity of thoughts. The contents of those thoughts, and there are usually parallel and simultaneous contents, include objects with which the organism is actually engaged or objects recalled from memory as well as feelings of the emotions that have just occurred. In turn, many of these "streams" of thought—of actual objects, of recalled objects, and of feelings—can induce emotions, from background to secondary, with or without our cognizance. The continuous exhibition of emotion derives from this overabundance of inducers, known and not known, simple and not so simple.

The continuity of the melodic line of background emotion is an important fact to consider in our observation of normal human behavior. When we observe someone with intact core consciousness, well before any words are spoken, we find ourselves presuming the subject's state of mind. Whether correct or not, some of the presumptions are based on a continuity of emotional signals available in the subject's behavior.

A note of caution on confusing terminology: On occasion, terms such as *alertness* and *arousal* are used as synonyms of *wakefulness, attention,* and even of *consciousness,* but they should not be. *Alertness* is often used instead of *wakefulness,* as when you say that you feel "quite alert" or that you think somebody is. For my purposes, the term *alertness* should signify that the subject is not just awake but apparently disposed to perceive and act. The proper meaning of *alert* is somewhere between "awake" and "attentive."

The term *arousal* is easier to define. It denotes the presence of signs of autonomic nervous system activation such as changes in skin color (rubor or pallor), behavior of skin hair (hair standing on end!), diameter of the pupils (larger or smaller), sweating, sexual erection, and so

on, which are reasonably covered by lay terms such as *excitement*. One can be awake, alert, and fully conscious without being "aroused" in this sense, but we all know that our organisms can be "aroused" in this sense during sleep, when we are not awake, attentive, or conscious. Even comatose patients can be aroused, only they do not know it. Tricky, isn't it?

Studying Consciousness from Its Absence

You may wonder how we can comment, from a personal perspective, on the absence of consciousness, considering that the absence of knowing and self should preclude our experience of that absence. The answer is that we come close to experiencing the absence of consciousness in a few circumstances. Consider the brief moments during which we come to awareness after an episode of loss of consciousness caused by fainting or anesthesia; or, in a more benign sort of way, the fleeting moments which precede fully waking up from the deep compensatory sleep that follows fatigue. In those transitional instants we have a glimpse of the impoverished mental state that preceded them. Images are being formed of people and objects and places around us, and yet, for a brief period which may seem all too long, the sense of self is missing and no individual ownership of thought is apparent. A split second later our sense of self is "on," and yes, we vaguely surmise that the images belong to us but not all the details fit clearly yet. It takes a while longer for the autobiographical self to be reinstated as a process and for the situation to be perfectly explained.

The question remains, however, as to how we can possibly glimpse such a state of nonconscious mental impoverishment when we were not really conscious during that state. We certainly have such glimpses, and I suspect that the reason why we do is that we lack, in those transitional instants, the memory of any experience of the instants that came immediately before the transition. Our conscious experience normally includes a brief memory of what we sense as "the just before," which is attached to what we innocently think is the

"now." That memory describes the sense of a self to whom some knowledge is being attributed. Immediately upon awakening, however, the brief memory that would have preserved the previous instant for the benefit of the current instant is not available, for the good reason that there was no conscious experience to be memorized. Our introspection of these anomalous states, then, reveals an important fact: the continuity of normal consciousness requires a brief memory, in the order of a fraction of a second, a trivial achievement for the human brain whose regular short-term memory for facts can last about sixty seconds.

The most extreme varieties of impaired consciousness—coma, persistent vegetative state, deep sleep, deep anesthesia—afford little opportunity for behavior analyses because nearly all manifestations in the "behavioral score" we discussed are abolished.[2] Correspondingly, nearly all the internal manifestations in the "cognitive score" are presumed to be abolished as well. The notion that consciousness phenomena and even mind phenomena are suspended in such situations is an intuition based on solid reflections on our own condition and on equally solid observations of the behavior of others. The notion is also fully supported by the rare but extremely valuable reports of persons who return to consciousness after being in coma. They can recall the descent into the nothingness of coma—much as we can recall the induction of general anesthesia—and the return to knowingness, but nothing at all is recalled of the intervening period, which can span weeks or months. It is legitimate to assume, given all the evidence, that little or nothing was in fact going on in the mind in such circumstances.[3]

Two other groups of patients, however, afford extensive opportunity for behavioral analyses and stand out in terms of the influence that their study had on my thinking about consciousness. One group is made up of patients with a complicated phenomenon known as *epileptic automatism*. The other group brings together patients who, as a result of a variety of neurologic diseases, develop a condition known by the blanket term *akinetic mutism*. In both groups, core consciousness

and extended consciousness are profoundly affected, and yet not all of the behaviors described in the "behavioral score" are abolished, thus leaving room for some intervention by the observer and for the analysis of a residual performance.[4]

EPILEPTIC AUTOMATISMS CAN be like a scalpel and separate consciousness from the things that are in consciousness. Automatisms can appear as part of seizures or immediately following seizures. The episodes that interest me the most are associated with absence seizures, although automatisms are also seen in association with so-called temporal-lobe seizures. Absence seizures are one of the main varieties of epilepsy, in which consciousness is momentarily suspended along with emotion, attention, and adequate behavior. The disturbance is accompanied by a characteristic electrical abnormality in the EEG. Absence seizures are of great value to the student of consciousness, and the typical variety of absence seizure is in fact one of the most pure examples of loss of consciousness—the term *absence* is shorthand for "absence of consciousness." The absence automatism that follows an especially long absence seizure is perhaps the purest example of all.

If you were talking to someone prone to absence seizures and absence automatisms, here is what might happen if an episode were to begin. Suddenly, while having a perfectly sensible conversation, the patient would interrupt himself in midsentence, freeze whatever other movement he was performing, and stare blankly, his eyes focused on nothing, his face devoid of any expression—a meaningless mask. The patient would remain awake. The muscular tone would be preserved. The patient would not fall, or have convulsions, or drop whatever he was holding in his hand. This state of suspended animation might last for as little as three seconds—a far longer time than you imagine when you are watching it—and for as long as tens of seconds. The longer it lasts, the more likely it is that absence proper will be followed by absence automatism, which, once again, can take a few seconds or many. As the automatism starts, the events become

even more intriguing. The situation is not unlike the unfreezing of film images when you release a freeze-frame control or when the jammed projector in a movie house gets to be unjammed. The show goes on. As the patient unfreezes he looks about, perhaps not at you but at something nearby, his face remains a blank, with no sign of a decipherable expression, he drinks from the glass on the table, smacks his lips, fumbles with his clothes, gets up, turns around, moves toward the door, opens it, hesitates just outside the threshold, then walks down the hallway. By this time you would have got up and followed him so that you might witness the end of the episode. One of several scenarios might unfold. In the most likely scenario, the patient might stop and stand somewhere in the hallway, appearing confused; or he might sit on a bench, if there were one. But the patient might possibly enter another room or continue walking. In the most extreme variety of such episodes, in what is known as an "epileptic fugue," the patient might even get out of the building and walk about in a street. To a good observer he would have looked strange and confused, but he might get by without any harm coming to him. Along the trajectory of any of these scenarios, most frequently within seconds, more rarely within a few minutes, the automatism episode would come to an end and the patient would look bewildered, wherever he would be at that moment. Consciousness would have returned as suddenly as it had disappeared, and you would have to be there to explain the situation to him and bring him back to where the two of you were before the episode began.

The patient would have no recollection whatsoever of the intervening time. The patient would not know then and not know ever what his organism had been doing during the episode. After an episode ends, such patients have no recollection of what went on during the seizure or during the extension of the seizure in the automatism period. They do remember what went on before the seizure and can retrieve those contents from memory, a clear indication that their learning mechanisms were intact prior to the seizure. They immediately learn what goes on after the seizure ends, a sign that the seizure

did not produce a permanent impairment of learning. But the events that occurred during the period of seizure have not been committed to memory or are not retrievable if they have.

Were you to have interrupted the patient at any point during the episode, he would have looked at you in utter bewilderment or perhaps with indifference. He would not have known who you were, spontaneously or upon specific questioning; he would not know who he was or what he was doing; and he might have simply kept you away with a vague gesture, hardly looking at you. The contents that make up a conscious mind would have been missing, and this could no more lead to a verbal report than to a highly intelligent action. He would have remained awake and attentive enough to process the object that came next into his perceptual purview, but inasmuch as we can deduce from the situation, that is all that would go on in the mind. There would have been no plan, no forethought, no sense of an individual organism wishing, wanting, considering, believing. There would have been no sense of self, no identifiable person with a past and an anticipated future—specifically, no core self and no autobiographical self.

In such circumstances, the presence of an object promotes the next action and that action may be adequate within the microcontext of the moment—drinking from a glass, opening a door. But that action, and other actions, will not be adequate in the broader context of circumstances in which the patient is operating. As one watches actions unfold, one realizes that they are devoid of ultimate purpose and are inappropriate for an individual in that situation.

There would have been, however, unmistakable wakefulness: the eyes would have been open; muscle tone, maintained. There would have been some ability to create neural patterns and presumably images: the objects around the patient had to be sufficiently mapped in visual or tactile terms so that he could execute actions successfully. And there would also have been attention, not high-level attention like we are having at this moment, but attention enough so that the perceptual and motor devices of the organism could turn to a particular object long enough and well enough for sensory images to be properly formed and movements to be executed with accuracy relative to those images, e.g., the visual image of a wall; the tactile image of the glass from which the patient could drink.

In other words, the patient would have had some elementary aspects of mind, would have had some contents in that mind pertaining to the objects surrounding him, but he would not have had a normal consciousness. He would not have developed, in parallel with the image of the objects surrounding him, an image of knowing centered on a self; an enhanced image of the objects he was interacting with; a sense of the appropriate connection to what went on before each given instant or what might happen in the instant ahead.

The dissociation between impaired consciousness and the ability to form neural patterns for objects, surprising as it may seem, is also borne out by intriguing new evidence. A patient in persistent vegetative state, a lighter form of coma in which there are signs of wakefulness but consciousness is gravely impaired, was studied with a functional imaging scan during which photographs of familiar human faces were projected onto her retinas. The result was activation of a region in the occipitotemporal cortices known to be activated by the perception of faces in normal, awake, and conscious persons. Thus even without consciousness, the brain can process sensory signals across varied neural stations and cause activation of at least some of the areas usually involved in the processes of perception.[5]

Observing an episode of absence automatism you would have watched the elaborate behaviors of an organism deprived of all extended consciousness and of everything but perhaps the dimmest form of core consciousness. One can only try to imagine the remains of a mind from which self and knowing have been removed, perhaps a mind strewn with images of things to be known but never really known, with things not really owned—stripped of the engine for deliberate action.

Let me conclude by commenting on the fact that emotion was missing throughout the episode. The suspension of emotion is an

important sign in absence seizures and in absence automatisms. Emotion is also missing in the akinetic mutisms described in the next section. The lack of emotion—no background emotions and no specific emotions—is conspicuous, but it has not been highlighted in the relevant literature. As I reflect on this finding, many years after I first noted it, I venture that absence of emotion is a reliable correlate of defective core consciousness, perhaps as much as the presence of some degree of continuous emoting is virtually always associated with the conscious state. A related finding occurs regularly during the natural experiment on consciousness we call sleep. Deep sleep is not accompanied by emotional expressions, but in dream sleep, during which consciousness returns in its odd way, emotional expressions are easily detectable in humans and in animals.

Finding parallel impairments of consciousness and emotion will seem all the more notable when we consider that patients in whom core consciousness is intact but extended consciousness is compromised have recognizably normal background and primary emotions. Emotions and core consciousness tend to go together, in the literal sense, by being present together or absent together.[6]

The lack of emotion is surprising given that, as we have seen, emotions can be triggered nonconsciously, from unattended thoughts or unknown dispositions, as well as from unperceivable aspects of our body states. The lack of emotion when core consciousness vanishes may be parsimoniously explained by suggesting that both emotions and core consciousness require, in part, the same neural substrates, and that strategically placed dysfunction compromises both kinds of processing. The shared substrates include the ensemble of neural structures which support the proto-self (to be described in chapter 5), the structures which both regulate and represent the body's internal states. I take the lack of emotion, from background emotion on up to higher levels of emotion, as a sign that important mechanisms of body regulation have been compromised. Core consciousness is functionally close to the disrupted mechanisms, interwoven with them, and thus compromised along with them. There is no such close functional relationship between emotional processing and extended consciousness. That is why, as noted in chapter 7, impairments of extended consciousness are not accompanied by a breakdown of emotion.

Subjects with normal consciousness can take stock of their emotions in the form of feelings, and those feelings, in turn, can generate a new melodic line of emotions that confers upon behavior the traits we so easily recognize as characteristic of sentient life. In the pathological condition, the suspension of the reverberating cycle of emotion-to-feeling-to-emotion robs behavior of a major telltale sign of sentience and generates in the observer the idea that something strange is going on in the mind of the subject observed. I would not be surprised to discover that the reason why we so confidently attribute consciousness to the minds of some animals, especially domestic animals, comes from the patently motivated flow of emotions they exhibit and from our automatic and reasonable assumption that such emotions are indeed caused by feelings that could only affect behavior in a sentient creature. I shall pursue this issue later.

ANOTHER IMPORTANT SOURCE of information regarding impaired consciousness comes from the study of patients with a condition known by the blanket term *akinetic mutism*. *Akinesia* is the technical term for lack of movement, usually due to an inability to initiate movement, although it often includes the slow execution of movement; *mutism*, as the word indicates, denotes an absence of speech. As usual, the terms are suggestive of what goes on externally, or does not, but miss the mark on the inside view. Internally, from all the available evidence, consciousness is severely diminished or even suspended altogether. The problem of so-called akinetic mutisms fascinated me for years and I spent many hours observing these patients, in their hospital beds or in my laboratory, studying their scans and electroencephalograms, and waiting patiently for their mutism to resolve so that I could perhaps talk to them. The story of one of my patients with this condition will give you an idea of what happens.

The stroke suffered by this patient, whom I will call L, produced damage to the internal and upper regions of the frontal lobe in both

hemispheres. An area known as the cingulate cortex was damaged, along with nearby regions. She had suddenly become motionless and speechless, and, by and large, she was to remain motionless and speechless for the best part of the next six months. She would lie in bed, often with her eyes open but with a blank facial expression. On occasion she might catch an object in motion—me, for instance, moving around her bed—and track for a few instants, eyes and head moving along for a moment, but the quiet, nonfocused staring would be resumed rapidly. The term *neutral* helps convey the equanimity of her expression, but once you concentrated on her eyes, the word *vacuous* gets closer to the mark. She was there but not there.

Her body was no more animated than her face. She might make a normal movement with arm and hand, for instance, to pull her bed covers, but in general her limbs were in repose. Together, body and face never expressed any emotion of any kind, background, primary, or secondary, although there were plenty of inducers offered, day to day, in the attempts at focused conversations or just plain bedside banter of physicians, nurses, medical students, friends, and relatives. Emotional neutrality reigned supreme, meaning that not only was there no response to external inducers, but no response, either, to internal inducers, those that might be present in her thoughts but, as it turns out, obviously were not.

When asked about her situation she almost invariably remained silent, although, after much coaxing, she might say her name, just once, only to resume her silence. She had nothing to say about the events leading to her admission, nothing to comment on her past or present. She did not react to the presence of her relatives and friends any more than she did to her physician and nurses. Neither photographs nor songs, neither darkness nor bright light, neither claps of thunder nor the rustle of rain, could move her to react. She never became upset with my insistent and repetitive questioning, never showed a flicker of worry about herself or anything else.

Months later, as she emerged from this state of narrowed existence and gradually began to answer some questions, she would clarify the enigma of her state of mind. Contrary to what a casual observer might have thought, her mind had not been imprisoned in the jail of her immobility. Instead, it appeared that there had not been much mind at all, and nothing that would resemble core consciousness, let alone extended consciousness. The passivity in her face and body was the appropriate reflection of her lack of mental animation. She had no recall of any particular experience during her long period of silence; she had never felt fear; had never been anxious; had never wished to communicate. For the period that immediately preceded her first answers to me, a matter of perhaps a few days, she vaguely recalled that she was being asked questions, but she felt that she really had nothing to say, and again, that caused her no suffering. Nothing had forced her not to speak her mind.

Unlike the patients with locked-in syndrome (discussed in chapter 8), L seems not to have had any sense of self and surroundings, any sense of knowing, for most of her long waking slumber. Even during her slow awakening, it is likely that her sense of self was impaired. Unlike locked-in patients, but along with the epileptic patients described earlier and the patients described in the next section, L could have moved perfectly—limbs, eyes, speech apparatus—had she had a conscious mind to formulate a plan and command a movement. But she did not. Although some images were probably being formed—it is difficult to imagine how she could track an object or how she could pull her bed covers by touch, with precision, if she were relying exclusively on reflexes—it appears that she had not been producing differentiated thought, reasoning, or planning, and that there had been no emotional reaction to any mental content, either. That momentous set of defects had been translated externally in a neutral facial expression, a virtual suspension of body movement, and mutism. Again, emotion was missing.

IN SOME PATIENTS with advanced stages of Alzheimer's disease, consciousness is also impaired, and in a manner similar to the one just described for akinetic mutism. Early in the disease, memory loss dominates the picture and consciousness is intact, but as the ravages of Alzheimer's deepen, one often finds a progressive degradation of

consciousness. Unfortunately, textbooks and lay descriptions of Alzheimer's emphasize the loss of memory and the early preservation of consciousness and often fail to mention this important aspect of the disease.

The decline first affects extended consciousness by narrowing its scope progressively to the point in which virtually all semblance of autobiographical self disappears. Eventually, it is the turn of core consciousness to be diminished to a degree in which even the simple sense of self is no longer present. Wakefulness is maintained and patients respond to people and objects in elementary fashion—a look or a touch, the holding of an object—but there is no sign that the responses issue from real knowing. In a matter of a few seconds, the continuity of the patients' attention is disrupted, and the lack of overall purpose becomes evident.

I have seen this disintegration occur in many Alzheimer's patients and never as painfully as in a dear friend who was also one of the notable philosophers of his generation and whose intellectual brilliance disguised his mental decline for all but those closest to him. On the last occasion I saw him, he uttered no word and gave no sign of recognizing me or his wife. His eyes, whose expression had been emptied out from within, would settle on a person or object for a few seconds, without any reaction ensuing in his face or body. No sign of emotion at all would ever arise, positive or negative. And yet he could make his wheelchair move, here and there about the room, somewhat unpredictably, for instance, to approach the large picture window and look out at nothing in particular.

Once, I saw him move close to the single, nearly empty bookcase in the room, reach for a shelf at about the level of the chair's armrest, and pick up a folded paper. It was a worn-out glossy print, 8 × 10, folded in four. He set it on his lap, slowly; he unfolded it, slowly; and he stared for a long time at the beautiful face in it, that of his smiling wife, now split in four quadrants by the deep creases in the countlessly folded paper. He looked but did not see. There was no glimmer of reaction, at any moment, no connection made between the portrait

and its living model who was sitting across from him, only a few feet away; no connection made to me, either, who had actually made the photograph ten years before, at a time of shared joy. The folding and unfolding of the photograph had happened regularly, from earlier in the progress of the disease, when he still knew that something was amiss, perhaps as a desperate attempt to cling to the certainty of what once was. Now it had become an unconscious ritual, performed with the same slow pace, in the same silence, with the same lack of affective resonance. In the sadness of the moment I was happy that he no longer could know.

REFLECTION ON THESE instances of disturbed consciousness reveals the following facts:

First, there is a sharp separation between, on the one hand, wakefulness, low-level attention, and brief, adequate behaviors, which can survive the disturbance of consciousness, and, on the other, emotion which is lost along with the sense of knowing and self. The defect of knowing and self and of recognizably motivated emotion goes hand in hand with defects in planning, in high-level attention, and in sustained and adequate behaviors. The decoupling of functions that we can observe in these cases exposes a layering of subcomponents which would have been difficult to notice, let alone tease apart, without the scalpel provided by neurological disease.

Second, for practical purposes we can classify the neurological examples of disrupted core consciousness as follows:

A. *Disruption of core consciousness with preserved wakefulness and preserved minimal attention/behavior.* The prime examples are akinetic mutisms and epileptic automatisms. Akinetic mutisms are caused by dysfunction in the cingulate cortex, in the basal forebrain, in the thalamus, and in the medial, peri-cingulate parietal cortex.

B. *Disruption of core consciousness with preserved wakefulness but defective minimal attention/behavior.* Absence seizures and persistent vegetative

state are the prime examples. Absence seizures are related to dysfunction in the thalamus or in the anterior cingulate cortex.

Persistent vegetative state, which is often confused with coma, can be distinguished from coma in that vegetative patients have cycles of sleep and wakefulness as shown by the opening and closing of their eyes and, sometimes, by their EEG patterns. Persistent vegetative state is discussed in chapter 8. It is frequently caused by dysfunction in a particular set of structures in the upper brain stem, hypothalamus, or thalamus.

C. *Disruption of core consciousness accompanied by disruption of wakefulness.* The examples are coma, the transient loss of consciousness caused by head injury or fainting, deep (dreamless) sleep, and deep anesthesia. Relevant aspects of coma are discussed in chapter 8, but we note that the typical site of dysfunction is in structures of the upper brain stem, hypothalamus, and thalamus. The control of sleep and wakefulness resides in the same general region, and the action of several anesthetics is known to take place in that region, too.

Third, as will become clear when we discuss the neuroanatomical correlates of consciousness (in chapters 6 and 8), nearly all the sites of brain damage associated with a significant disruption of core consciousness share one important trait: they are located near the brain's midline, in fact, the left and right sides of these structures are like mirror images, looking at each other across the midline. At the level of the brain stem and diencephalon (the region that encompasses the thalamus and hypothalamus), the damaged sites are close to the long set of canals and ventricles that define the midline of the entire central nervous system. At cortical level, they are located in the medial (internal) surface of the brain. None of them can be seen when we inspect the lateral (external) surfaces of the brain, and all of them occupy an intriguingly "central" position. These structures are of old evolutionary vintage, they are present in numerous nonhuman species, and they mature early in individual human development.

Chapter Four

The Hint Half Hinted

Language and Consciousness

On several occasions when I was in medical school and in neurology training, I remember asking some of the wisest people around me how we produced the conscious mind. Curiously, I always got the same answer: language did it. I was told that creatures without language were limited to their uncognizant existence but not we fortunate humans because language made us know. Consciousness was a verbal interpretation of ongoing mental processes. Language also gave us the requisite remove to look at things from a proper distance. The answer sounded too easy, far too simple for something which I then imagined unconquerably complex, and also quite implausible, given what I saw when I went to the zoo. I never believed it and I am glad I did not.

Language—that is, words and sentences—is a translation of something else, a conversion from nonlinguistic images which stand for entities, events, relationships, and inferences. If language operates for